REDUCING ROAD CARNAGE USING A WEB BASED MODEL FOR MONITORING ROAD TRAFFIC CRIME

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A Research Thesis submitted to the Institute of Postgraduate Studies and Research for Partial Fulfillment of the Requirements for the Master of Science in Information Technology of Kabarak University.

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DECLARATION

I hereby declare that this research is my original work and has not been submitted to any other university or college for purpose of examination or academic award. Any information given in my entire work and all the relevant sources are quoted and acknowledged accordingly

Signature …… Date …….

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RECOMMENDATION

This thesis entitled **"Reducing Road Carnage using a Web Based Model for Monitoring Road Traffic Crimes."** and written by Makupi Daniel is presented to the institute of postgraduate studies and research of Kabarak University. We have reviewed is thesis and recommended it be accepted in partial fulfillment of the requirements for the degree of Master of Science in information technology.

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I praise God for the gift of life, family, friends and provision without which I would not have made it this far in my academic pursuits. Indeed, the very ability to read and comprehend is a gift that only you, God, gives. All honor, praise and glory to you.

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DEDICATION

To

My Dad, Mr. David Chemadi

My Mum, Mrs. Nelly Kiplagat

ABSTRACT

Road traffic accidents have been a major cause of deaths in Kenya. The effort by Kenya police to enforce traffic laws has done little to salvage the situation. Although there has been other remedies towards curbing road accidents such as; improvements in vehicle design and licensing to skill the situation calls for further solution particularly targeting driver behavior since careless driving has been identified as a major cause of road accidents. The research provides a solution by designing and implementing a model that monitors traffic crimes committed by drivers on Kenyan roads by cumulatively computing the Driver Road Safety Index (DRSI) which serves as an indicator of identifying careless drivers and therefore withdraw them from the road by dispossessing them of the driving license. The model is implemented using a web based prototype. The study adopted scientific and design research approaches. Scientific approach was used to gather relevant data through focus groups required for coming up with relevant weights for different crimes .The engineering design approach was used to implement the model.

Keywords: Model, Web-based application, Roads

Table of Contents

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

WBRM	Web Based Road Carnage Management
DRSI	Driver Road Safety Index
FAA	Federal Aviation Administration
RMA	Reliability Maintainability and Availability
MVC	Model View Controller pattern
SOA	Service Oriented Architecture
API	Application Programming Interface
WSN	Wireless Sensor Networks
RTA	Road Traffic Accidents
MLD	Magnetic Loop Detector
ECU	Electronic Control Units
ITS	Intelligent Transport System
RFID	Radio Frequency Identification
DSRC	Dedicated Short Range Communication
SAE	Society of Automotive Engineers
V2V	Vehicle to vehicle
MANET’s	Mobile Adhoc networks

OPERATIONAL DEFINITION OF TERMS

Web based model	Is a software package that is accessible through the web browser in that the software and database reside on a central server rather than being installed on the desktop system and is accessed over a network (James D. and Danny c., 1999).
Model	Is a program that runs on a computer that creates a model, or simulation, of a real-world feature, phenomenon or event (David W., 2011).
Road	Is a thoroughfare, route, or way on land between two places that has been paved or otherwise improved to allow travel by foot or some form of conveyance, including a horse, cart, bicycle, or motor vehicle (O'Flaherty, 2002).

CHAPTER ONE

INTRODUCTION

This part clarifies on the foundation of the ideas and issues to be tended to like reasons for street mischances, street mishaps toll in Kenya and globally and issues identified with street bloodletting. It also continues to express the announcement of the examination issue, laying out the exploration goals, records the examination addresses, and characterizes the extension, suppositions, centrality and the normal results of the study.

1.0 Background of the study

m Street auto collision otherwise called an engine vehicle mishap or street gore happens when a vehicle crashes into another vehicle, person on foot, creature, street trash, or other stationary obstacle, for example, a tree or utility post and missing track. Street mishaps overall prompt to death and handicap and additionally money related expenses to both society and the people included.

As per WHO report Road wounds brought about 1.4 million passings in 2013, up from 1.1 million passings in 1990. Around 68,000 of these happened in youngsters under five years of age. All high-wage nations have diminishing passing rates, while the dominant part of low-wage nations having expanding demise rates because of car accidents. Center salary nations have the most elevated rate with 20 passings for every 100,000 occupants, 80% of all street fatalities by just 52% of all vehicles. While the passing rate in Africa is the most astounding (24.1 for every 100,000 tenants), the least rate is to be found in Europe (10.3).

In Kenya especially Road mischances is the main source of death after jungle fever and Hiv/Aids as indicated by (Odero, Khayesi and Heda 2003) as refered to in (Thomas N. Kibua and P.O. Chitere, 2004) as a rule likewise affecting the monetarily profitable populace in Kenya. For sure there is a requirement for sanctioning measures equipped towards lessening mortality, dismalness, incapacity and expanded cost of human services coming about because of preventable street mishaps.

Additional time transport partners accuse the run down condition of Kenyan streets as the main source of mishaps. In spite of late change of foundation in Kenya in any case, deadly street mischances keep on being accounted for. This has come about to a habitual pettiness between

particularly the administrators of the Public Service Vehicles (PSV)and the Traffic division of Kenya Police, with the previous faulting the poor condition of Kenyan streets on mischances while the last points the finger at PSV administrators particularly drivers on flouting the set down controls. Overtime many drivers have been apprehended due to issues related to inconsiderate driving, ineptitude, over speeding, smashed driving and a horde of different indecencies that render them inclined to bringing on mishaps that could have been avoided if a safe distance with other drivers and pedestrians had been observed (Benson N, 2012).

The Traffic Police then again, while accused of authorizing The Traffic Act, have on various events been found on camera getting influences, and have highlighted in different defilement lists reports as driving in the bad habit. The Transparency International-Kenya report of 2011 reason out that the Kenyan Police laxity is the major contributory of accidents which is also supported by the East African Bribery Index Report (EABI), it's the traffic arm of this association that tops the rundown.

As per the Kenya Roads board, there are 160,886 km of open streets with 11,197 km ≈ 7% are tarmacked. This thusly implies the vast majority of the streets may not be effortlessly motorable. In any case, lion's share of the reported street mishaps happen in the huge areas with the three noteworthy expressways. The highways are Nairobi-Thika road, Nairobi-Mombasa street, and the Nairobi-Nakuru-Eldoret streets reporting the majority of the mischances. Thika road (50.4 km) and Mombasa street (470 km) happen to be a portion of the busiest streets in Kenya as indicated by Kenya Roads Board report of 2012; notwithstanding there has been a thorough development arrange in accordance with vision 2030. There are roughly 80 recorded dark spots, with the greater part being along these three parkways as per Kenya police report.

Regardless of the 2003 institution and implementation of more stringent traffic runs by the then pastor of transport the late Hon. John Michuki primarily focusing on the PSV's. Traveler limit with regards to matatu was lessened to 13; speed confine set to 80kph and speed governors presented, seat straps for all travelers was made required and the screening of drivers and conductors, who now needed to meet stricter rules as indicated by Kenya Law Reports of 2003. The numbers mischances keep on escalating as per WHO report.

Notwithstanding the wellbeing measures other exertion incorporates traveler show frameworks which exist yet they are not appropriate for use in the casual transport part because of their high

cost and many-sided quality. They are regularly undertaking kind requiring concentrated interest in equipment and programming. The stages they are produced on collect to frameworks that need noteworthy preparing for its compelling use. These elements make them difficult to be received by open transport and along these lines its utilization in supporting street bloodletting administration.

In this way the hazard of street slaughter have not been tended to yet or the limit of inclusion in street mishaps. Consequently this study proposes an answer for screen movement violations submitted by drivers on Kenyan streets by in total registering DRSI. The framework utilizes a customer server approach were an event or gripes is caught by recording in a database. At that point a law authorization officer logins and affirms the DRSI and makes the imperative activity. The proposed framework will be on the web and along these lines connect the area the episode has happened.

1.1 Statement of the research problem

The absence of a model for reducing violations by processing driver road security index of people in charge of street massacre has demonstrated hard to decrease loss of lives. There is utilization of manual frameworks were a law requirement in case of a mishap happening makes calls furthermore doing recording on papers. The recording set up is along these lines manual and absence of a la mode data on the off chance that a man submits an offense. Additionally there's no real way to observe and check the people inclusion in wrongdoing when he confers another offense at better place. Likewise there has not been a system in type of a model to think of the limit of inclusion in street bloodletting and thusly serve as an assurance to ingrain train to the wrongdoer.

1.2 Objective of the study

The main objective of the study is to develop a model that would aid in reducing traffic crimes by cumulatively computing the driver road safety index (DRSI). This index identifies road unworthy drivers and withdraw them from the road. The design of the said model is guided by the following specific objectives;

i. To identify the main causes of road carnage in Kenya and the efforts that has been put in place to manage road carnage.

ii. To design a model for monitoring traffic crimes cumulatively and compute the driver road safety index.
iii. To implement a prototype of a web based application for managing road carnage.

1.3 Research Questions

The research seeks to give answers to the following questions:-

i. What are the main causes of road carnage in Kenya and the efforts that has been put in place to manage road carnage?
ii. How can a model for monitoring traffic crimes cumulatively and compute the driver road safety index be designed.
iii. How can a prototype of a web based application for managing road carnage be implemented.

1.4 Significance of the study

The utilization of an electronic model in the improvement and coming up of a model to process the DRSI to decide the level of inclusion in violations has not been done yet. A fruitful model utilizing Web based instruments is a huge expansion to the collection of learning in the range of decreasing road mishaps by observing driver conduct. Such a model is instrumental in the improvement of reasonable and simple to utilize Web based road bloodletting observing applications that can possibly alter the way numerous partners, and particularly the law implementation, direct their exercises.

1.5 Expected outcomes

The output of this research is to come up with the following deliverables;

a) A report on the main causes of road carnage in Kenya and the efforts that has been put in place to manage road carnage?
b) A web based model for reducing road carnage by cumulatively computing the Driver Road Safety Index (DRSI).
c) A prototype for a web based implementation model to assist law enforcement to reduce road carnage.

1.6 Justification of the study

A lot of efforts by stakeholders and partners have done little in reducing the menace of road carnage especially in developing countries. In Kenya alone according WHO of 2015 about 2 million lives are lost to road accidents were the populace most involved are young people. Therefore a feasible novel idea would be the only remedy to the situation at hand and in this case to counter loss of lives and fatalities associated with road carnage is as shown in this research that comes up with a web based model for reducing road carnage.

A considerable measure of endeavors by partners and accomplices have done little in lessening the hazard of road gore in third world nations. In Kenya alone concurring WHO of 2015 around 2 million lives are lost to accident mishaps were the masses most included are youngsters. In this way a plausible original thought would be the main solution for the current circumstance and for this situation to counter loss of lives and fatalities connected with accidents is as appeared in this study that surfaces with an electronic model for diminishing these mishaps.

1.7 Scope of the study

The study comes up with a web based model for reducing road carnage through computation of driver road safety index. This study investigation does not cover effectively existing cures towards countering street slaughter. A great deal of endeavors have been executed so far in the vehicle business in vision towards diminishing street mischances were most procedures are hypothetical in nature instead of this mechanical electronic arrangement. The study will however not focus on worries of security of the electronic model once facilitated yet just shows how this online arrangement can be a type of a framework to decrease street bloodletting through sorted out capacity to empower street massacre administration.

The arrangement is a model to create and exhibit the pertinence of this idea of an electronic model to encourage street butchery lessening and not a business capable online application. The study utilizes System appraisal to set destinations to serve as type of assessing the model.

1.8 Limitations of the Study.

The scientist won't not have the capacity to get test information that Law requirement offices as the key accomplices have named private. Time and the accessibility of assets i.e., law requirement

officers to talk about and react may likewise be viewed as the constraining variables for this exploration.

1.9 Assumptions

The administration of Kenya through the law authorization organizations collaborates on various road massacre issues that have been accounted for earlier. Additionally how they lessen street savagery to forestall death toll through mishaps.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

In this section the reasons for street mishaps, street bloodletting administration endeavors, demonstrating process lastly advancements utilized by online models. The calculated structure and the proposed display for the study will likewise be introduced and examined.

2.1 Cause of road accidents

Street is the for the most part ordinarily utilized method for transport as a part of Kenya. Street transport is sorted into two, fundamentally private and open vehicles. It has confronted a considerable measure of difficulties which incorporate; loss of lives' through reckless driving, overspending, and fix's by law authorization. As per WHO somewhere around 3000 and 13 000 Kenyans lose their lives through street car accidents consistently. The larger part of these casualties are powerless street clients, people on foot, motorcyclists, and cyclists. Notwithstanding this, almost 33% of passings are among travelers a considerable lot of whom are slaughtered in perilous types of open transportation.

The wrongdoings required through street butchery appear as; murder, capturing, mishaps and utilizing vehicles to take. It's being executed by individuals who are for the most part enrolled drivers who have guaranteed driving permit. The majority of the cases which show up in events books of law authorization have no traceability due to absence of a precise method for reporting street massacre. It is a genuine blame coming about to avoidable passings and a decent number of them are without set after safeguard (Patton, M. Q., 1990).

However there has been speculation into methods for lessening difficulties of street bloodletting attempted like signalized crossing point control were sensors are presently to supply continuous information for activity versatile flag control and relieving repeating and nonrecurring clog on interstates. The numerous advancements upheld by the development of microchips and different hardware segments in activity control framework innovation amid the previous decade have been set up.. Likewise relative straightforwardness with which inquire about and broad client learning can be recovered has additionally helped organizations in selecting the most fitting advancements and sending arrangements to moderate street bloodletting. The Internet with its helpful access to

open and private libraries contain assessment reports of sensor execution and movement administration methodologies which empowers the quick sharing of test and operational encounters. This has been utilized as a part of Sensor applications in activity control and administration (Gillwald, et al.., 2015).

2.1.0 Road design and road accidents

Street plan is additionally among contributing variables were in a 1985 US ponder it demonstrated that around 34% of genuine accidents had contributing components identified with the roadway or its surroundings. A large portion of these accidents included a human component (Harry L. and Jerry A. R., 1995). The street or natural component made a huge commitment to the conditions of the crash, or did not permit space to recuperate. Notwithstanding these conditions it was valued that as often as possible the driver is faulted instead of the street; those reporting the mishap tend to disregard the human components included, for example, the nuances of outline and support that a driver could neglect to watch or deficiently adjust for (Ray F. and Jorge A. S., 2002). From this exploration cautious outline and support, with all around planned convergences, street surfaces, perceivability and movement control gadgets, can bring about huge enhancements in mischance rates.

Singular streets likewise have generally varying execution in case of an effect. In Europe there are presently Euro RAP tests that show how "self-clarifying" and pardoning a specific street and its roadside would be in case of a noteworthy occurrence. In the UK, investigate has demonstrated that interest in a sheltered street foundation program could yield a ⅓ diminishment in street passings, sparing as much as £6 billion every year. (Slope, J., 2008) A consortium of 13 noteworthy street security partners have framed the Campaign for Safe Road Design, which is approaching the UK Government to make safe street plan a national transport need.

2.1.1 Human factor on road accidents

The other contributing component that outcomes to mishaps is the Human variables where in vehicle crashes incorporate all elements identified with drivers and other street clients that may add to an impact. Principles like driver conduct, visual and sound-related keenness, basic leadership capacity, and response speed. A 1985 report in light of British and American crash

information discovered driver mistake, inebriation and other human components contribute completely or somewhat to around 93% of accidents (Harry L. and Jerry A. R., 1995).A street mishap review of British drivers found that most thought they were superior to normal drivers; a conflicting result demonstrating pomposity in their capacities. Almost all drivers who had been included in crash did not trust themselves to be to blame (Drivers.com. 2000-02-11). As indicated by Transport Research Laboratory overview of 2007 one review of drivers reported that they thought the key components of good driving were: controlling an auto including a decent consciousness of the auto's size and abilities; perusing and responding to street conditions, climate, street signs and the earth and readiness, perusing and suspecting the conduct of different drivers.

In spite of the fact that capability in these aptitudes is educated and tried as a feature of the driving exam, a "great" driver can in any case be at a high danger of slamming on account of the sentiment being positive about more difficult circumstances is experienced as proof of driving capacity, and that "demonstrated" capacity strengthens the sentiments of certainty. Certainty bolsters itself and becomes unchecked until something happen like a "close miss" or a mishap. An exploration Galway Independent study finished up Irish drivers are exceptionally wellbeing cognizant with respect to other European drivers. Be that as it may, this does not mean fundamentally bring down crash rates in Ireland. Notwithstanding changes in street plans and Human components have been wide-scale selections of guidelines of the street close by law requirement strategies that included drink-driving laws, setting of speed points of confinement, and speed authorization frameworks, for example, speed cameras. A few nations driving tests have been extended to test another driver's conduct amid crises, and their danger discernment.

There are uniqueness in age with crash rates vulnerability were youngsters have a tendency to have great response times, lopsidedly more youthful male drivers highlight in mischances (Thew and Rosemary, 2006) with analysts watching that numerous show practices and states of mind to hazard that can put them in more dangerous circumstances than other street clients. This is reflected by statisticians when they set protection rates for various age bunches, halfway in view of their age, sex, and decision of vehicle. More seasoned drivers with slower responses may be relied upon to be required in more mischances, however this has not been the situation as they tend to drive less and, obviously, more warily.

Endeavors to force movement approaches can be confounded by nearby conditions and driver conduct. In 1969 Leeming cautioned that there is and adjust to be struck while "enhancing" the security of a street (Leeming, J.J. 1969). On the other hand, an area that does not look unsafe may have a high crash recurrence. This is, to a limited extent, on the grounds that if drivers see an area as unsafe, they take more alert. Mishaps might will probably happen when perilous street or activity conditions are not evident initially, or where the conditions are excessively confused for the constrained human machine to see and respond in the time and separation accessible. High occurrence of accidents is not characteristic of high damage hazard. Accidents are basic in zones of high vehicle clog yet lethal accidents happen lopsidedly on rustic streets during the evening when activity is generally light. This marvel has been seen in hazard remuneration examine, where the anticipated decreases in mischance rates have not happened after authoritative or specialized changes. One study watched that the presentation of enhanced brakes brought about more forceful driving, (Sagberg, Fosser, and Saetermo, 1997) and another contended that obligatory safety belt laws have not been joined by an unmistakably credited fall in general fatalities (Adam and John, 1982). Most cases of hazard remuneration counterbalancing the impacts of vehicle direction and belt utilize laws has been ruined by research utilizing more refined information (Robertson LS).

In the 1990s, Hans Monderman's investigations of driver conduct drove him to the acknowledgment that signs and directions adversy affected a driver's capacity to communicate securely with other street clients. Monderman created shared space standards, established in the standards of the woonerven of the 1970s. He presumed that the evacuation of thruway mess, while permitting drivers and other street clients to blend with equivalent need, could help drivers perceive ecological signs. They depended on their psychological abilities alone, lessening activity speeds profoundly and bringing about lower levels of street losses and lower levels of clog (Ben, 2005).

However a few accidents are proposed; organized accidents, for instance, include no less than one gathering who wants to crash a vehicle to submit lucrative cases to an insurance agency (Lascher, Edward L. also, Michael R., 2001). In the USA in the 1990s, offenders selected Latin migrants to purposely crash autos, for the most part by cutting before another auto and hammering on the brakes. It was an illicit and unsafe occupation, and they were ordinarily paid just $100. Jose Luis

Lopez Perez, an arranged crash driver, kicked the bucket after one such move, prompting to an examination that revealed the expanding recurrence of this kind of crash.

2.1.2 over speeding and road accidents

m Engine vehicle speed is likewise another giver to mishap toll were the U.S. Bureau of Transportation's Federal Highway Administration audit inquire about on movement speed in 1998.The synopsis says: "The proof demonstrates the danger of having a crash is expanded both for vehicles voyaging slower than the normal speed, and for those going over the normal speed". The danger of being harmed increments exponentially with rates much quicker than the middle speed. The seriousness of a crash relies on upon the vehicle speed change at effect. There is restricted proof recommending lower speed limits result in lower speeds on a framework wide premise. Most crashes identified with speed include speeding too quickly. More research is still expected to decide the adequacy of movement quieting.

The Road and Traffic Authority (RTA) of the Australian condition of New South Wales (NSW) state speeding (voyaging too quickly for the common conditions or over the posted speed farthest point is a figure around 40 percent of street passing's. The RTA additionally noticed that speeding expands the danger of a crash and its seriousness. On another study, the RTA qualify their cases by alluding to one particular bit of research from 1997, and compose "look into has demonstrated that the danger of a crash bringing on death or damage increments quickly, even with little increments over a suitably set speed restrict." The contributory calculate report the official British street setback insights appear for 2006, that "surpassing pace utmost" was a contributory consider 5% of all loss crashes (14% of every single deadly crash), and "voyaging too quick for conditions" was a contributory figure 11% of all loss crashes (18% of every single lethal crash).

2.1.3 Driver impairment on road accidents

Street mischances are additionally brought about by driver weaknesses keeping drivers from driving at their commonality were variables like liquor as per the Government of Canada, coroner reports from 2008 recommended very nearly 40% of lethally harmed drivers devoured some amount of liquor genius to being required in mishaps. Separate from shortcoming because of liquor abuse is physical harm, with numerous legitimate controls setting straightforward sight tests

requesting fitting vehicle changes before being permitted to drive; Youth Insurance insights demonstrate scandalously higher number of times something happens all of a sudden spontaneous accidents and passings among drivers in their youngsters or mid-twenties, with protection rates mirroring this information.

These drivers have the most astounding frequency of passings among all driver age assembles, a reality that was endorsed before the happening to cell phones. Females in this age aggregate show to some degree bring down death rates than guys yet at the same time enlist well over the center point for drivers of any age. Likewise inside this gathering, the most astounding spontaneous rate happens inside the primary year of authorized driving. Hence numerous US states have put into law a zero-resilience in the wake of accepting a moving infringement inside the initial six months to one year of getting a permit brings about programmed permit suspension. No US state permits fourteen year-olds to get drivers' licenses any more.

In examination different purviews demand Driver retesting for response inclination and vision trailing Sleep inadequacy, Fatigue, inebriation with respect to including sprinkling application drugs. Diversion Research recommends that the driver's credit is worried by diverting sounds one as discussions and enlisted on the wing call interference driving. Numerous wards now oblige or keep a few sorts of telephone inside the auto. Late overview directed by British researchers recommends that composition gave a pink sneak past a similar token have an impact; orchestral arrangements is drawing closer to quiet, yet boringly could recover the driver to a fire and ice of diversion.

Additionally either conditions cut back basically more terrible circumstance, similar to: Driver could hear a stick drop measurements of alcohol influence driving execution than as a decision cannabis or alcohol in detachment or Taking picked dosages of a portion of medications affectionately intertwined, which differently don't bring about debilitation and inside one zone join to draw on tiredness or at change disability. This possible more perceptible in a drained individual whose renal work is less balanced than a more youthful individual's agreeing UK Department for Transport. In this way there are circumstances when a man might be insufficient, however similarly lawfully permitted to move, and turns into a potential endanger to themselves and other street clients. Walkers or cyclists are occupied with a similar style and can correspondingly harm themselves or others when out and about.

2.1.4 Vehicle arrangements in road accidents

Vehicle game plan is additionally a variable that a few portions trust adds to street mishaps (Broughton and Walter, 2007). Safety belts Research has demonstrated that, over all crash sorts, it is more improbable that safety belts were worn in impacts including demise or genuine damage, as opposed to light harm; wearing a safety belt decreases the danger of death by around 45 percent (Broughton and Walter, 2007). Safety belt utilize is questionable, with outstanding pundits, for example, Professor John Adams proposing that their utilization may prompt to a net increment in street losses because of a marvel known as hazard remuneration (David B., 2006).

Be that as it may, real perception of driver practices previously, then after the fact safety belt laws does not bolster the hazard remuneration speculation. A few imperative driving practices were seen out and about previously, then after the fact the belt utilize law was authorized in Newfoundland and in Nova Scotia amid a similar period without a law. Belt utilize expanded from 16 percent to 77 percent in Newfoundland and remained for all intents and purposes unaltered in Nova Scotia. Four driver practices (speed, halting at convergences when the control light was golden, turning left before approaching movement, and crevices in taking after separation) were measured at different destinations previously, then after the fact the law. Changes in these practices in Newfoundland were like those in Nova Scotia, with the exception of that drivers in Newfoundland drove slower on turnpikes after the law, as opposed to the hazard remuneration hypothesis (Lund AK. what's more, Zador P., 1984).

An all-around outlined and very much looked after vehicle, with great brakes, tires and balanced suspension will be more controllable in a crisis and therefore be better prepared to keep away from impacts. Some compulsory vehicle examination plans incorporate tests for a few parts of roadworthiness, for example, the UK's MOT test or German TÜV conformance review. The game plan of parts in a vehicle as likewise developed to enhance security after impact, both for vehicle inhabitants and for those outside of the vehicle. Quite a bit of this work was driven via car industry rivalry and mechanical development, prompting to measures, for example, Saab's wellbeing confine and strengthened rooftop mainstays of 1946, Ford's 1956 Lifeguard security bundle, and Saab and Volvo's presentation of standard fit safety belts in 1959. Different activities were

quickened as a response to shopper weight, after distributions, for example, Ralph Nader's 1965 book Unsafe at Any Speed blamed engine makers for lack of concern towards security.

In the mid-1970s British Leyland began a serious software engineer of vehicle security inquire about, creating various model exploratory wellbeing vehicles showing different advancements for tenant and passerby assurance, for example, air packs, electronically monitored slowing mechanisms, affect engrossing side-boards, front and back head restrictions, run-punctured tires, smooth and deformable front-closes, affect retaining guards, and retractable headlamps (Keith A., n.d). Outline has additionally been affected by government enactment, for example, the Euro NCAP affect test. Normal elements intended to enhance security incorporate thicker columns, wellbeing glass, insides with no sharp edges, more grounded bodies, other dynamic or detached wellbeing components, and smooth outsides to diminish the outcomes of a contact with people on foot. The UK Department for Transport distributes street setback insights for every sort of crash and vehicle through its Road Casualties Great Britain report. These measurements demonstrate a ten to one proportion of in-vehicle fatalities between sorts of auto. In many autos, inhabitants have a 2–8% shot of death in a two-fender bender.

Likewise focus of gravity has a tendency to have more genuine outcomes. Rollovers have turned out to be more regular as of late, maybe because of expanded fame of taller SUVs, individual's transporters, and minivans, which have a higher focus of gravity than standard traveler autos. Rollovers can be lethal, particularly if the tenants are shot out on the grounds that they were not wearing safety belts (83% of discharges amid rollovers were deadly when the driver did not wear a safety belt, contrasted with 25% when they did). Another plan of Mercedes Benz famously fizzled a 'moose test' (sudden swerving to maintain a strategic distance from a snag), a few makers upgraded suspension utilizing security control connected to an electronically monitored slowing mechanism to lessen the probability of rollover. In the wake of retrofitting these frameworks to its models in 1999–2000, Mercedes saw its models required in less crashes (Broughton and Walter, 2007). Around 40% of new US vehicles, predominantly the SUVs, vans and pickup trucks that are more vulnerable to rollover, are being created with a lower focal point of gravity and upgraded suspension with solidness control connected to its stopping automation to diminish the danger of rollover and meet US government prerequisites that order hostile to rollover innovation by September 2011.

As per transport Statistics Bulletin 2007 reports motorcyclists have little insurance other than their attire and protective caps. This distinction is reflected in the setback measurements, where they are more than twice as liable to endure extremely after an impact. In 2005 there were 198,735 street crashes with 271,017 reported setbacks on streets in Great Britain. This included 3,201 passings (1.1%) and 28,954 genuine wounds (10.7%) in general. Of these setbacks 178,302 (66%) were auto clients and 24,824 (9%) were motorcyclists, of whom 569 were murdered (2.3%) and 5,939 genuinely harmed (24%).

2.1.5 Road accidents internationally

The street transport part additionally remains an exceptionally aggressive industry. With a specific end goal to keep up their piece of the pie, organizations need to work all the more effectively, give higher quality administrations, and offer extra administrations than their opponents (European Foundation for the Improvement of Living and Working Conditions, 2004). Work weight in the vehicle area is regularly an aftereffect of 'without a moment to spare' administration: merchandise must be conveyed at the point in the generation procedure when the client needs them (European Agency for Safety and Health at Work (EU-OSHA), 2010).

Street transport wellbeing is an essential issue in created countries like the United States, Australia, and for EU nations by and large, business related engine vehicle accidents are evaluated to bring about between one-quarter to more than 33% of all business related passings (ERSO, 2007). As per a Danish examination of street car crashes (Carstensen et al., 2001), the accompanying components of overwhelming great vehicles expanded the mishap danger of trucks in correlation with traveler autos elements of substantial great vehicles expanded the mischance danger of trucks in correlation with traveler autos: The measurements of trucks added to circumstances emerging that can form into mischances that would not emerge with traveler autos; the diminished braking and hesitant capacities of trucks can add to circumstances all the more frequently forming into impacts, and the impacts happen at higher speed; the size and weight of trucks may imply that crashes result in more genuine individual wounds than comparable crashes including traveler autos.

Driving errors made by substantial products vehicle drivers might be more genuine as a result of the weight, estimate, shape, moving capacities, braking capacities, and so forth., of the vehicle. Transport drivers are not just at hazard from street mischances. The more extensive scope of word

related security and medical problems that may influence transport drivers include: Accidents and wounds identified with stacking, emptying vehicles, vehicle outline and upkeep; Musculoskeletal and vibration related disarranges; introduction to risky substances; hot and frosty taxis; Stress and savagery from individuals from the general population.

Around 33% of the passings of individuals in work environment mishaps in the EU are identified with transport. These mishaps as a rule include individuals: being struck or keep running over by moving vehicles (e.g. amid turning around); tumbling from vehicles; being struck by items tumbling from vehicles; or vehicles toppling (European Agency for Safety and Health at Work (EU-OSHA), 2001a).The primary sorts of transport mischances are: Vehicle crashes, People being struck or keep running over by moving vehicles (e.g. amid turning around or coupling), People tumbling from vehicles, People struck by items tumbling from vehicles, or vehicles toppling (European Agency for Safety and Health at Work (EU-OSHA), 2007).

2.2 Road carnage management efforts

Management includes distinguishing the mission, objective, methodology, principles and control of human undertaking to add to the accomplishment of an endeavor (Prabbal, 2009). This suggests viable correspondence: an undertaking situation rather than a physical or mechanical component infers human inspiration and infers some kind of fruitful advancement or framework result. Management of auto collisions through coordinated efforts to reduce road carnage is required.

2.2.0 Vehicle to vehicle interaction

As of late the created nations are increasingly observed progressing mechanically by tackling data important supply given by the associations of various correspondence systems. New handheld gadgets like cell phones and tablets enhance data handling and overall access of clients. Amid the most recent ten years, progresses in both equipment and programming advancements have brought about the requirement for interfacing the vehicles with each other. (Filippo, 2005).

Portable Adhoc organize hypothesis is a standout amongst the most imperative advances supporting vehicular remote correspondence, and it is critical innovation for the engine vehicle-related system improvement. The essential clarification of MANETs depends on the start of two remote portable units to speak with each other (S. Corson and J. Macker, 1999).

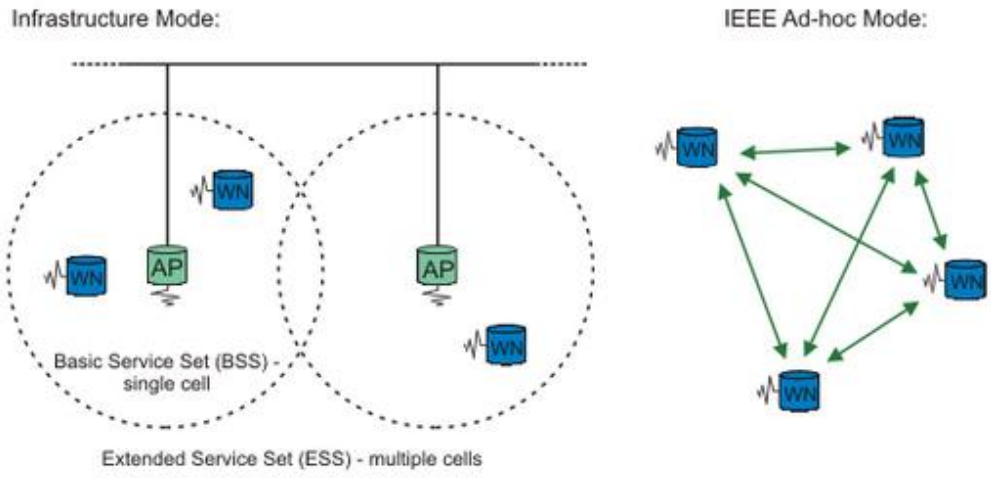

Figure 1: Infrastructure-based and Ad hoc networks example (Source: S. Corson and J. Macker, 1999).)

Remote portable systems have as a rule been founded on the cell thought and relied on upon great essential hardware to work and support, in which cell phones speak with get to focuses or base stations associated with the settled system fundamental gear. Run of the mill cases of this sort of remote systems are GSM, UMTS, WLL, WLAN, and so forth. (Hubaux et al, 2001)

In the course of the most recent couple of years the accessibility of remote correspondence and handheld gadgets has invigorated research on self-arranging systems that don't require pre-set up fundamental hardware to work. These systems comprise of self-decision hubs that cooperate so as to move data starting with one place then onto the next. Typically these hubs go about as end frameworks and switches in the meantime. A MANET is an accumulation of remote portable hubs that progressively change as expected to shape a system to trade data without utilizing any prior settled system hardware or focal place administration. At a given point in time contingent upon the hubs' positions and their transmitter and beneficiary scope designs, transmission control levels and co-channel obstruction levels, a remote availability as an arbitrary, multi-jump chart or a system arranging between the hubs. This system topology may change with time as the hubs move or change to improve a fit to new conditions in their transmission and gathering limits (Maxim and Jean-Pierre, 2007).

The activity principles in systems are entirely unique in relation to those in essential gear to work remote system, including: Peer-to-associate systems flags that happen between two hubs those are inside one jump. Organize activity is normally predictable; Remote-to-Remote Communication between two hubs past a solitary bounce yet which keep up a steady course between them. This are as a consequence of more than two, however not a considerable measure of hubs remaining inside correspondence scope of each other in a solitary range or potentially moving as a gathering. The activity is much the same as standard system movement; Pattern of conduct Traffic which happens when hubs are changing and moving around. Courses must be revamped. This outcomes in a poor availability and system action in short blasts (Michele el al…, 2009).

Since the topology of the system is always showing signs of change, the issue of steering bundles between any combine of hubs turns into a testing errand. In a MANET switches (i.e. hosts) can be portable and bury - switch availability can change regularly amid ordinary operation. Interestingly the Internet like other telecom systems has a semi settled framework comprising of switches or switches that forward information over hardwired joins. The refinement is that albeit traveling clients may move, they do most system related capacities in an altered area. Portable clients must work "on the go" changing purposes of connection as vital. In either case extra systems administration support might be required to track a client's area in the system so data can be sent to its present area utilizing the directing backing inside the more customary altered order (H. Luo et al, 2000).

Web is scarcely tuned to permit versatility amid the information exchanges since conventions are not imagined for gadgets that oftentimes change their purpose of connection in the topology. There is regularly a change of the physical IP address every time a versatile hub changes its purpose of connection and in this way its reachability to the Internet topology. This outcomes in losing bundles in travel and breaking transport conventions associations if versatility is not took care of by particular administrations. The convention stack should in this manner be redesigned with the capacity to cross systems amid information exchanges, without breaking the correspondence session and with least transmission postponements and flagging overhead. This is generally alluded to as portability support. Have versatility support is taken care of by Mobile IPv6

(Christensson, P. 2006).Interestingly, the objective of portable specially appointed systems administration is to develop versatility into the field of independent, versatile, remote spaces, where an arrangement of hubs, which might be consolidated switches and has, themselves shape the system directing foundation in an impromptu way. With Mobile Ad Hoc Networking, the steering foundation can move alongside the end gadgets. Hence the foundation's directing topology can change, and the tending to inside the topology can change. In this worldview an end-client's relationship with a versatile switch or get to point decides its area in the MANET. As said over a client's personality might be impermanent or perpetual. The significant contrasts in the structure of the steering foundation causes that a great part of the settled framework's control innovation is no more drawn out helpful. The foundation's steering calculations and a significant part of the systems administration suite must be improved to work productively and adequately in portable environment.

They additionally recommended that three classes of gauges manage the vehicular systems. The IEEE 802.11is the present convention were another revision, IEEE 802.11p is being chipped away at to bolster vehicular systems. The IEEE 802.11p is just a part of a gathering of measures identified with all layers of conventions for V2V operations. The IEEE 802.11p standard is constrained by the extent of IEEE 802.11, which is entirely a MAC and PHY level standard that is intended to work inside a solitary coherent channel.

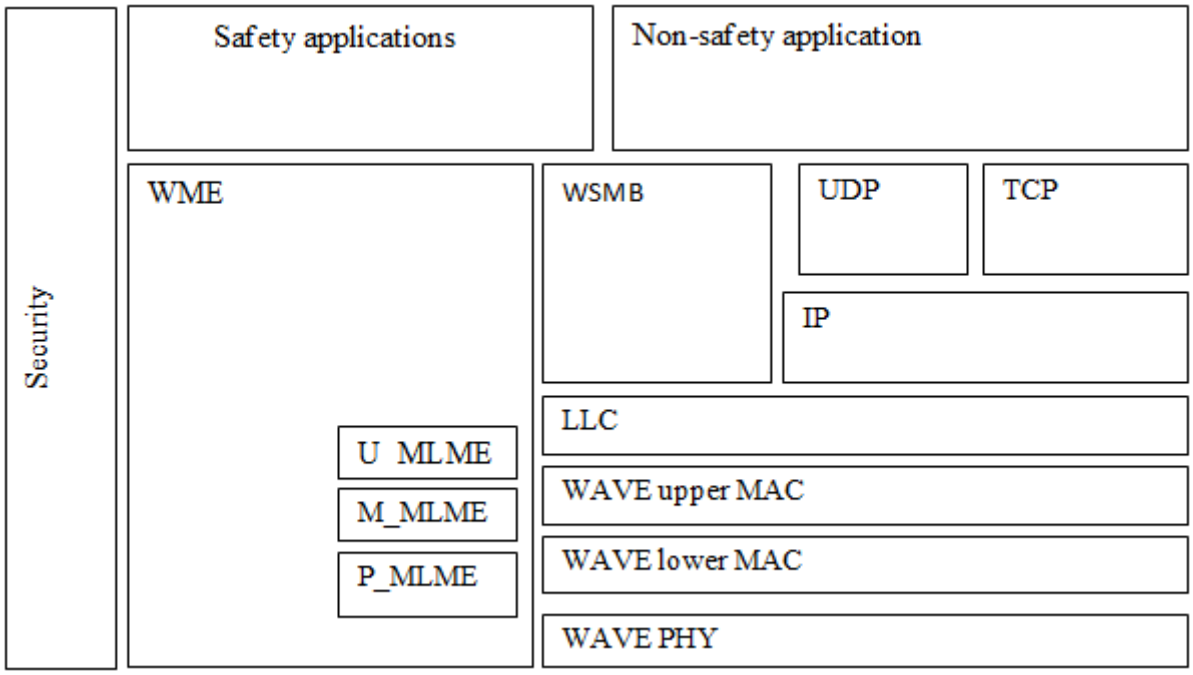

Figure 2: V2V standards and communication stacks (Source: Jiang, D. and Delgrossi, L.)

All affirmation and complexities identified with the V2V operational idea are dealt with by the upper layer IEEE 1609 models. The selection to be relocated to is IEEE 802.11p. The IEEE 802.11p institutionalization handle starts from the designation of the Dedicated Short Range Communications (DSRC) range band in the United States and the push to characterize the innovation for utilization in the DSRC band. (Guillaume, 2008)

The essential objective is to empower open security applications that can spare lives and enhance activity stream. Private administrations are additionally allowed keeping in mind the end goal to spread the arrangement costs and to empower the snappy improvement and reception of DSRC innovations and applications. In 1999 the U.S. Government Communication Commission assigned 75MHz of Dedicated Short Range Communications (DSRC) range at 5.9 GHz to be utilized solely for vehicle-to-vehicle and framework to-vehicle interchanges.

The outline underneath demonstrates the DSRC range organized into seven 10 MHz wide channels. Channel 178 is the control channel (CCH), which is confined to security correspondences as it were. The two channels at the finishes of the range band are held for

extraordinary employments. The rest are administration channels (SCH) accessible for both wellbeing and non-security use (NIST-CDV Workshop, 2010).

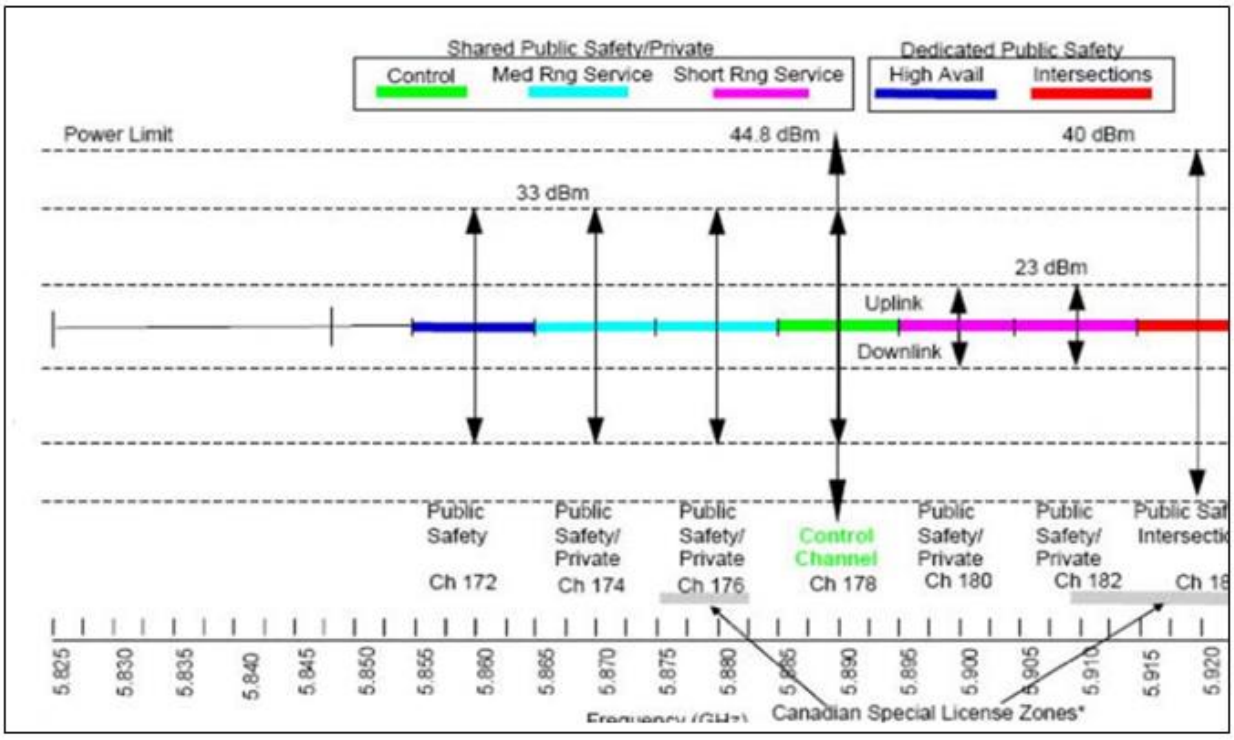

Figure 3: DSRC spectrum band and channels in the U.S (source: Federal Communications Commission (FCC).

The Federal Communications Commission (FCC) gives the DSRC band to free along these lines unlicensed range. It is free since it doesn't charge an expense for the range utilization. The 900 MHz, 2.4 GHz and 5 GHz are additionally unlicensed groups yet for different purposes. Likewise in an offer for obliging vehicular to vehicular correspondence Europe moved into put a range aside for vehicular correspondence in 2008. The European Commission from that point chose to give a solitary far reaching recurrence band that can be utilized for prompt and dependable correspondence amongst autos, and amongst autos and roadside foundation. It is 30 MHz of range in the 5.9 Gigahertz (GHz) band which is allotted by national powers crosswise over Europe to street wellbeing applications, without excepting different administrations as of now set up, for example, in radio novice administrations (Harvey J.Miller and Shih-Lung Shaw 2001).

All in all V2V correspondence empowers Traffic Safety change by proficiently giving data to the driver. With the assistance of V2V correspondence data like, Warnings on entering crossing points or leaving interstates, Hazardous area cautioning: impediment revelation, reporting mischances, Sudden stop notices: forward impact cautioning, pre-crash detecting or cautioning, Lane evolving notices, Privileging ambulances, fire trucks, and squad cars is empowered by benefiting data to the driver.

2.2.1 Smart Camera Network for Traffic Information Collection

The utilization of Intelligent frameworks are these days at the concentration of open powers and research groups which goes for giving effective answers for enhancing resident's way of life and wellbeing. The effectiveness of such sort of frameworks depends on the provoke preparing of the procured transport-related data for responding to clog, unsafe circumstances, and, all the more by and large enhancing the circumstances of individuals and merchandise. Keen Transport Systems (ITSs) empowers vehicles to be completely incorporated with minimal effort remote gadgets suited to set up an expansive system through the effort of roadside system.

ScanTraffic is a product dealing with the information gathering layer of and ITS created inside it is inescapable and heterogeneous foundation to screen and control urban portability. It incorporates a multi-level design which goes for the coordination and streamlining of the chain shaped by information gathering frameworks; conglomeration, administration, and on-line control frameworks; off-line frameworks going for foundation arranging; data frameworks focused to nationals and districts to handle and administer the vehicle portability. In addition it uses visual Wireless Sensor Networks (WSNs) to gather traffic-related information Nodes in a visual WSN are not the customary WSN hubs. Without a doubt, they are (small) keen cameras, i.e., gadgets outfitted with a microcontroller, an IEEE 802.15.4 handset and a low-determination CMOS camera. (Barbagli, B et al 2011)

Shrewd cameras use picture handling innovation to concentrate data from the gained picture. It is favorable over great sensors in light of adaptability. An arrangement of pictures contains a great deal more data than a scalar esteem; in this way camera-based sensors can play out an extensive variety of undertakings, practically supplanting different sorts of sensors. For instance, a brilliant camera can be utilized as a light sensor, a movement identifier, an inhabitance sensor, and so on. Keen cameras can likewise quantitatively supplant great sensors. For instance we utilize a solitary

shrewd camera to screen the inhabitance status of up to 10 parking spots, rather than utilizing one inductive sensor for every space (Daniele A, 2012).

From financial view brilliant cameras is exorbitant and devours a considerable measure of force yet the higher cost per unit is offset by the decrease in the quantity of sensors which likewise prompts to less expensive arrangement and upkeep. Control utilization issue is embraced through on-board picture preparing: just important data (e.g., number of checked vehicles, parking spot inhabitance status, and so forth.) is sent over the system, in this manner decreasing the quantity of traded messages which are the primary driver of vitality utilization in WSNs (Chen, W, 2006).

Savvy cameras additionally use visual WSNs as a product framework to completely deal with the visual WSNs used to gather traffic-related information (Barbagli, B, 2011). They accomplish this through; applying visual WSNs to the ITS area, giving another arrangement having numerous points of interest over current frameworks in light of scalar sensors and recognizing the base arrangement of administrations to be given by a product dealing with a visual WSN. The actualized framework engineering of ScanTraffic sent in the land-side of the Pisa International Airport is demonstrated as follows.

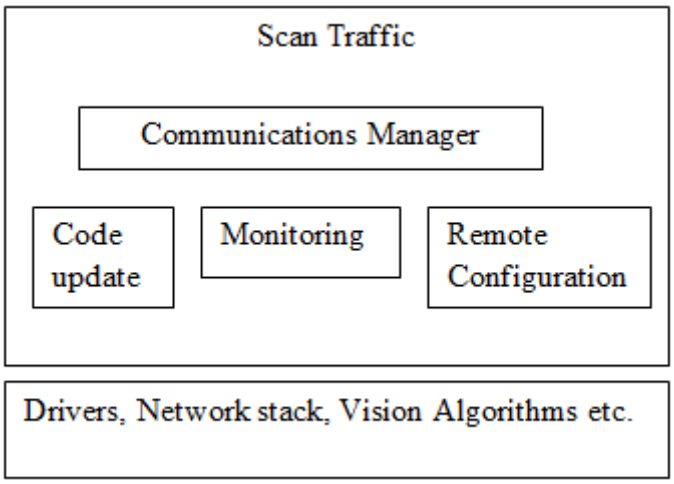

Figure 4: General architecture of Scan traffic system (source: (Barbagli, B, 2011).

The ScanTraffic WSNs gather data about parking area inhabitance and traffic flow. They utilized two implanted vision calculations portrayed in (Magrini et al 2011): one calculation include autos passing a street segment; the other calculation identifies the inhabitance status of an arrangement

of parking spots. The "flow sensor" is a shrewd camera running the previous calculation and the name "stopping sensor" to signify a savvy camera running the last mentioned. As depicted in (Magrini et al 2011), those calculations accomplish a general location rate of 95% with a false caution rate of 0.1%. Each visual WSN is associated with whatever is left of the framework by means of a backhaul interface. An uncommon hub in the WSN, the organizer, goes about as an entryway between the WSN and the upper layers. In the Ipermob model the backhaul connection is a HiperLAN interface and the organizer utilizes the UDP/IP convention to speak with upper levels.

To this end savvy camera actualized an arrangement of conventions taking after the web benefit approach on installed frameworks (Gutierrez et al.., 2011). This arrangement depends on the 6LoWPAN guidelines and can bolster complex topologies like the work. Control over the detecting action and access to the gathered information are conceivable through a REST interface gave by each sensor hub in the system. They utilized the Constrained Application Protocol (CoAP) to actualize such RESTful environment.

The significant drawback of output activity is the absence of constant support, making it inadmissible for ongoing applications. In this way they ought to have considered another arrangement in light of group tree topology. They ought to want to utilize one of the ways to deal with actualize a reference point empowered bunch tree arrange, and to stretch out Mirtes to bolster it. The progressions will be perplexing and less vigorous, yet it will bolster constant applications.

2.2.2 RFID use in management of highways

The utilization of RFID in administration of parkways has been actualized in Malasya and depends on arm innovation which works through a progression of subsystems, including the checking and controlling subsystem of road, the turnpike subsystem of multi-way distinguishing proof and tolling split record administration, the interstate toll accumulation subsystem of RFID and the extensive data administration stage of asset sharing. The trade and transmission of information and data is accomplished through the utilization PC organizing innovation and were administration is done through a bound together control of expressway. Furthermore, they can give intense information support to the development of their individual framework and accomplish the sharing of data assets (Vishnu et al… , Jun 2012).

The interstate watching and controlling subsystem of relies on upon premises that; In the control point, it is made out of the RF marks which are associated with the vehicle and contain the information of ID card, vehicle brands, driver's name and others, the perusers that are presented in the diverse control centers and gathering mechanical assemblies. It can finish customized recognizing verification of vehicle character and the supervision of vehicle, and in the meantime transmits the watching data to the total control center server through the framework.

Awaiting of radio recurrence cards is done in the interstate's aggregate control focus were driver's personality is completed to understand the data administration of vehicle like checking the installment records of vehicles, the authenticity of the vehicle (Angell, I. furthermore, Kietzmann, J. 2006). Opportune comprehension of movement condition to decide the position of vehicle to understand the following of voyaging vehicles is performed utilizing the ID number of RF card connected on the vehicle and the IP address of the beneficiary, and consolidating with GIS and GPS innovation, the continuous control and planning of vehicle, the advancement of activity courses and the lightening of activity clog should likewise be possible (Butters, A.2006).

This innovation can likewise be utilized as a part of the administration of transport installments where it can be outfit for toll accumulation. The interstate subsystem of multi-way recognizable proof and tolling split record administration give toll fractionation (F. Wear, 2004). The operations are as per the following: The accompanying segments make up the toll framework; vehicle electronic label, way recognizing stations, information preparing focuses, card senders, card perusers and other equipment's. Way recognizing stations are set in the crossing point of an interstate; were an establishment of the peruser set up. Electronic tag containing data is then appended to the vehicle.

The area data went through will be caught by the electronic tag and transferred to the focal toll arrangement of aggregate administration focus when vehicles get past the way distinguishing stations of RFID. It will give information support to radio recurrence recognizable proof toll subsystem. In this manner the position of way distinguishing stations passed precisely know the voyaging course of the vehicle and lead exact toll accumulation, and precisely do toll liquidation for the proprietors in the net (Zhang H., 2009). The framework recognizes the way of the vehicle, as well as records the vehicles‟ venture out mileage to help with benefit sharing. In this way in circumstance were a vehicle escapes the charge, it just influences the benefit sharing of the

organizations that showed up the wonder of escape from expense. Also, the loss of different organizations will be made up by the organizations that showed up the escape cost marvel (S. Lauren and B. Mariko, 2007). Accordingly spillage of tolls in freeway is decreased.

In like manner the peruser normally perceives information when a fast vehicle collides with the work district of gathering device in toll station through the development way, the, (for instance, the code of electronic tag, the code of vehicle sort, the information of proprietorship, the code of toll station in portals, the date and time of defeating toll station in entryways and so on.) that is passed on by the vehicles electronic tag, and at the same time carries on the confirmation of the vehicle character, then the data information will be transmitted to toll dominant presences in the toll station using the data transmission unit after that certification is correct. The toll gatherer will bear on customized amassing according to the measure of social event that is recorded exactly by the center toll gathering structure in the total organization center. Upon the productive social event, it opens the banner green light and aides the vehicle to pass routinely. If no banner is gotten or the information of vehicle sort is not legal, then the notice will be given out and the toll station will execute manual dealing with. Charging information is normally exchanged to the total organization center structure to store, anticipating others use (C.M. Roberts, 2006).

The far reaching data administration stage of asset sharing is additionally empowered were assembled data about vehicle, roadway toll and movement observation from the three sub-framework and in addition the continuous history information data related with street system is utilized with PC organizing innovation and the database innovation to manufacture an extensive data administration stage. This stage along these lines accomplishes sharing and full utilization of data.

The extensive data administration stage utilized a Windows 2000/Windows XP as the working framework stage and embraced protest arranged programming strategy to manufacture its backend database based SQL Server2000 and its application Client/Server mode. The framework has incredible security, adaptability and practicality. The framework obliged security instrument through security grid by setting up individual benefits. It gave approved information just (W. Wen, 2010). Checking the development data of vehicle and street current circumstance through this stage to increase sensible game plans about movement Highway transportation administration division is conceivable. Inspecting office can ask installments continuously circumstance about vehicle to

upgrade its supervision. The proprietors of vehicle may confirm and check the installment circumstance about their own particular vehicles, for instance: the measure of installment, installment recurrence et cetera.

From effectiveness thought RFID innovation is a reflection towards acknowledgment of roadway informatization. The application tackled the issues which exist in the administration of thruway well and enormously enhanced the level of supervision of the vehicles on the roadway .notwithstanding it performed stopping charge toll on the interstate by proficiently computerizing toll gathering, dispensing with the burdens of the movement blockage in turnpike and giving productivity in parkways. It dispensed with the simulated mistakes and the illicit thing about debasement thus on in light of the fact that there is no individual occupied with installment accumulation. Besides, it likewise maintains a strategic distance from the loss of toll and makes the toll gathering turn out to be more sensible and straightforward. At last, it makes the administration of expressway turn out to be more cutting edge, informationalized and wise (L. Jerry, 2001).

2.2.3 The human senses

The human's window to the world is through faculties. Vision is the most critical sense for the driving assignment. Outwardly 90 % of all data required for the driving assignment is seen (Sivak, 1996). For safe driving great vision isn't an adequate condition. Human discernment can be sorted into two procedures, to be specific base up and beat down handling. Base up handling alludes to jolt examination driven by the information alone (Matthews, Davies, Westerman, and Stammers, 2008)". Beat down alludes to tangible info that actuates the individual's applicable information, inspiration and desires (Cohen, 2009; Weller, Schlag, Gatti, Jorna, and Van der Leur, 2006). The cooperation between both procedures achieves Perception (Weller et al. 2006) show the part of both procedures for the driving assignment by alluding to the driver's speed decision when entering an obscure street.

Best down procedures impacts the speed the drivers pick (e.g. the driver is roused to go home as quick as could be allowed as he or she wouldn't like to miss the rugby coordinate), while the minor modification he or she makes amid driving are basically base up driven. Notwithstanding knowledge and desires influences driver's top-down motivational elements. A driver picks up this experience amid his or her driving profession. Driver's desires are framed by these encounters.

Youthful drivers have less issues seeing data, yet more seasoned drivers are more fit for relating the contribution to their experience and along these lines ready to settle on proper choices. On the off chance that a more seasoned driver, in any case, doesn't have adequate driving background, he or she won't have the capacity to repay his or her age related lacks. This may be the situation in Oman, where numerous individuals began driving a vehicle in their fifties or sixties. Subsequently driving background and the collaboration between top-down and base up procedures clarifies why more seasoned individuals are less much of the time required in RTAs than anticipated because of their age related insufficiencies.

It is not just what we see that is vital regarding street security, yet how we process and react to saw data. The vital variable is the means by which the driver judges the circumstance. As per Malaterre (1990), 59 % of all RTAs happen because of misinterpretation of the activity circumstance. How a street client makes this judgment is along these lines essential to get it. Human conduct is objective driven (Richetin, Conner, and Perugini, 2011; Theeuwes, 2001; Thomas L, 2007). A man tries to fulfill his or her objective. This objective can be partitioned into sub-objectives and the sub-objectives can be separated into sets of activities (Theeuwes, 2001). Finding a fancied state in an issue situation is like finishing the objective (Newell, Rosenbloom, and Laird, 1987).

With a specific end goal to accomplish a sought express a man needs to find a way to locate the neighborly choice. Finishing a stage, he or she looks at the new state to the craved state and is in this way ready to control whether the wanted state has as of now been found. The previously mentioned forms have been depicted as mental models or, all the more as of late, as circumstance mindfulness. Circumstance mindfulness is outstanding in the avionics field were fundamentally portrays degree an administrator knows about what is going on (Matthews et al., 2008).

For an administrator to act properly then the level of circumstance mindfulness should be higher. Since driving a vehicle and flying a flying machine are both errands that rely on upon natural information factors (Ma and Kaber, 2005) furthermore because of its achievement in avionics, circumstance mindfulness has turned into a well known approach in the field of street wellbeing research (Baumann, Petzoldt, and Krems, 2006; Ma and Kaber, 2005; Sommer, 2012).

Circumstance mindfulness are distinctive relying upon the ways to deal with (e.g. Endsley, 1988; Regal, Rogers, and Boucek, 1988; Smith and Hancock, 1995). A standout amongst the most unmistakable methodologies was introduced by Endsley, who characterized circumstance

mindfulness as "the impression of components in the earth inside a volume of time and space, the understanding of their importance and the projection of their status sooner rather than later (Endsley, 1988)". In such manner, circumstance mindfulness can be comprehended as a mental model of the present circumstance which gives the premise to the determination of activities. Drivers, for instance, ought to shape presumptions about the improvement of a movement circumstance. In the event that an auto will stop or will the passerby cross the street, and so on.? For each performed activity it impacts on the circumstance, the model must be "revived". Circumstance mindfulness is in this manner a state and a procedure (Baumann et al., 2006).

Endsley (1995) recognized three segments of circumstance mindfulness: view of components in the earth and understanding of their importance in connection to assignment, and projection of their status sooner rather than later. Level one is presumably the most crucial component of circumstance mindfulness. At the main stage, ecological signs are seen. These signals can be clear similar to a caution or unpretentious like a slight change in the in a motor segment (Weller et al., 2006).

Not seeing imperative prompts in the earth would definitely expand the likelihood of shaping a wrong photo of the circumstance and in this way improving the probability a mischance. A portion of the inconspicuous signs may just be seen unwittingly (Endsley, 2000). Additionally the sort of data being seen relies on upon the driver's conduct and in addition the restrictions of his or her tangible framework. On a natural course, the driver won't not focus on street signs. It is hence conceivable that he or she manages imperative data (Otte and Kühnel, 1982)

A case gave as an outline how effectively essential data can be supervised. "A lady, who depicted herself as amateur driver, collided with an approaching auto that was going on her path. The issue was that this lady didn't see a development site and a notice sign demonstrating that one path is shut. She reported that she generally took this street every day and along these lines didn't expect any deviation". On the off chance that she would have seen the notice sign, the RTA won't not have had happened. The lady had a low level of circumstance mindfulness. In addition, this normal for situational mindfulness shows that even experienced drivers commit errors, a view supported by numerous known analysts on human components like at the second level, the apparent data is translated. Numerous bits of data must be incorporated and decided as to their significance to the individual's projection (Reason, 2000).

In conclusion the more the data accessible, the all the more requesting the procedure is. Clearly, this makes the level defenseless against extra errands (e.g. discussions). The impact of extra errands on circumstance mindfulness and how circumstance mindfulness is identified with ideas of workload, working memory and long haul memory is depicted somewhere else (Endsley and Garland, 2000; Ma and Kaber, 2005). In view of the apparent data and their elucidation, the individual figures future circumstances (level three).

2.2.4 Fuzzy systems

Different concentration in hindering and overseeing street bloodletting is utilization of fluffy activity controls issue of enhancing activity security in the intersections, benefitting as much as possible from the capacity of the intersection and minimizing the accidents. Movement signs are the most reasonable strategy for controlling activity in a bustling intersection or path .The observing and controlling of Road/path movement is a noteworthy issue in numerous nations including Kenya as a result of expanding number of vehicles (Larkin, L. I., 1985).

Roadways advancements have a lower stage prompting to movement blocking issue or clog issue. Activity over-burdening or clog have a ton of variables which adds to street mishaps like the assignment of vehicles on the path/street, human way of life, open conduct and movement light framework are a noteworthy issue. An activity lights framework controls movement at intersection/crossing point in conjunction with a Traffic policeman remaining at an activity convergence every day to conquer this blockage issue particularly amid pinnacle hours.

The execution and structure of a wise activity control framework utilizing fluffy rationale innovation has the ability to copy human insight for controlling movement lights. Fluffy rationale innovation permits the fulfillment of genuine standards which is like how a human would think. Fluffy rationale is useful for controlling and taking care of crossing points path since they are better contrasted with movement cops who now and again set back activity flag control when the convergence is pressed.

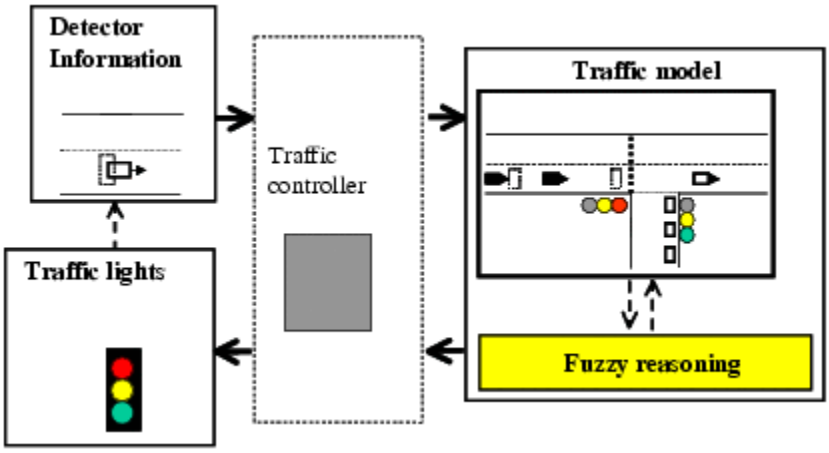

Figure 5: Fuzzy system framework for use in signalized intersection (Kamlesh Kumar P. et al...2015)

From the outline above fluffy rationale controller accomplishes control of convergences through fuzzification by changing over the fresh contribution to fluffy contribution by changing over fresh set to a fluffy set by checking the quantity of vehicle through a sensor in an augmentation request and sending this tally number to fuzzification framework. The fluffy basic leadership framework takes a line fluffy esteem from fuzzification from which it settles on a choice utilizing information base and fluffy administer base database. After that the outcome is exchanged to fuzzification by means of yield variable and a Knowledge Base whose fundamental point is decide the best approach for known info diminishing the quantity of vehicles in a crossing point path (O. Cordon et.. al, 1997)

From the chart above feathery method of reasoning controller finishes control of joinings through fuzzification by changing over the new commitment to fleecy commitment by changing over crisp set to a soft set by checking the amount of vehicle through a sensor in an expansion demand and sending this count number to fuzzification structure. The cushy essential administration structure takes a line soft regard from fuzzification from which it settles on a decision using data base and fleecy regulate base database. After that the result is traded to fuzzification by method for yield variable and a Knowledge Base whose guideline point is choose the best course of action for known data decreasing the amount of vehicles in a joining way (Kamlesh Kumar P. et al..2015)

In conclusion sensor is the key equipment of controller and it channels development and sends information to a cushioned controller where the soft controller checks oversee build database and

settles on decision in light of action conclusion. The cushy method of reasoning in the action signals control Improves development and security in the crossing point making the most from the convergence and minimizing the tending to vehicles. From the chart above feathery reason controller finishes control of joinings through fuzzification by changing over the new commitment to cushy commitment by changing over new set to a fleecy set by checking the amount of vehicle through a sensor in an expansion demand and sending this count number to fuzzification system. The feathery fundamental administration structure takes a line fleecy regard from fuzzification from which it settles on a decision using data base and soft oversee base database. After that the result is traded to fuzzification by method for yield variable and a Knowledge Base whose standard point is choose the best course of action for known data lessening the amount of vehicles in a meeting way.

In conclusion sensor is the central equipment of controller and it channels development and sends information to a fleecy controller where the cushioned controller checks oversee build database and settles on decision in light of movement conclusion. The cushioned justification in the action signals control Improves development and security in the crossing point making the most from the convergence and minimizing the tending to vehicles. From the diagram above cushioned method of reasoning controller fulfills control of unions through fuzzification by changing over the crisp commitment to feathery commitment by changing over new set to a cushy set by checking the amount of vehicle through a sensor in an expansion demand and sending this count number to fuzzification structure. The feathery essential administration system takes a line cushioned regard from fuzzification from which it settles on a decision using data base and fleecy manage base database. After that the result is traded to fuzzification by method for yield variable and a Knowledge Base whose rule point is choose the best game plan for known data decreasing the amount of vehicles in a joining way (A Bardossy et al..1995)

In conclusion sensor is the major equipment of controller and it channels development and sends information to a soft controller where the feathery controller checks manage build database and settles on decision in light of movement conclusion. The fleecy method of reasoning in the action signals control Improves development and security in the crossing point making the most from the convergence and minimizing the tending to vehicles. From the diagram above soft reason

controller fulfills control of mergings through fuzzification by changing over the new commitment to cushy commitment by changing over crisp set to a cushioned set by checking the amount of vehicle through a sensor in an expansion demand and sending this count number to fuzzification system. The feathery fundamental authority system takes a line fleecy regard from fuzzification from which it settles on a decision using data base and soft oversee base database. After that the result is traded to fuzzification by method for yield variable and a Knowledge Base whose guideline point is choose the best plan for known data reducing the amount of vehicles in a joining way (Patcha and J.M. Park, 2007)

In conclusion sensor is the principal equipment of controller and it channels development and sends information to a cushy controller where the fleecy controller checks regulate build database and settles on decision in light of movement conclusion. The fleecy method of reasoning in the action signals control Improves development and security in the crossing point making the most from the convergence and minimizing the tending to vehicles. From the chart above cushy method of reasoning controller achieves control of unions through fuzzification by changing over the crisp commitment to soft commitment by changing over new set to a fleecy set by checking the amount of vehicle through a sensor in an expansion demand and sending this count number to fuzzification structure. The feathery fundamental authority system takes a line cushioned regard from fuzzification from which it settles on a decision using data base and soft direct base database. After that the result is traded to fuzzification by method for yield variable and a Knowledge Base whose standard point is choose the best course of action for known data lessening the amount of vehicles in a meeting way (Kamlesh Kumar P. et al..2015)

In conclusion sensor is the basic equipment of controller and it channels development and sends information to a cushy controller where the cushioned controller checks direct build database and settles on decision in light of movement conclusion. The cushioned justification in the action signals control Improves development and security in the crossing point making the most from the convergence and minimizing the tending to vehicles. From the chart above cushy reason controller achieves control of meetings through fuzzification by changing over the crisp commitment to cushioned commitment by changing over new set to a fleecy set by checking the amount of vehicle through a sensor in an expansion demand and sending this count number to fuzzification system.

The fleecy essential authority system takes a line cushy regard from fuzzification from which it settles on a decision using data base and feathery manage base database. After that the result is traded to fuzzification by method for yield variable and a Knowledge Base whose guideline point is choose the best game plan for known data lessening the amount of vehicles in a merging way (Y. Jin, 2000)

In conclusion sensor is the major equipment of controller and it channels development and sends information to a fleecy controller where the feathery controller checks manage build database and settles on decision in light of action conclusion. The feathery method of reasoning in the action signals control Improves development and security in the crossing point making the most from the convergence and minimizing the tending to vehicles. From the diagram above cushioned justification controller finishes control of joinings through fuzzification by changing over the crisp commitment to cushy commitment by changing over new set to a soft set by checking the amount of vehicle through a sensor in an expansion demand and sending this count number to fuzzification system. The cushy fundamental authority system takes a line feathery regard from fuzzification from which it settles on a decision using data base and soft regulate base database. After that the result is traded to fuzzification by method for yield variable and a Knowledge Base whose guideline point is choose the best game plan for known data reducing the amount of vehicles in a merging way (Jui, Y.,. et al..2015)

In conclusion sensor is the principal equipment of controller and it channels development and sends information to a cushy controller where the fleecy controller checks manage build database and settles on decision in light of action conclusion. The feathery reason in the action signals control Improves development and security in the crossing point making the most from the convergence and minimizing the tending to vehicles. From the diagram above feathery justification controller fulfills control of mergings through fuzzification by changing over the new commitment to cushioned commitment by changing over crisp set to a soft set by checking the amount of vehicle through a sensor in an expansion demand and sending this

2.3 Modeling processes

A mathematical model is a description of a system using mathematical concepts and language. The process of developing a mathematical model is termed mathematical modeling. Mathematical

models can take many forms, including dynamical systems, statistical models, differential equations, or game theoretic models. These and other types of models can overlap, with a given model involving a variety of abstract structures. Mathematical models may include logical models. In this case of Driver Road Safety Index the quality of scientific field depends on how well the mathematical models developed on the theoretical side agree with results of repeatable experiments (Bender, E, 2000).

The process of Mathematical modeling brings real world representation of problems in mathematical terms in an attempt to find solutions to the problems. A mathematical model is a simplification or abstraction of a (complex) real world problem or situation into a mathematical form, thereby converting the real world problem into a mathematical problem. The mathematical problem can then be solved using any technique to obtain a mathematical solution (Bender, E, 2000).The solution can then be interpreted and translated into real terms. Figure 6 shows a simplified view of the process of mathematical modeling.

A numerical model is a depiction of a framework utilizing scientific ideas and dialect. The way toward building up a scientific model is named numerical displaying. Numerical models can take numerous structures, including dynamical frameworks, measurable models, differential conditions, or amusement theoretic models. These and different sorts of models can cover, with a given model including an assortment of dynamic structures. Scientific models may incorporate intelligent models. For this situation of Driver Road Safety Index the nature of logical field relies on upon how well the scientific models created on the hypothetical side concur with aftereffects of repeatable trials (Bender, E, 2000).

The procedure of Mathematical displaying brings certifiable representation of issues in numerical terms trying to discover answers for the issues. A scientific model is a disentanglement or deliberation of a (mind boggling) true issue or circumstance into a numerical shape, in this manner changing over this present reality issue into a scientific issue. The scientific issue can then be settled utilizing any method to acquire a numerical arrangement (Bender, E, 2000).The arrangement can then be deciphered and converted into genuine terms. Figure 6 demonstrates a streamlined perspective of the procedure of numerical displaying.

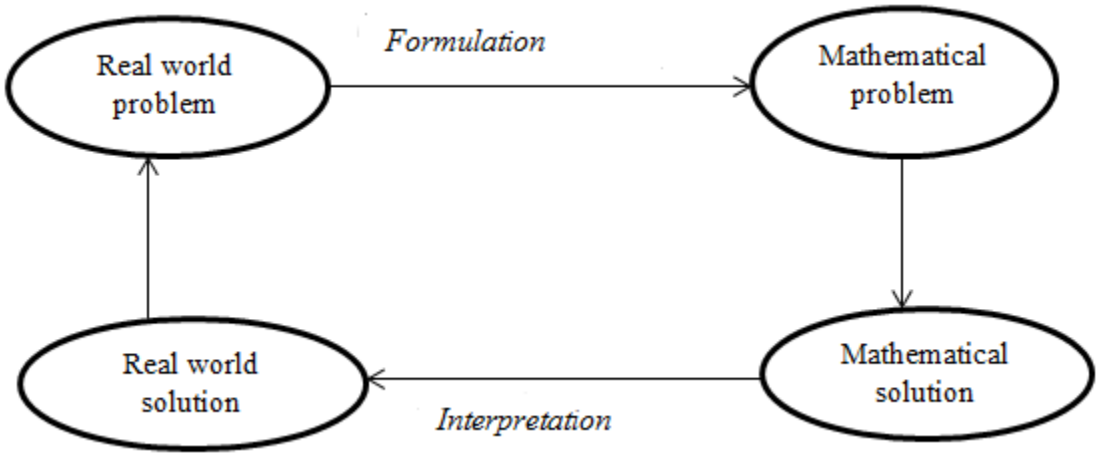

Figure 6: A simple view of the mathematical modeling process

The above is a terribly disentangled definition for the standard complex procedure of displaying (Swetz and Hartzler, 1991). The beginning stage of scientific displaying is this present reality issue or circumstance. The accentuation is in taking care of an issue instead of finding an answer that must exist. The issue won't not be explained totally, albeit moving one stage to another brings an answer nearer. In other circumstance guess of the answer for an issue not to a "correct reply" either does not exist or is inaccessible (Arora M, 1991).

Through scientific displaying critical thinking can be accomplished numerically. Arithmetic ought to be exhibited in real life as opposed to confounding arrangement of formulae wrote on the writing slate. Arithmetic ought to be put in setting and concentrate on why science exists in any case. In addition, numerous testing and energizing aptitudes are utilized as a part of creating models and these have frequently been disregarded in conventional school arithmetic. The framework relating contributions to yields relies on upon factors like: choice factors, state factors, exogenous factors, and irregular factors. In designing, scientific models are utilized to amplify a specific yield. The framework will require certain data sources (Abrams, 2001).

Autonomous factors are otherwise called Decision factors. Exogenous factors are once in a while known as parameters or constants. The factors are not free of each different as the state factors are reliant on the choice, info, irregular, and exogenous factors. The machine state is affected by the autonomous factors (North, D.W. 1968).Although there is no restriction to the quantity of target

capacities and requirements a model can have, enhancing the model turns out to be more included (computationally) as the number increments.

The Functions of the yield factors or state factors get to be Objectives and limitations of the framework and its clients (Dodge .Y, 2003). The target capacities will rely on upon the point of view of the model's client. Contingent upon the specific situation, a target capacity is otherwise called a list of execution, as it is some measure important to the client. Scientific demonstrating is utilized as a part of building to dissect a framework to be controlled or upgraded. An elucidating model of the framework can be worked as a speculation of how the framework could function, or attempt to gauge how an unforeseeable occasion could influence the framework. For recreations in designing diverse control methodologies can be attempted (North, D.W. 1968).

In determination scientific model portrays a framework by an arrangement of factors and an arrangement of conditions that set up connections between the factors. The Variables can be of various sorts; genuine or whole number numbers, Boolean values or strings and so on. The factors speak to the properties of the framework, for instance, measured framework yields like signs, timing information, counters, and occasion event (yes/no). The real model is the arrangement of capacities that depict the relations between the distinctive factors.

2.4 Technologies used by web based models.

Road slaughter recognition are all endeavors that are united to moderate death toll, property and mass killings through concocting method for forestalling or deflecting street massacre (Lee Jong-Wook and James D.W, 2004). Street savagery decrease in a setting of an online model happens as in street butchery issues can be caught for future utilize and examination. Normal electronic application take after a model view controller design which has three sections figure 1 (Trygve, 1989).

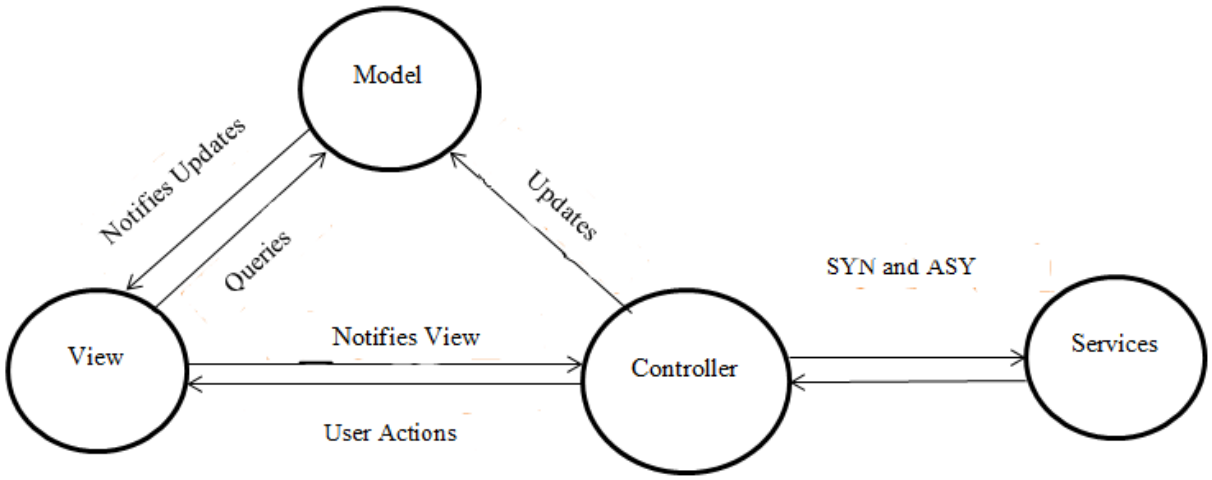

Figure 7: Modified Basic components of MVC architectural pattern and information flow (Trygve, 1989).

The view renders the interfaces were the client collaborates with and ordinarily comprised of scripting dialects such has HTML. Along these lines the HTML page sends data to the controller. The controller reacts and handle occasions which are the client activities and ordinarily conjures changes to model and view. The model is the space layer which contains the application rationale layer which adds intending to crude information. It additionally contains a capacity system with an asset administration layer underneath.

The capacity system can be encouraged by database, for example, MySQL which is a free broadly accessible web crawler that can be utilized has a quick, solid DBMS with particular motor design. It has been utilized as a part of catching data for further investigation in different frameworks like Electronic Database System, the web and web programming. It can be utilized to build up a framework for assessing impacts created in tests utilizing a product or and equipment model (San Murugesan, 2005).

2.4.0 GSM/GPS technology for controlling traffic

GSM/GPS innovation application is a blend of Android Technology and Web Services. It gives Information about transport to private utilize or for open utilize. It gives data about: government transport vehicles for open administration, school transport transportation, individual vehicles, mishap scenes and so on. It can be utilized to track the vehicles through utilization of GPS (Global Positioning System) and GCM (Google Cloud Messaging). By utilizing the GPS and GCM

innovation it demonstrates the position of vehicle on Google Map to the client who asked for (E. D. Kaplan, 1996).

The innovation utilizes four segments a Web Server to store the data, GPS gadget to track the vehicle, GCM and Client side application. The web server is Cloud based Amazon benefit i.e. Amazon Simple DB, secured with online database to store data. It is like localhost database yet it has capacity limit much more noteworthy than localhost database loaded with security. The second is GPS gadget to track the vehicle. This is the fundamental part of the application. For GPS gadget they utilized two methodologies: initially, utilized Android portable as GPS gadget, second is they utilized a GPS gadget that does following by fitting into the vehicle. The Third segment is GCM to send and get the messages through web. At the point when following is done then the GPS gadget utilizes the co-ordinates to send data through GCM innovation. The application got to be easy to use interface for customers (Sayyed and k.m.rayudu, 2015).

They likewise utilized Google Cloud Messaging (GCM) to empower sending information from servers to both Android applications or Chrome applications and expansions. The administration gave straightforward, lightweight system that servers used to advise versatile applications to contact the server specifically, to get redesigned application or client information. The lining of messages and conveyance to the objective application running on the objective gadget is handles by the administration. Likewise they utilized Google Map to show line and stick objects. Google Earth programming and Google Map gave track presentations to show areas of vehicles.

The GPS following framework followed the present position of the vehicle and indicated it to the client who needs to go by the vehicle. The framework then decreased the sitting tight time for voyaging. The GPS Device sends vehicles' present position to the server. The server on demand from the customer demonstrated the customer the present area of the vehicle on the Google Map.

2.4.1 Geo-conferencing and transportation

Geographic data framework (GIS) turns into a capable instrument in overseeing activity since it has an ability to handle and process spatial information in a vast volume. GIS is a framework that sources of info, stores, recovers, redesigns, shows, and thoroughly examinations spatial information in light of PC equipment and programming (Zhang H, 2011). The GIS is an innovation that makes maps, coordinates data, imagines and takes care of issues, and create profitable

arrangements (Sadoun B, 2010). Applying GIS for street administration framework have been utilized before as a part of created nations (Yusoff N, 2014). It turns into a compelling framework to screen every one of the exercises that happen on the streets and store the records for future improvement.

The innovation additionally fills in as a choice emotionally supportive network (DSS) for street advancement and development from a perspective of future. It is created as a web stage. The innovation of Web based GIS or Web GIS for this situation among numerous advances that can be embraced for GIS is an Internet-based stage that gives customer side applications utilizing WWW conventions running on the overall web which can implant geographic data information and in addition non-geographic information (Feng X and Quanwen L 2010). It is a kind of GIS which is joined by the quick improvement of Internet (Xinkai Y et al, 2010). Web GIS contains different points of interest contrasted with desktop GIS (Xie F, 2010). Accordingly GIS becames powerful in street administration through Open source electronic GIS programming utilized as a part of building up the framework so as to minimize the upkeep cost. The framework gave a far reaching framework that observed and oversees street conditions which is likewise ready to be gotten to by clients through the web.

They built up the framework design by masterminding GIS and GIS-related information on the server. Information is at first named either changeless or brief. Changeless information has been subjected to quality control (QA/QC) to guarantee every single required standard and particulars have been met and that the information will be accessible to all framework clients. Information named brief is either being created and created or used just by a particular client or gathering of clients for a particular venture in constrained time (Goodchild M, 2010). While lasting information can be put away in a solitary, special arrangement of envelopes and subfolders, brief information requires that an arrangement of organizers and subfolders for the capacity be doled out to the client or gathering of clients.

The Web GIS has ability to info, prepare, and ultimately envision the outcomes on screen utilizing web stage. Framework outline is the primary strategy in web improvement. It demonstrated the general segments in the framework. Improvement of the web has three crucial segments to make it run effectively. The engineering of framework plan is appeared in beneath.

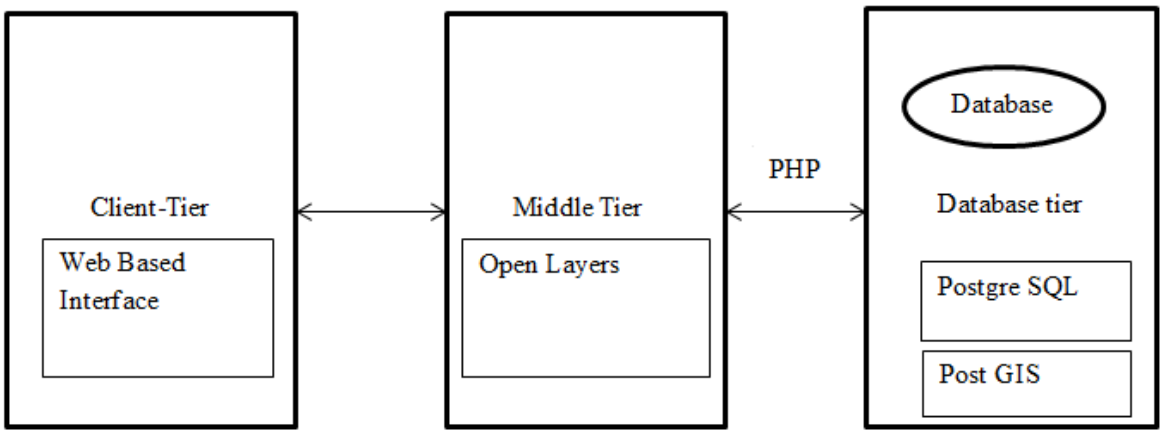

Figure 8: The architecture of web-based GIS system (source: Goodchild M, 2010).

The Client-level of online GIS utilizes a web program to show data to clients. This level turns into the interface to get client ask for handling. The customer level backings diverse Web programs, for example, Internet Explorer, Mozilla Firefox, Google Chrome and others. Web program permits clients to enter their demand (Fitzpatrick J., 2009). They built up an interface utilizing hypertext markup dialect (HTML) as the primary programming scripting of the interface. The substance of the site page were composed in the frame HTML component before distributed on the web program. They implanted JavaScript dialect in the HTML scripts to produce intelligent and dynamic representation.

The primary page of the framework that arrangements with the clients is the Client level. The realistic UI (GUI) gets client asks for through the web program. At that point, the solicitations will be exchanged to the database level for handling. The information required will be recovered from the focal database in the database level. In this manner, the outcome will be exchanged again through web level and imagined on the customer level for user.The Middle level turns into the most essential level of the entire framework. This level is to control the entire procedure of the framework. After customer level gets the solicitations from client, the outcomes will be sent back to client by means of middleware. It serves as the scaffold medium between customer level and database level for web GIS framework.

The association utilized HTTP and SQL to decipher between them. Open Layers system was appended in this level for guide perception. Open Layers is an intense and adaptable capacities for showing maps in web program utilizing JavaScript library. It is establishment of all networks mapping system, for example, Google Maps, Open Street Map, Google Satellite, Yahoo Maps, and Bing Maps (Perez AS, 2012). It utilizes three web mapping applications which incorporate Google Maps, Google Satellite, and Open Street Map to look in assortment of interface show.

The Database level or server level is a level that stores and recovers data in this framework. It is the database administration framework (DBMS) for this web. The Postgre SQL/Post GIS database was set in the database level to oversee and give information when preparing were run. The server side scripting dialect Hypertext preprocessor (PHP) customer level speaks with the database level. PHP code was implanted in HTML code. At the point when customers summon the HTML page, the Web server executes the scripts, which thus get to the information from Postgre SQL/Post GIS database. The Web server then composes the information into HTML page and sends it back to the program. Therefore, clients can see street data and most limited way course that recovered from database on the site page (Perez AS, 2012).

To affirm mischance areas effectively before entering them into the Google Earth stage site visits should be possible in parallel. Amid site visits photos are taken. Likewise to check the mischance area data GPS bolster material is required. All focuses that had as of now been georeferenced are put into the GPS in the accompanying way: The WGS84 decimal directions were added to the ArcMap focuses (instrument utilized: Add XY Coordinates); A predefined Excel table was utilized with the directions and mischance record number fields rounded out lastly the two documents were foreign made into the GPS gadget (Hackeloeer.A, 2014)

To display the expressive outline messages, the Excel content table gave instrument should have been altered through: rectification of the condensings, road names and extra content in the table. At that point, the titles for every field characterized with sections made in the table for every characteristic being introduced. At long last, a Word document was made with all the data set out for every line in the table.

2.5 Theories informing the study

2.5.1 The use of Technology Acceptance Model (TAM)

Technology Acceptance Model (TAM) is used as the foundation in this study for two reasons; (a) it is easy to be applied and (b) provide better understanding on the relationship amongst the variables used in the study (Amin, 2008). Furthermore, it is one of the most influential models which have been widely used in the studies of the determinants of information system acceptance (Ramayah and Jantan, 2004).Introduced in 1989 by Fred D. Davis, TAM is an information systems theory that models how users come to accept and use a technology. TAM is an adaptation of TRA and specifically tailored for modeling user acceptance of information systems
(Venkatesh, 2000; Ramayah & Jantan, 2004; Sun & Zhang, 2006; Amin, 2007a; Chung, 2008). TAM is established generally to provide an explanation of the determinants of technology acceptance and capable of explaining user behavior across a broad range of end-user technologies and user populations while at the same time being parsimonious and theoretically justified (Alrafi, 2006; Amin, 2007b; Amin, Baba & Muhammad, 2007; Amin, 2008; Chung, 2008). The model proposes that when users are presented with a particular technology, two particular beliefs namely perceived usefulness and perceived ease of use affected their behavioral intention to use the system.

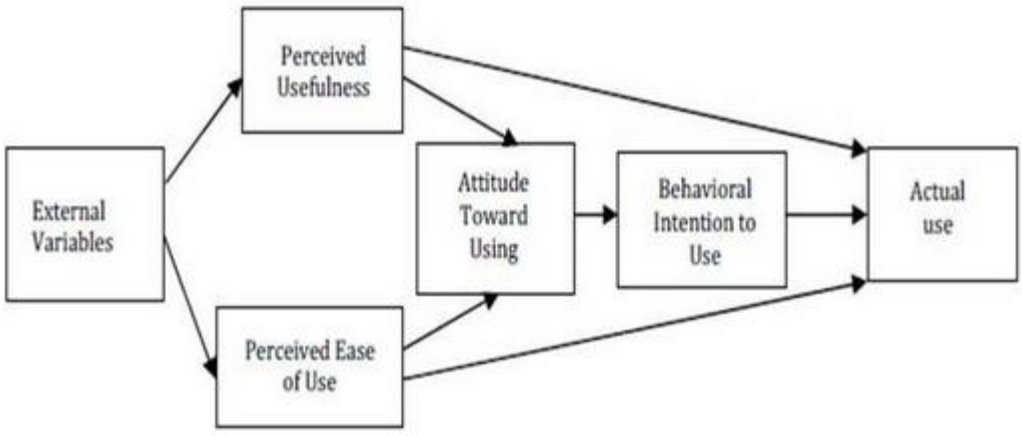

Figure 8:TAM Ali H. Al-Badi, Abdullah S. Al-Rashdi and Taher A. Ba-Omar, 2011 Technology Acceptance: Course and Teaching Surveys Case Study at Sultan Qaboos University.

Technology Acceptance Model has been studied in various setting. For example, Leong (2003) has conducted a study on the robustness of TAM after a decade of its establishment to find out

whether TAM is still valid after rapid changes in systems and technologies. He replicated Davis et al. (1989) and used Ms Access as the application software in his study. The results supported the applicability of TAM in the recent technologies where it showed that the two salient beliefs in TAM still provide significant effects on the usage of the tested technology. A longitudinal study examining technology acceptance by school teachers in Hong Kong has been carried out by Hu, Clark and Ma (2003). They found that perceived usefulness was the most important determinant of teachers' acceptance of Power Point application. However, contrary to Davis et al. (1989), perceived ease of use failed to show a significant effect on intention.

According to Hu et al. this contrary result might be due to job relevancy was perceived far more important than ease of use. Thus, even how easy the technology is, it will still not be used if it is perceived as not useful or relevance in one's job. In Malaysia, Md Noor, Hashim, Haron and Ariffin (2005) have studied the effect of perception of trust, risk and sharing on intention to share and actual sharing of information at the customer to community (C2C) travel and tourism websites. Contradictory to other TAM findings, this study found perceived usefulness and ease of use of knowledge sharing website did not contribute to the intention behavior.

Ignatius and Ramayah (2005) provide an empirical investigation on Course Website Acceptance Model (CWAM) which is a modification from TAM (Davis et al., 1989) in investigating course website acceptance amongst students in universities and they suggested that culture may have a potential effect on adoption of information technologies especially in the developing countries. Amin (2008) presented a study on factors influencing the intentions of customers in Malaysia to use mobile phone credit cards and found TAM variables have significantly affected customer intention to use mobile phone credit cards. Previously, Amin et al. (2007) have conducted an examination on mobile banking acceptance by Malaysian customers where they added perceived credibility, perceived self-efficacy and normative pressure with TAM. They discovered all elements are significant factors of behavioral intention except for normative pressure where this factor has no significant effect on the intention to use mobile banking.

Besides mobile banking, studies have also been conducted on acceptance of internet banking in Malaysia. Md Nor (2008) has studied the impact of ethnicity on internet banking adoption. He selected Malay and Chinese ethnic groups and compared their perceptions on internet banking adoption. He found Malays and Chinese perceived trust as the most influential factor of internet banking adoption in Malaysia. However the Chinese also put higher emphasis on perceived

usefulness than the Malays. According to Md Nor, this result might be due to the cultural traits where the Chinese tend to put more emphasis on the benefits they will get before adopting any technology.

Another study on internet banking adoption was conducted by Lallmahamood (2007) who found perceived security and privacy as the second important element in internet banking adoption after perceived usefulness. He found perceived usefulness, ease of use and credibility have explained approximately 53.2% of variance in intention to adopt internet banking.

Ramayah, Mohd Suki and Ibrahim (2005) have examined technology acceptance of online bill payment system and found support for applicability of TAM in explaining intention to use online bill payment system among postgraduate students in Malaysia. TAM has also been tested in taxation environment. Online tax services have been established to offer more convenience and accessibility of tax services and information to the taxpayers. Wang (2002) has conducted an empirical study on adoption of electronic filing systems in Taiwan and found extended TAM contributes 62% of explained variance in behavioral intention. The results showed perceived usefulness, ease of use and credibility did have significant effect on behavioral intention with perceived ease of use contributed more to intention as compare to the other variables.

A study to investigate determinants of user acceptance of online tax payment has been conducted in Taiwan by Hung etal. (2006). However, in Taiwan, the online tax filing and online tax payment facilities are incorporated into one system and is named as Online Tax Filing and Payment System (OTFPS). They have employed decomposed TPB theory which also includes the TAM variables in explaining Taiwanese taxpayers in accepting the OTFPS. The findings showed that the model explained 72% of variance in intention and both TAM variables were significant determinants of intention to use the OTFPS.

In Malaysia, Lai, Sheikh Obid and Meera (2005) have empirically tested e-Filing system acceptance among the tax practitioners. They found that e-Filing system was perceived as useful and easy to use and the respondents had positive attitudes towards using the system.

2.5.2 Technology adoption

The emergence of electronic government, so called e-government is the evidence of successful utilization of information system in government organizations. Internet technology is proven to be the most powerful and popular means of delivering government around the world (Wangpipatwong, Chutimaskul & Papasratorn, 2008).

A study to identify factors related to benefits and barriers of e-government adoption has been conducted by Gilbert and Balestrini (2004). They found nine factors important to government's adoption where three of them namely less time, cost and avoiding interaction; are related to benefits while the other six particularly experience, information quality, financial security, low stress, trust and visual appeal are factors that are related to the barriers of adoption. They concluded that adoption rate will not likely be increased if factors related to barriers are not properly addressed. Hence, users' acceptance has critical impact on the success of the system adopted. If users are not willing to accept a new information system, it will not bring full benefits to the organization that has made.

According to Pikkarainen et al. the usage of a system can be an indicator of information system success. Whether the system is regarded as good or bad depends on how the users perceived about the system. If the users perceived that the system is useless and did not accept the system, then that system cannot be regarded as an effective system, however if the users perceived that the systems useful and accept it, then the system has achieved its goal on efficiency and effectiveness. In other words, no matter how good the system is, without users, the system would still be a failure. As such, in ensuring the success of any developed systems, it is vital to find out reasons why people decide to use or not to use the information system and determine factors that may affect their acceptance of those systems.

2.7 Summary of Reviewed Literature

As a consequence of review to the related writing various variables add to the danger of street butchery, including vehicle outline, speed of operation, street plan, street environment, and driver aptitude, weakness because of liquor or medications, and conduct, remarkably speeding and road dashing. Around the world, engine vehicle impacts prompt to death and handicap and in addition money related expenses to both society and the people included.

Street car accidents can be arranged into head-on, street takeoff, backside, side crashes, and rollovers. In spite of the fact that car accidents are uncommon regarding the quantity of vehicles out and about and the separation they travel, tending to the contributing elements can lessen their probability. For instance, appropriate signage can diminish driver mistake and along these lines decrease crash recurrence by a third or more.

Additionally from the writing V2V correspondence framework underpins the as of now accessible driver help frameworks. With help of the communicated vehicle parameters the versatile journey control and stop pilot capacities can be made strides. With unique ease roadside units (RSU) the street sign acknowledgment capacity can be upheld and the unwavering quality can be made strides. In extraordinary cases it could offer wellbeing capacities if there should be an occurrence of scaffold or passage tallness or entryway width. Another vital field of utilization could be the policing and requirement. Police can utilize the V2V correspondence in a few ways particularly checking the movement principles, for example, Surveillance (e.g. finding stolen vehicles), Speed estimations, Pull-over orders, Red light drive through and limited passages.

The coordinated roadway administration has great directing centrality for administration of expressways and astute activity administration master framework utilizing RFID innovation. The framework gives both for all intents and purposes essential activity information accumulation and control data and can follow criminal or illicit vehicles, for example, stolen autos or vehicles that dodge tickets, tolls or vehicle charges. By doing as such they expanded productivity since RFID is exceptionally steady innovation. With the disposal of human association in the whole toll gathering process, they likewise gave a superior ETC framework actualized in Malaysia. However the innovation of RFID has deserts in parts of standard, correspondences, security and cost.

In ScanTraffic it indicated how an appropriate system/programming configuration is important to completely misuse savvy cameras highlights. It was manufactured in light of Mirtes and the inserted vision calculations which were past work of the gathering. They effectively incorporated the calculation escalated vision calculation with Mirtes without bargaining its continuous elements and added mistake redress procedures to Mirtes so as to address the correspondence issues postured by genuine situations. Be that as it may they require conventional scalar WSNs like remote configuration and code-upgrade. The engineering is sufficiently general to be reused in different applications, not really identified with the ITS space.

The far reaching framework advancement for street administration framework was produced by utilizing open source programming. The free programming was utilized as a part of Web GIS turn into the center part of the framework since it can bolster street information which comprise of

spatial and non-spatial information. The framework Development for the framework included two sections which are framework plan and framework improvement. This framework is gainful to street executive to accumulate data in a solitary database and choice emotionally supportive network for street upkeep. It likewise gave perception to open clients to arrange their voyage. It turns into a change on street administration framework were information are gathered from related organizations and embedded into the database. The database will turn out to be more redesigned and the nature of information is affirmed. Different components, for example, photographs and recordings can be transferred in the database to enhance delineate.

In conclusion Traffic Management endeavors are intended to enhance effectiveness of the transportation organize by giving data either to the proprietors of the transportation arrange or to the drivers on the system.

2.8 Research Gap

From the writing, the analyst has noticed that Road wellbeing powers and partners to-date have not yet sufficiently committed thoughtfulness regarding the requirement for Driver Road Safety Index (DRSI), wanting to work through shallow choices of street administration. In like manner this approach over the long haul can risk street security endeavors. Street wellbeing partners subsequently, must seek after a more vital approach in the street administration which would prompt to probability of diminishing street gore. This concentrate along these lines tries to fill this reasonable hole by inspecting how DRSI can fabricate a maintainable option keeping in mind the end goal to accomplish street wellbeing and decrease auto collisions in Kenyan streets.

2.9 Conceptual framework

The conceptual model that will be used to guide the research is presented in this section. It will be in two phases;

Step1: Formula derivation conceptual framework

Step2: Prototype implementation conceptual framework.

The formula derivation conceptual framework will be such that; variables that cause road accidents form the independent variables while government regulations are the moderating variables. How the independent variable crime that generates DRSI is has derived as shown in figure 9 below. Therefore upon summation of crime results derived Driver Road Safety Index (DRSI).

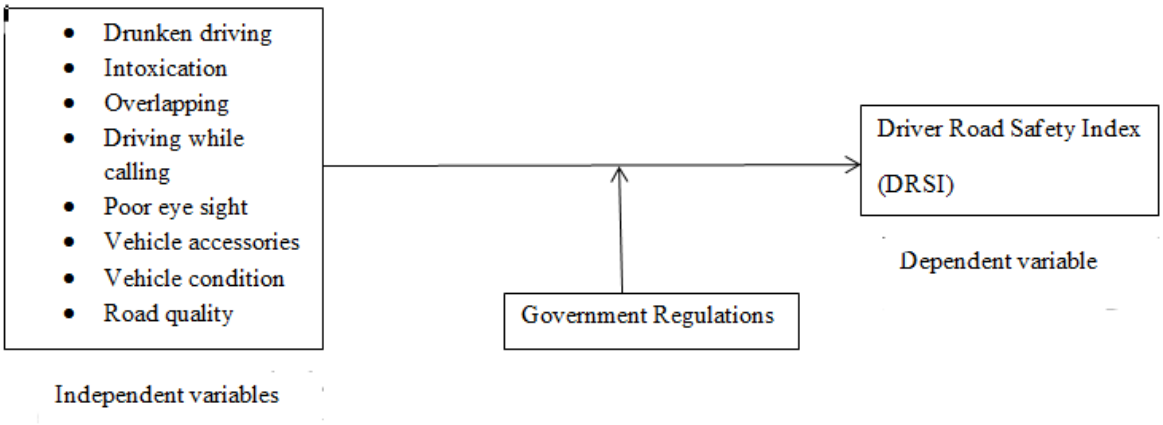

Figure 9: Formula derivation conceptual framework

While the proposed environment for provision of modeling and simulation of web based application will have two elements; the genuine regular clients who send enrollment as drivers and in this way given an distinguishing proof and the law enforcement organizations like the traffic officers who are responsible for keeping an eye on Kenyan streets.

The web based prototype will consist of the following modules; User authentication that will register drivers with unique identity for the purpose of achieving confidentiality, integrity and security (CIA) of user details and transactions, Record management to be able to track transactional activities done by the users or the requests send by partners and the Database module

to act as a repository were information will be stored. The information will be retrieved per request depending on the privilege of the user.

The Software platforms of operation will be any computer that runs either windows or Linux operating system. And the hardware will encompass the computers which support both Linux and windows operating system therefore windows and Linux PC hardware configurations will be followed. The figure below shows the diagram of the web based model.

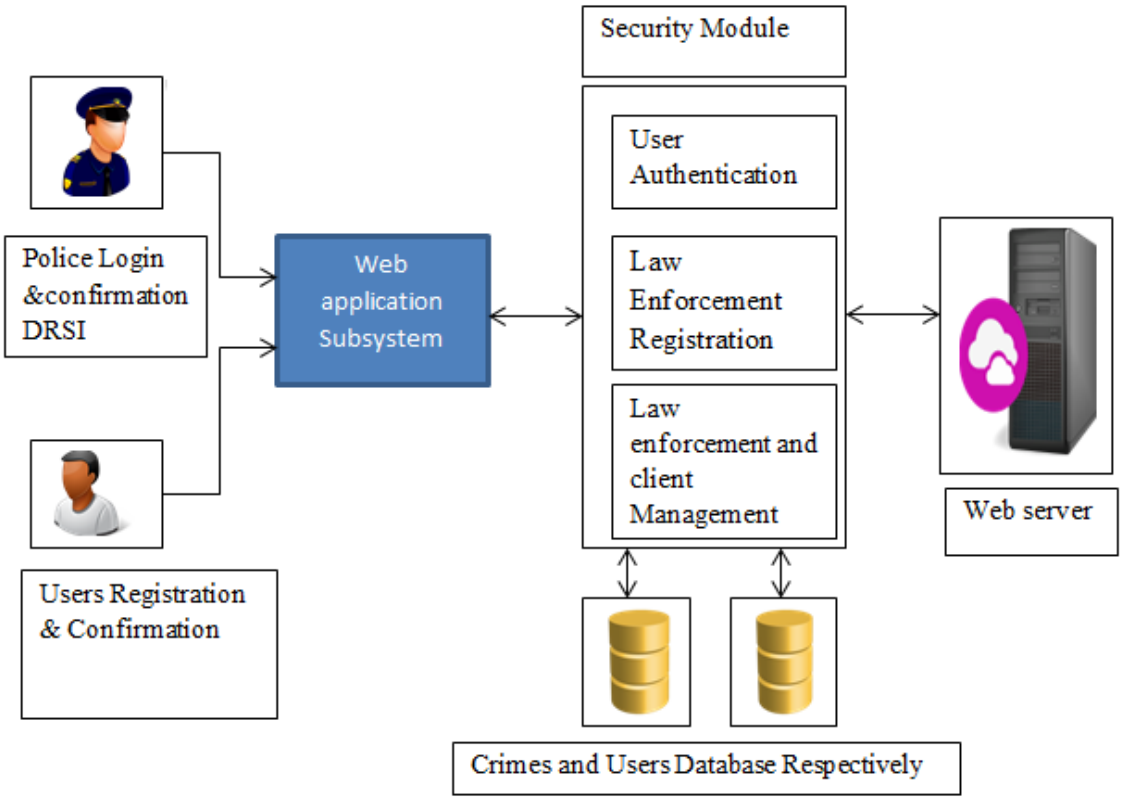

Figure 10: Conceptual framework of a web based prototype to manage road carnage.

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CHAPTER THREE

METHODOLOGY

3.0 Introduction

This part examines the techniques that were utilized as a part of the improvement, prototyping and assessment of a Web Based Model for Monitoring Road Traffic Crime to Reduce Road Carnage.

3.1 Research paradigm

The study adopted scientific and engineering design approaches. The scientific approach was used to assemble applicable information through concentration bunches required for thinking of pertinent weights for various wrongdoings .The engineering approach was utilized to actualize the model.

3.2 Measurement methodology

In keeping with previous literature on road management and the need for a Web based prototype, measurement items for each construct were developed. They were tested using five point lekirt scale (Agree, strongly agree, not sure, disagree, strongly disagree) and randomized in the instrument in order to avoid bias.

The following brief description of the proposed web based road management solution was presented to the respondents in order to delimit the context within which they were expected to use in responding to the questions asked.

"The proposed web based road management prototype will store driver's details, enforcement details and guest visitor information. This information will be accessed by law enforcement officers to check the Driver Road Safety Index (DRSI), also members of public can check before boarding a vehicle by performing a search. The government and law enforcement in turn gets details of person responsible for road carnage".

3.3 Population

The population for the study comprised of 50 traffic police officers from Nakuru central police station and 150 drivers along Eldoret-Nakuru-Nairobi highway. The highway is part of Great trans-African highway that cuts across a large part of Africa also its representative in that, among the

notorious black spots in the republic of Kenya are along the same major highway. Therefore Eldoret-Nakuru-Nairobi highway is thus representative of the entire country.

3.4 Sampling technique

Simple random sampling was used to obtain the desired sample size according to Mugenda and Mugenda (2003) such that 10% of the population is adequate enough to produce a sample size. Therefore a sample size for the study was calculated as follows;

n = (10% / 100%) * Target population

= (10/100) * 300 = 30 respondents.

3.4 Instruments

The data was collected by focus group using a questionnaire entitled "Causes of road accidents and Factors influencing the need for a driver road safety index (DRSI) among stakeholders" presented in APPENDIX A.

The questions and scales used in these questionnaires were refined by an extensive survey of literature on similar works. These questionnaires were self-administered or administered by the researcher in instances where the respondents were not able to respond on their own.

3.5 Pilot study

A total of 30 respondents comprising of members of public, enforcement officers from Nakuru central police traffic department and drivers both *bodaboda* taxi operators and public transport (PSV) drivers were sampled in these survey. In this study the Cronbach's alpha (α) was used to measure the reliability of the instrument. Variables that produced alpha value at least equal to 0.7 will be considered reliable. The Table 1 shows the results of the reliability test of the pilot study.

Table 1: Reliability test of the study items

S/no	Variable	Number of items in Test	Cronbach's Alpha
i.	Main factors contributing to road accidents	4	0.817
ii.	Specific causes of road accidents	9	0.918
iii.	Respondents opinion on DRSI Application use	8	0.788

Since all the variables produced a Cronbach's alpha greater than 0.7, the research instrument was considered reliable.

3.6 Data analysis

Pearson correlation was used to analyze the data collected in order to help in identifying the structure of the relationships between the variables in the study. This helped in explaining the relationship between them in terms of common underlying dimensions or factors that influence the need for a Web Based Model to reduce road carnage (Everitt & Dunn, 2001). Data entry and descriptive analysis was done using SPSS version 20 (IBM, 2013). The insights obtained from the survey informed the subsequent development of the Web Based Model to reduce road carnage.

3.7 Model development

Scientific model proposed for calculation of DRSI upon perspectives through concentration bunches with various partners and thought of the DRSI based on traffic Act Cap 39 of 1953 laws of Kenya to decide weights to be assigned out to the different violations and the limit of settling on a choice and the circumstance whereupon conviction can be affected.

Driver Road Safety Index will be computed using the formula;

i. (DRSI) = F (X_1Cr_1+ X_2Cr_2+ X_3Cr_3+…… X_n+Cr_n)
   Where;
ii. X_1, X_2, X_3 ……. Xn respectively are the weights determined through focus group discussion by this study.
   While;

Cr_1, Cr_2, Cr_3 ……..Crn respectively are the crimes associated with road carnage that are to be managed once DRSI is computed. The model works in the premise that an assigned threshold warrants a disqualification from possession or renewal of driving licenses. Cases are assigned weights depending on the offence perpetrated.

At that point an aggregate edge for instance once it achieves a specific threshold then triggers a caution requiring a requisite action. Likewise on the off chance that he/she goes for a protection approach then a guarantor needs to cover that individual he/she knows the protection strategy to subject in view of defenselessness to road accidents.

3.8 Prototype Implementation

A prototype was made to actualize the model. A model is the making of a working model of a product module to exhibit the achievability of the capacity. The model is later refined for consideration in a last item (Abidemi O, 2004). A model empowers you to completely see how simple or troublesome it will be to execute a portion of the components of the framework. It additionally can allows clients to remark on the ease of use and handiness of the UI plan and gives you a chance to survey the fit between the product devices chose, the utilitarian particular, and the client needs. Moreover, prototyping can encourage characterize the utilization cases, and it really presents utilize defense demonstrating much simpler, definition by Google bunches.

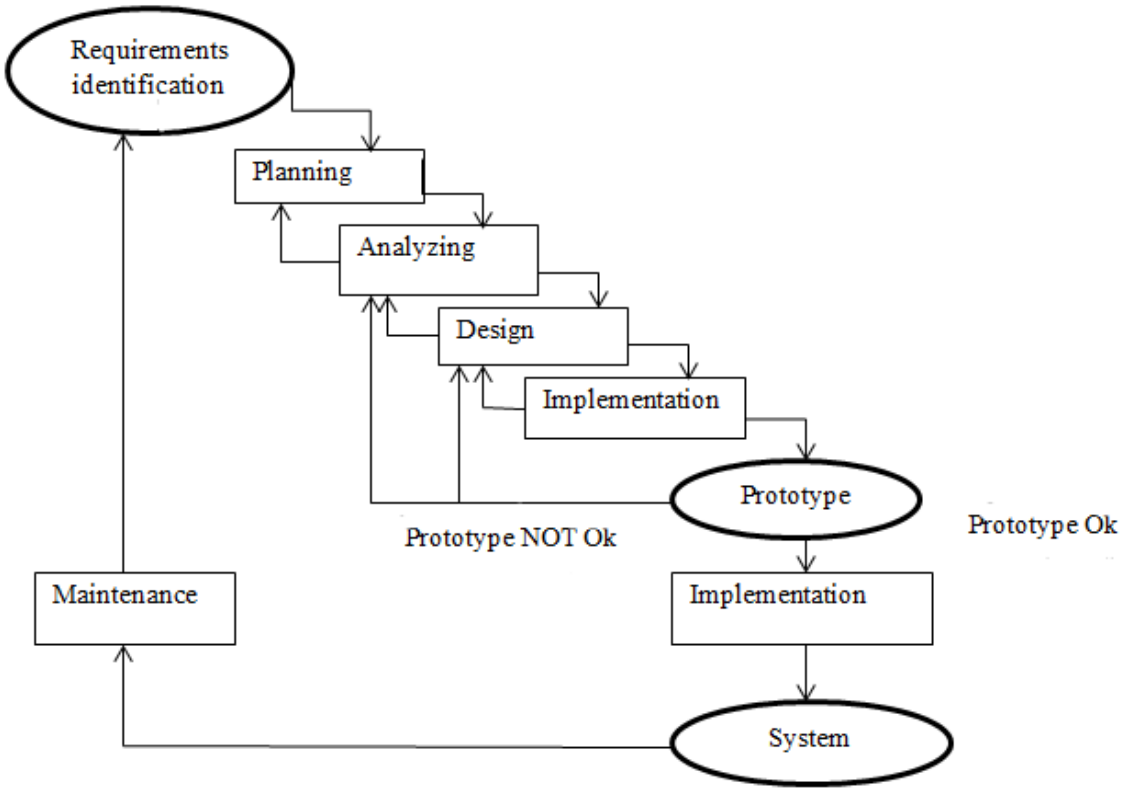

Figure 11: Rapid prototyping (source: NASA, 2004)

3.9 Prototype evaluation

The approach that was utilized as a part of the assessment of the model is the 'Objective based assessment of IT frameworks'. Objective based assessment is a specialized and efficient assessment strategy whose principle goal is to set up whether the model meets the set specialized targets (Patton, 1990). Assessing a framework 'accordingly' is an assessment approach that requires just the evaluator and does not include the end clients. The assessment criteria in this assessment approach are gotten from the frameworks prerequisites particular and depiction displayed in segment 4.2 (Cronholm and Goldkuhl, 2003).

The Web based model for lessening street savagery model was assessed by taking after destinations.

1. **Law enforcement registration:** The system should be able to capture the name and ID number of the officer, traffic station department attached.
2. **Guest registration:** The system should be able to capture guest demographic information such as name, gender and year of birth, incidence location, victims and type of vehicle.

3. **Information input:** The system should allow for the input of an accident data by the law enforcement officer and guest can also enter information on an accident scenes.
4. **Information search**: The system should allow for the public to search details of drivers and get data about the driver rating basing on whether the driver is Accepted, Average or Disqualified.
5. **Administrator's registration:** The system should register Admins to create and register the other users of the system.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Introduction

In this chapter the user survey results, model design and the need for a driver road safety index (DRSI) are discussed.

4.1 Factors contributing to road accidents

This section involves a description of the respondent's conduct concerning the main causes of road accidents. The section tackles research question one. The main causes of road accidents analyzed accordingly and presented in Table 2 below:

Table 2: Main Factors contributing to road accidents

	SA	**A**	**N**	**D**	**SD**		
Statement	Freq (%)	Freq(%)	Freq(%)	Freq(%)	Freq(%)	χ^2	*P*-value
Human error and careless driving are the main causes of road accidents in Kenya	7(23.3)	16(53.3)	3(10.0)	2(6.7)	2(6.7)	23.67	0.000
Bad weather conditions are the main causes of road accidents in Kenya	15 (50.0)	7(23.3)	4(13.3)	2(6.7)	2(6.7)	19.66	0.001
Poor conditions of road are the main causes of road accidents in Kenya	15(50.0)	5(16.7)	1(3.3)	2(6.7)	7(23.3)	20.66	0.000
Mechanical problems are the main causes of road accidents in Kenya	8(26.7)	10(33.3)	7(23.3)	2(6.7)	3(10.0)	4.00	0.406

Key: SD = Strongly Disagree; D=Disagree; N = Neutral; A = Agree; SA = Strongly Agree; Freq=Frequencies and %=Percentages. Source: research data (2016)

The findings above revealed that a majority of the respondents agreed Human error and careless driving are the main causes of road accidents in Kenya (76.6%). This findings is supported by the chi-square results (χ^2 =23.67;p<0.01).The findings also indicated that respondents strongly agreed that Poor conditions of road are the main causes of road accidents in Kenya (50.0%).According to Table 1, respondents agreed that Bad weather conditions are the main causes of road accidents in Kenya(73.3%).However, the difference in respondents' perception regarding whether mechanical problems are the main causes of road accidents in Kenya was not statistically significant with the chi-square results (χ^2 =4.00;p>0.01)

On the other hand the respondents view towards the specific crimes on the road was also analyzed accordingly and presented in Table 3 below:

Table 3: Specific causes of road accidents

	SA	**A**	**N**	**D**	**SD**		
Statement	Freq (%)	Freq(%)	Freq(%)	Freq(%)	Freq(%)	χ^2	*P*-value
Driving while calling cause road accidents	10(33.3)	15(50.0)		3(10)	2(6.7)	15.07	0.002
Overlapping in roads cause road accidents		18(60.0)	9(30.0)	2(6.7)	1(3.3)	24.67	0.000
Unavailability of road signs and traffic control lights cause accidents	18(60.0)			10(33.3)	2(6.7)	12.80	0.002
Status of the road such as tarmacked or rough road cause road accidents	14(46.7)	5(16.7)	6(20.0)	1(3.3)	4(13.3)	15.67	0.004
Poor eyesight cause road accidents	9(30.0)	16(53.3)	1(3.3)	2(6.7)	2(6.7)	27.67	0.000
Drunken driving or intoxication is a cause of road accidents	3(10)	14(46.7)	6(20.0)	3(10.0)	4(13.3)	14.33	0.006

Heavy rains cause road accidents	14(46.7)	6(20.0)	2(6.7)	2(6.7)	6(20.0)	16.00	0.003
Speed limit contribute to road accidents	18(60.0)	5(16.7)	4(13.3)	2(6.7)	1(3.3)	31.67	0.000
Eating while Driving contribute to road accidents	3(10.0)	5(16.7)	5(16.7)	10(33.3)	7(23.3)	4.67	0.323

Key: SD = Strongly Disagree; D=Disagree; N = Neutral; A = Agree; SA = Strongly Agree; Freq=Frequencies and %=Percentages. Source: research data (2016)

According to Table 3, a majority of the respondents strongly agreed that speed limit contribute to road accidents (60.0%).This findings is supported by the chi-square results (χ^2 =31.67;p<0.01).This was in consistent with 60.0% who preferred that overlapping in roads cause road accidents (χ^2 =24.67;p<0.01).The findings further indicated that respondents strongly agreed that poor eyesight cause road accidents (53.3%). in addition 60.0% respondents strongly agreed that unavailability of road signs and traffic control lights cause accidents. This was supported by 63.4% of the respondents who agreed that status of the road such as tarmacked or rough road cause road accidents depending on condition of the vehicle and the speed of the driver. It was noted that 83.3% of the respondents agreed that driving while calling cause road accidents. This is because calling while driving reduces driver's concentration leading to accidents. It is worth noting that 56.7% of the respondents asserted that drunken driving or intoxication is a cause of road accidents which is compounded by heavy rains (66.7%). However, difference in respondents' perception regarding whether eating while driving contribute to road accidents was not statistically significant with the chi-square results (χ^2 =4.00;p>0.01)

4.2 Driver Road Safety index Model Design

The indicators of the driver road safety index is as shown below based on the specific goal of coming up with a DRSI to answer the questions on human errors that contribute to road accidents measured based on crime involvement as shown in the figure below.

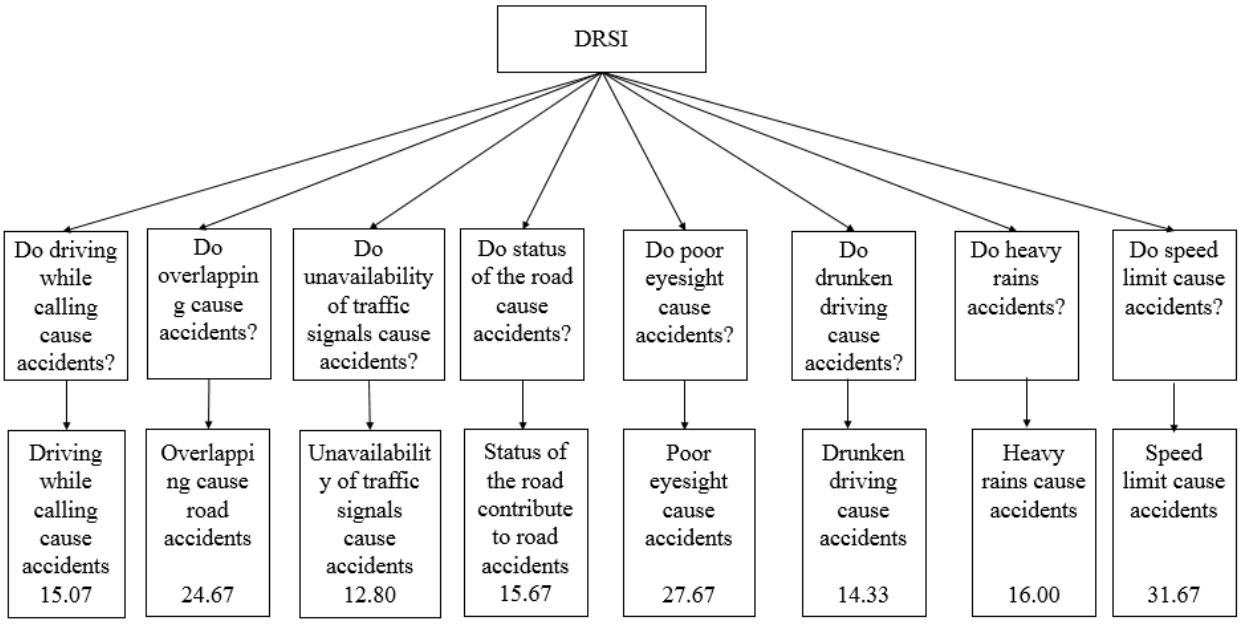

Figure 12: Goal question metric approach for DRSI

The various Chi-square values determine respondent's agreement for each crime. Therefore the different chi square values represent the intensity of user's agreement.

4.2.1 Derivation of metrics and scale of Assessment for DRSI

This section presents the design process for the envisaged model to assess driver road safety index. It attempts to solve research question two. The design of this model was guided by the results of research questions one which indicated human error as the main cause of road accidents in Kenya specifically the following human causes were singled out based on their Chi-square values:

- Driving while calling cause road accidents with χ^2 value 15.07
- Overlapping in roads cause road accidents with χ^2 value 24.67
- Unavailability of road signs and traffic control lights cause accidents with χ^2 value 12.80
- Status of the road such as tarmacked or rough road cause road accidents with χ^2 value 15.67
- Poor eyesight cause road accidents with χ^2 value 27.67
- Drunken driving or intoxication is a cause of road accidents with χ^2 value 14.33
- Heavy rains cause road accidents with χ^2 value 16.00

- Speed limit contribute to road accidents with χ^2 value 31.67

These causes were therefore considered to be indicators of driver road safety index (DRSI) as shown by the following correlation analysis determining significance of relationship between causes of road accidents and driver road safety index as shown below in Table 4.

Table 4: Relationship between driver road safety index and causes of road accidents

		CAUSES OF ROAD ACCIDENTS	DRIVER ROAD SAFETY INDEX
CAUSES OF ROAD ACCIDENTS	Pearson Correlation	1	.898**
	Sig. (2-tailed)		.000
	N	30	30
DRIVER ROAD SAFETY INDEX	Pearson Correlation	.898**	1
	Sig. (2-tailed)	.000	
	N	30	30

**. Correlation is significant at the 0.01 level (2-tailed).

The findings of the analyzed data indicated that there exist a strong positive and statistically significant relationship between causes of road accidents and driver road safety index (r=0.898; $\boldsymbol{p}$<0.01).In other words, factors such as driving while calling unavailability of road signs and traffic control lights, poor eyesight and drunken driving or intoxication cause road accidents. As the offense increases the corresponding driver road safety index (DRSI) increases.

This index is therefore a function of the identified human causes summarized below.

i. DRSI = F (DC, DD, OP, ED, SL, PE…..)

ii. $DRSI = X_1DC + X_2DD + X_3OP + X_4ED + X_5SL + X_6PE + \ldots\ldots\ldots\ldots X_nCr_n$

Where X_1, X_2, X_3 ……. Xn respectively are the weights determined in the next section.

4.3 Relevant weights assigned to different crimes for computation of the Driver road safety index (DRSI)

To determine the weights, the fines imposed on traffic crimes were taken into consideration as stipulated by the traffic Act chapter 403 laws of Kenya as shown in APPENDIX C. Also further consultation were done with the NTSA (National Transport and safety authority) to determine the time period of cumulating crimes and two months was feasible.

4.4 Derivation of relevant weights

The relevant weights assigned for different crimes based on the traffic Act above were computed based on the penalties to be paid such that;

Weights for a crime will be; $\frac{Penalties\ for\ the\ \ specific\ Crime}{Total\ Sum\ of\ penalties\ for\ All\ Crimes} * 100 = \text{Relevant Weight}$

Therefore the relevant weights are summarized in a tabular form as shown below in Table 5 for inclusion of the relevant weights and crime in the DRSI model.

Table 4: summarized crimes and Index based on penalties in the Traffic Act

	Road crimes	Relevant weights
i.	Over speeding	6.8
ii.	Drunken driving	68
iii.	Careless driving	6.8
iv.	Driving on wrong way	3.4
v.	Obstruction of road	6.8
vi.	Driving with part of the body outside	0.7
vii.	Overloading	1.4
viii.	Driving while calling	1.4
ix.	Driving on footpath	3.4
x.	Others	0.3
	Total Weight	100

The table above shows different weights assigned to different crimes that can be used for computation of DRSI. Using the table of weights and in consideration of crimes a driver can get involved in model metrics can then be agreed as shown in the next section.

4.5 Model metrics

In this section model measurements are discussed. The measurements are determined by the number of crimes a driver is involved in multiplied by100. The more the number of crimes the higher the degree or percentage of DRSI.

The model cumulates crime on a maximum period of 2 months and once the crimes cumulated arrives at 50% in that all crimes committed by a driver add to a threshold of 5 then the driver is permanently disqualified from driving and deleted from driver's database.

The measurements of the model is such that the best case scenario where a driver is not involved in any crime cumulates to a threshold of 0 so that 0 divided by maximum possible crimes multiplied by 100 will be 0% . i.e.

Best case scenario will be; $\frac{No\ Crimes}{Max} * 100 = 0\ \%$

On the other hand the worst case scenario is such that in all accidents committed or crimes a driver gets involved in it cumulates to a maximum of 10 times in all crime such that when all weights are taken into consideration the worst case scenario will be 100%;

Therefore worst case scenario will be; $\frac{10\ Times}{Max} * 100 = 100\%$

Any crimes between 0% and 49 % will attract relevant penalties as stipulated by the traffic Act. The diver road safety index model DRSI will either issue best, average or disqualified driver regarding on the threshold of involvement which computes the DRSI percentage.

4.6 The need for DRSI to reduce road carnage

The conduct of the Respondent's towards the need for a DRSI to reduce road carnage was also analyzed accordingly and presented in Table 5 below:

Table 5: Respondents' opinion on DSRI application use

	SA	**A**	**N**	**D**	**SD**		
Statement	Freq(%)	Freq(%)	Freq(%)	Freq(%)	Freq(%)	χ^2	*P*-value
Would you like to use such an application	17(56.7)	6(20.0)	4(13.3)	1(3.3)	2(6.7)	27.66	0.000
Can the application reduce road accidents	15(50.0)	6(20.0)	5(16.7)	3(10.0)	1(3.3)	19.33	0.000
Would you like to know more about the application	15(50.0)	7(23.3)	1(3.3)	5(16.7)	2(6.7)	20.67	0.000
Would you like to use the service	16(53.3)	4(13.3)	3(10.00	2(6.7)	5(16.7)	21.67	0.000
Can the application be of benefit	17(56.7)	4(13.3)	2(6.7)	4(13.3)	3(10.0)	25.67	0.000
Can you spend money to accesses the service.	16(53.3)	5(16.7)	6(20.0)	1(3.3)	2(6.7)	23.67	0.000
Being listed on such a service might associate me with illegal activities or crime if it is misused	6(53.3)	8(26.7)	2(6.7)	2(6.7)	2(6.7)	25.33	0.000
I fear that making my personal details public is risky by using such an application	19(63.3)	6(20.0)	2(6.7)	2(6.7)	1(3.3)	37.67	0.000

Key: SD = Strongly Disagree; D=Disagree; N = Neutral; A = Agree; SA = Strongly Agree; Freq=Frequencies and %=Percentages. Source: research data (2016)

The results revealed that a majority of the respondents agreed that they feared making their personal details public is risky by using such an application (60.0%).This findings is supported by the chi-square results (χ^2 =37.67; p<0.01). this was in agreement with 80.0%) who averred that being listed on such a service might associate them with illegal activities or crime if it is misused (χ^2 =25.33;p<0.01).However 76.7% of the respondents affirmed that would like to use such an application because it can reduce road accidents (70.0%).Similarly 70.0% respondents furthermore agreed that the application is of benefit and that they are willing to know more about the application (73.3).It was noted that 70.0% of the respondents agreed that they were willing to spend money to accesses the service and willing to access the service (66.6%)

CHAPTER FIVE

MODEL IMPLEMANTATION

5.0 Introduction

This chapter discusses the process that was followed in the development of the prototype for reducing road carnage using web based tools. It attempts to answer research question three. The functional decomposition approach comprising of 5 steps described in sections 5.1 up to 5.6 was followed in the development of the model.

5.1.1 System Objectives

The Web based road carnage solution is a platform for enabling the public and the law enforcement officers to check the Driver Road Safety Index of a particular Driver and therefore regulate the driver behavior. The current scenario can be occasioned by lack of a technology in place to reduce road carnage by controlling the driver behavior relying on available technologies to provide the said solution. The proposed solution thus provides an option for enforcement officers and also the members of public who are faced by these kind dilemmas and who may not be able to understand existence of a solution to provision driver rating.

5.1.2 System functionality

The proposed model was subjected to authentication and security to ensure that all users are registered before allowing them to access any of the system functionality. All successful and unsuccessful attempts to access system functionality in addition to all information sent by system users were recorded for reporting purposes.

Also all users were allowed to register prior to accessing any of the system functionality. For new enforcement officers, name, age, enforcement officer number and gender were required. Members of the public will also be required to register as guests to enable submission of information regarding an accident scene.

Utmost care was taken at the entry point of the system to ensure details of drivers being entered are valid. To this end, the registration process can also be enhanced to require that details submitted about a driver is vetted or recommended by government registry. The involvement of National

Transport Safety Authority (NTSA) in the registration process can also be instrumental in verifying the identities of drivers from their pre-existing licensing records.

The de-registration process can be either voluntary, where the Guest user opts out or forced, where the user is blocked from using the system for various reasons such as illegitimately or falsely report crime.

The system allowed public as well as registered enforcement officers to search for Driver Road Safety Index of a particular driver. The results of successful information searches will be provisioned on a user friendly the interface.

The system also allowed registered enforcement officers and also the members of the public to enter details of an accident scene. The details of an accident occurrence entered by members of the public shall be verified by a law enforcement officer. This information were made available when searched by members of the public using the car registration number and also the driver license number.

5.1.3 System components

The system comprises of four main components discussed below and presented in Figure 24.

1. **Users:** There are two main types of users;
    a) **Guests:** These are members of the public who are seeking information about the driver road safety indices of a particular driver. They are interested in knowing the driver rating before boarding a vehicle. The gender and the driving years are also provided including the number plate of the vehicle.
    b) **Enforcement officers:** These are police officers who Mann Kenyan roads this include traffic police officers and officers from National Transport Safety Authority (NTSA). They are able to enter the accident scene details into the system upon occurrence of a crime.
2. **Hosting service providers:** There infrastructure is used for provision of space for hosting of the web based system. The web based server handles the two way transmission of all communications as well as session setup and maintenance between the user and the system.
3. **Web Based road carnage monitoring system to reduce road accidents**
    This is the core of the architecture and it comprises of the following major components;

a) **User authentication:** This module has two core functions; (i) ensuring that only registered users' access system functionality, and (ii) recording all system access activities for reporting purposes.
b) **Guest and Enforcement registration:** This module handles the capture and recording of user details at the point of entry.
c) **Search module:** This module presents a list of drivers, there rating information and car registration numbers.
d) **Core application logic:** This module contains the logic required to receive and processes user requests, perform database searches and return results in the form of driver details to enforcement and members of the public.
e) **Databases:** The system maintains four main databases; (i) the users database that keeps a list of all users registered to access the system, (ii) the crimes database that keeps a record of all crimes that have occurred, (iii) the drivers database that keeps a master list of license numbers and also car registration numbers associated to a particular driver and (iv) the search information database that keeps a list of accident details for information search. The system has a number of additional transactional databases that keep records of user access and information searches.

5.1.4 Interfaces between system components

There are two main methods that will be used to interface between the systems components;

I. Web based interface for two-way communication between the user and the system through the webserver, and
II. A Graphical User interface (GUI) presented on an android mobile platform. These interfaces and how they relate to the system components are presented in Figure 24.

5.1.5 Processes required to achieving system functionality

The rapid prototyping approach discussed in section 3.5 and depicted in Figure 22 was followed in developing a functional system from the model.

a) **Gather requirements:** The requirements for the proposed system were inferred from literature and refined using results from the user survey presented in section 3.3.

b) **Quick design:** The system processes described in section 4.2.3 was translated into flow charts. A database was then designed based on the proposed processes and flowcharts.

c) **Build prototype:** A prototype was then built using PHP as the programming language and MySQL as the database and hosted online.

d) **Evaluate and refine requirements:** The system requirements were refined on an ongoing basis using feedback from the system development, deployment and testing process.

e) **Design, code and test final product:** Once the requirements were found to be satisfactory a final version of the system was completed and tested with real users in a pilot study. Feedback from this stage informed some additional development and refinement of both the model and system.

5.1.6 Conclusion

This section discussed the 5 stage functional decomposition process that was followed in the development of the prototype for a web based road carnage monitoring model. The process involved the definition of system functionality, the description of the specific components, a discussion on the interfaces between the various components and an outline of the process to be followed in transforming the model to a functional prototype.

5.2 Design and testing of the web based road carnage monitoring to reduce accidents.

The main objective of this study was to examine the practicability of using a web based monitoring of drivers through a driver road safety index. A conceptual model to graphically describe the system was developed with input from existing models in literature such as the GPS web based GIS vehicle tracking system (Butters, A.2006). The model incorporates four main components; the users, the hosting service providers, the enforcement officers and the web based road carnage monitoring system. This section presents the system logic and database design. In addition, the testing results and an evaluation report of the prototype are also presented. There are four main functions of the system; guest registration, enforcement registration, information search and driver index details. An overview of the system is depicted in Figure 25**.**

5.2.1 User and provider registration process

The registration process is the entry point into the system and caters for the two types of system users, namely; guests and enforcement officers. Guests register by providing their name, age, national ID number, mobile phone and gender. Enforcement officers enter details of accident scene

in order for processing the driver road safety index. The user registration process is outlined in Figure 26 and the provider process in Figure 27.

5.2.2 Information search process

The information search process, outlined in Figure 28, is performed using a search bar by entering car registration number and driver's license details. Upon search performance it displays information regarding the driver index and the vehicle details associated to the driver.

5.2.3 Driver details entry process

The entry of driver details process, depicted in Figure 29, allows registered users to enter details of the accident scene. Once the information is entered it can be available through a search bar for members of the public to search information.

5.2.4 Entity relationship diagram

The entity relationship diagram for the system is presented in Figure 31. It comprises of 11 tables that contain four main types of information;

i. User and enforcement information: wbs_user, wbs_gender and wbs_enforcemet.
ii. Vehicle and driver information: wbs_vehicle and wbs_details.
iii. Driver index information: wbs_register and wbs_search.
iv. Driver information: wbs_details, wbs_driver.

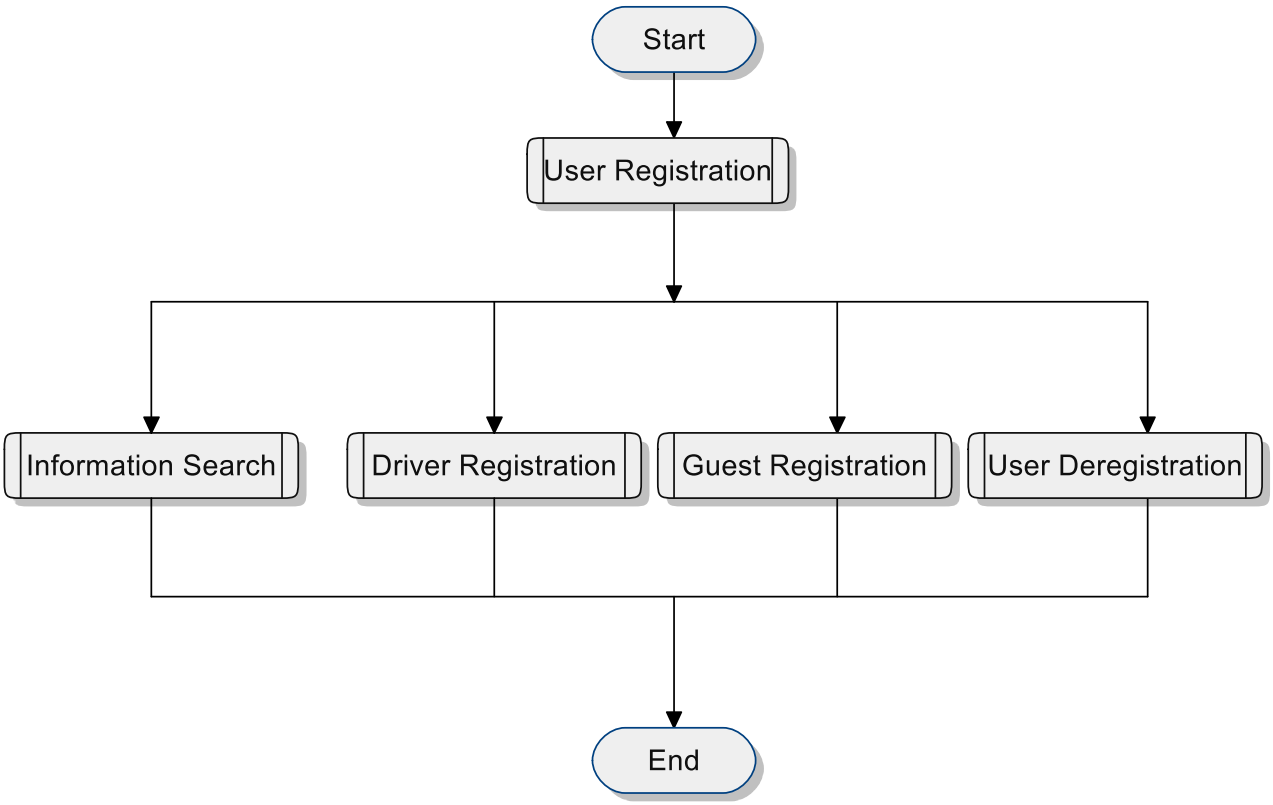

Figure 13: Flow chart of WBRM prototype

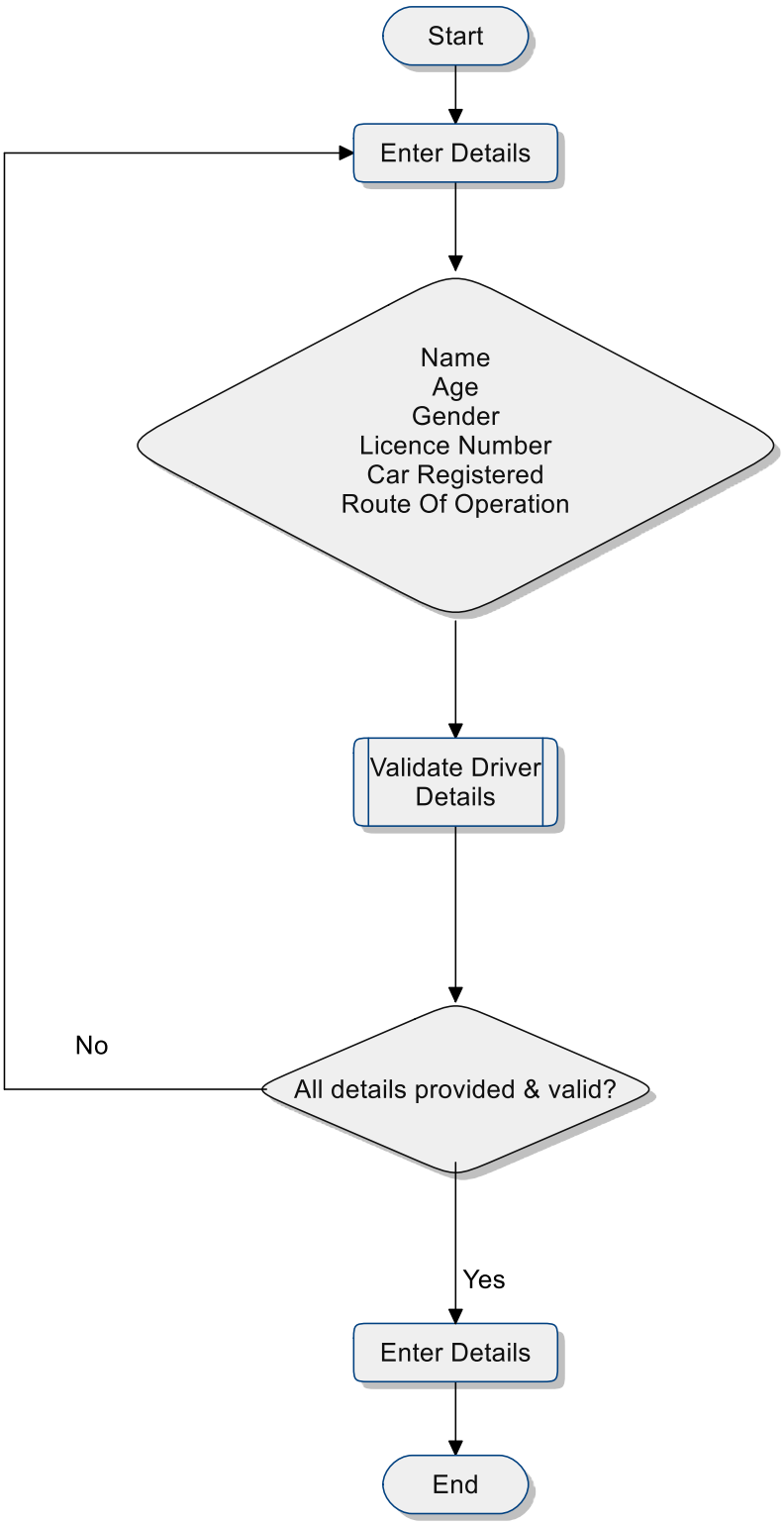

Figure 14: Driver registration process

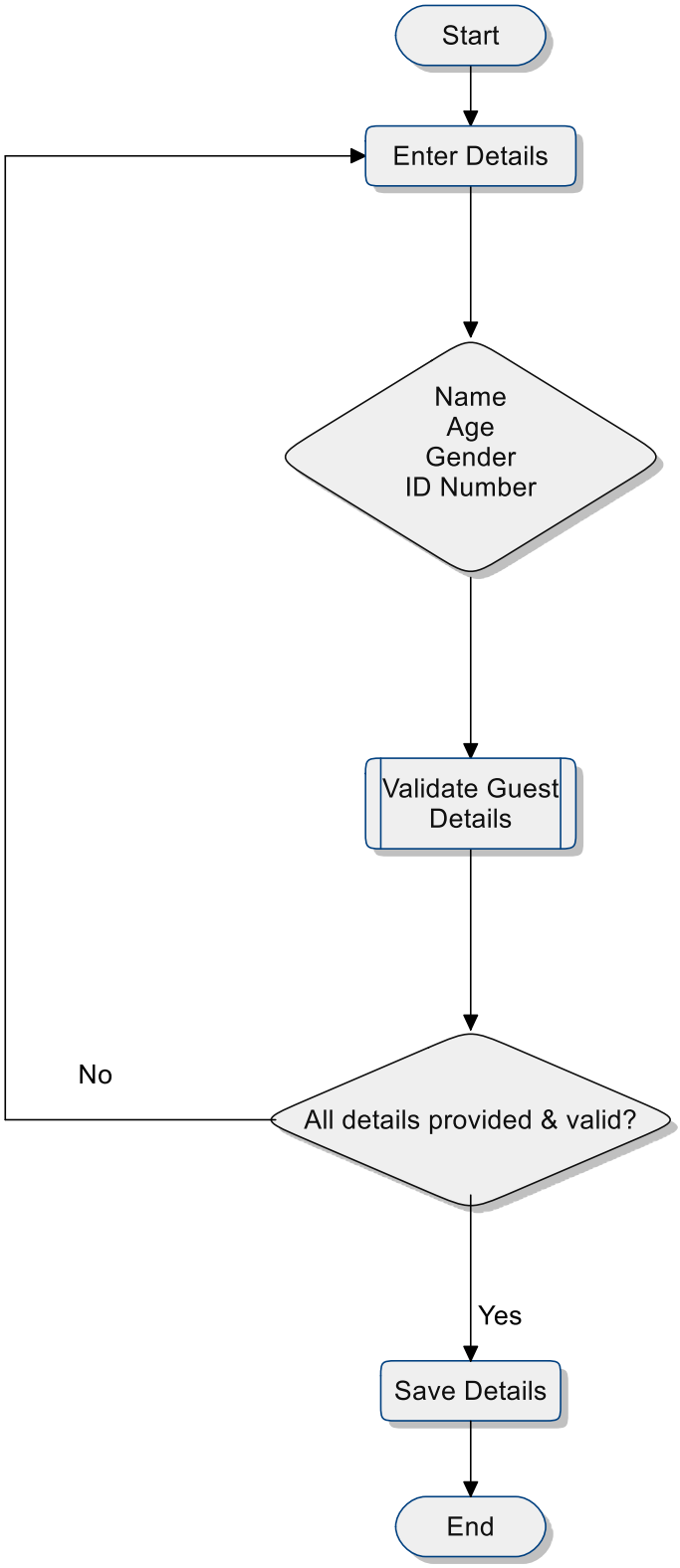

Figure 15: Guest registration process

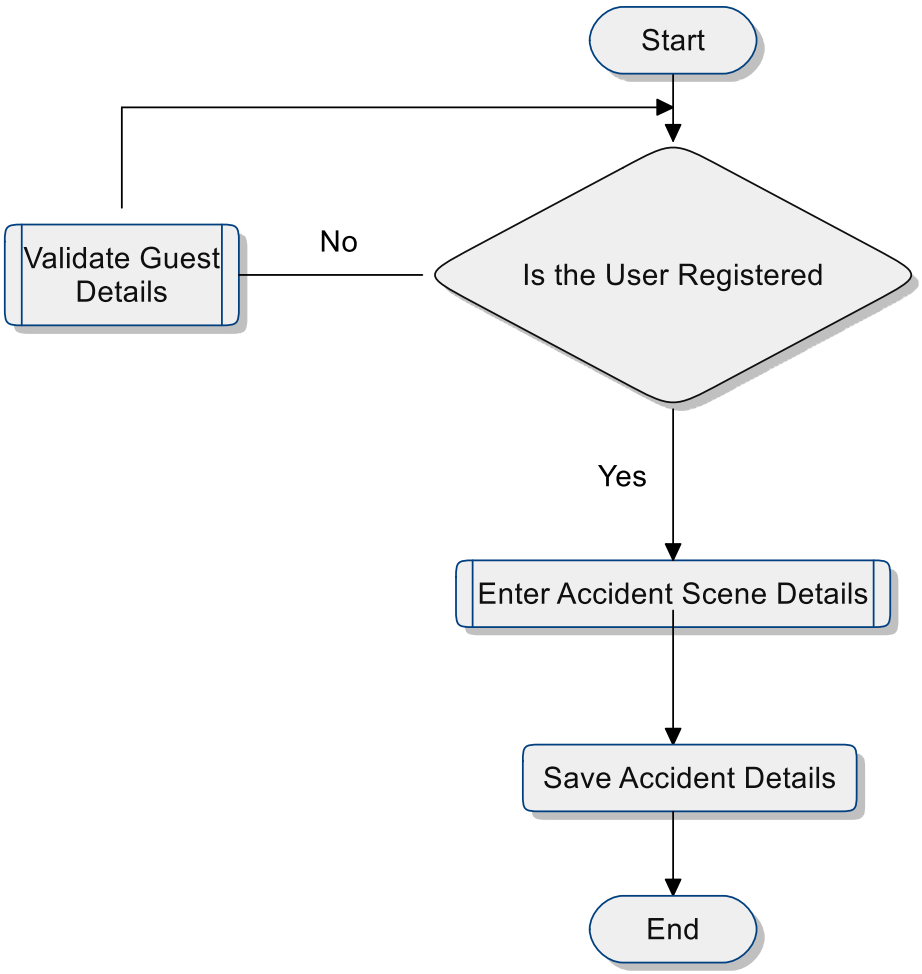

Figure 16: Accident entry process

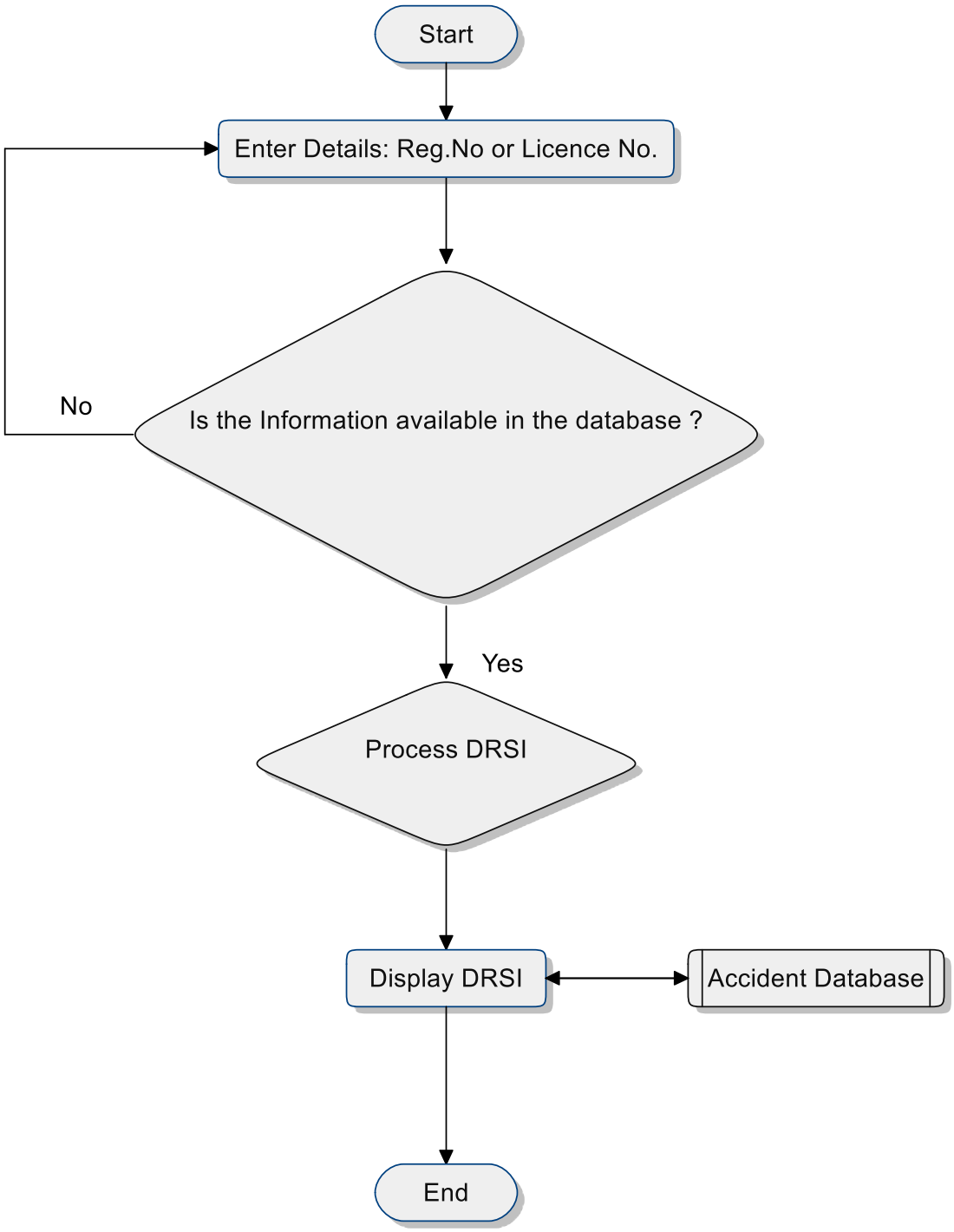

Figure 17: Information search process

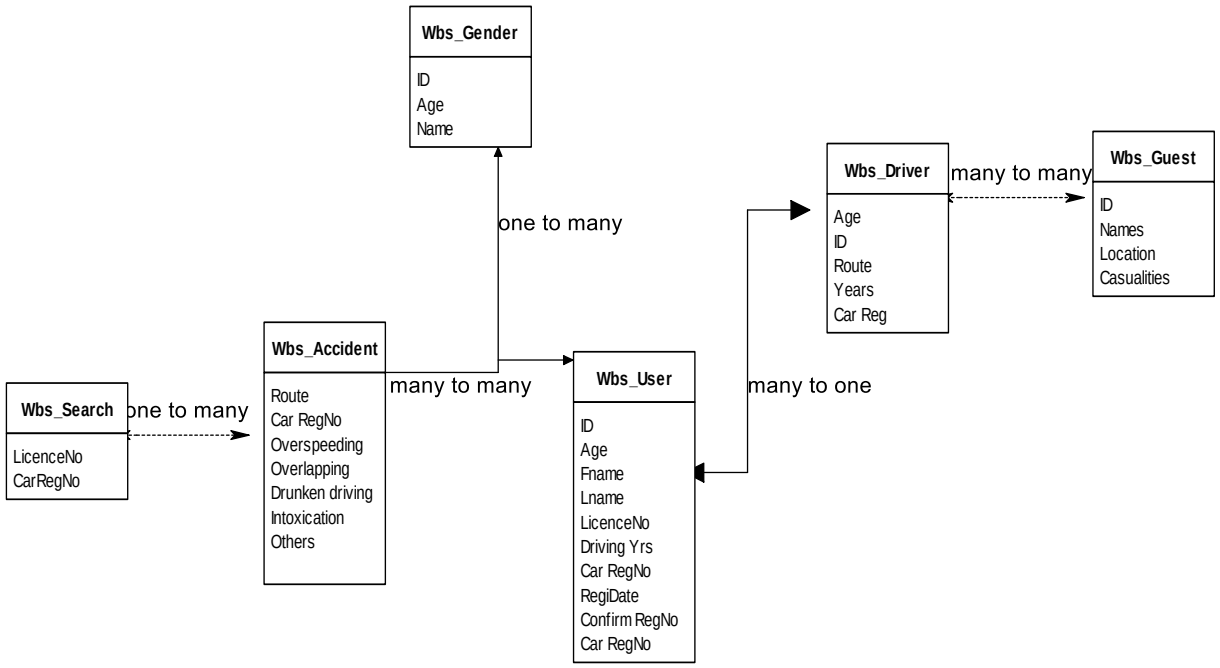

Figure 18: Database schema

5.2.5 Proof of concept

The system was developed to implement the Web based model for monitoring road carnage. The program was developed using the PHP programming language and the MySQL database for data storage and retrieval. The development environment was the Windows 7 operating system using the Adobe Dreamweaver CS3 IDE. The Apache web server was used to host and test the system locally while online hosting done by hosting on www.makupi.me.co.ke/drsi for testing purposes. The hosting platform provided by www.kenyandomains.com

The registration process begins with the capture of user details using a registration form. These details were keyed into the system using the web interface in Figure 19.

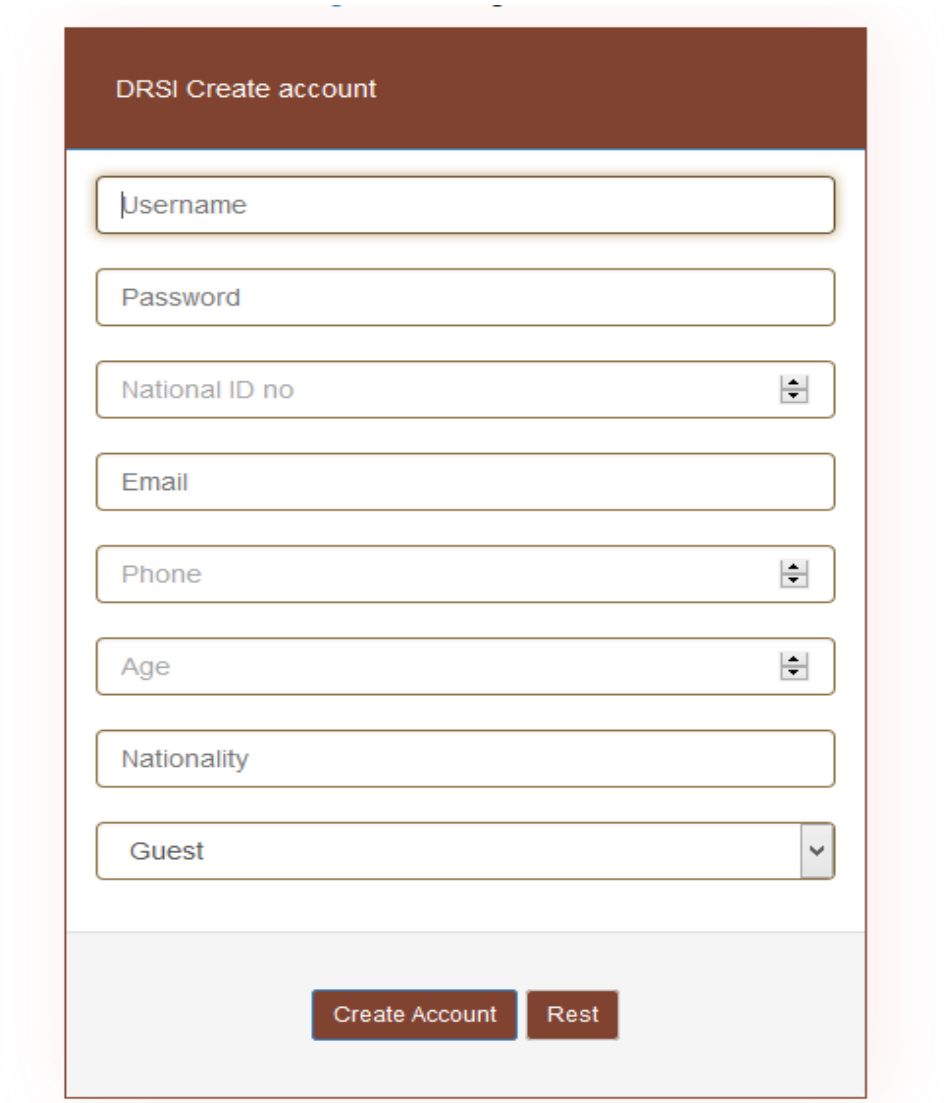

Figure 19: Web interface for user registration

Once the user details were saved, and authentication process is captured the users can then be able to login as shown below in figure 20 below.

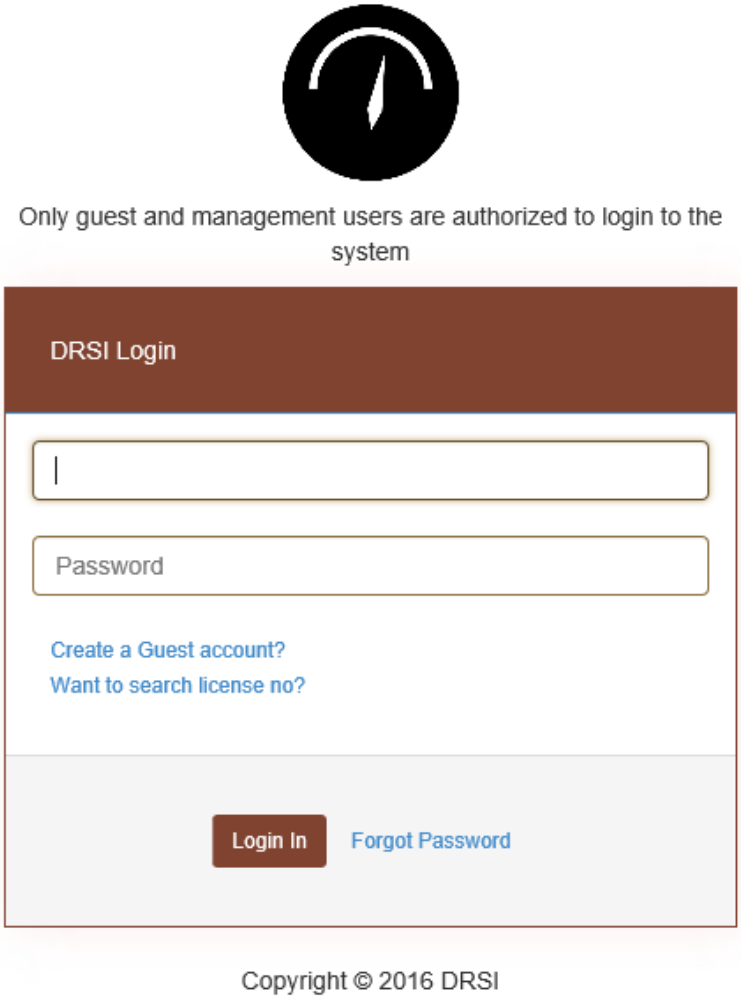

Figure 20: user login interface

Once the users are logged in they can be able to enter in crime scene details as shown below in figure 22 and figure 23 respectively. Once a user was registered they could then enter vehicle registration details by keying in the search bar as shown below in Figure 21.

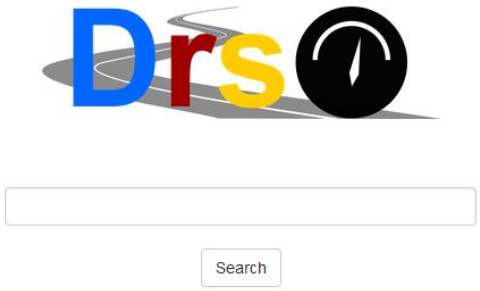

Figure 21: Information search process

The driver road safety index is displayed upon successful information search as shown below in Figure 22.

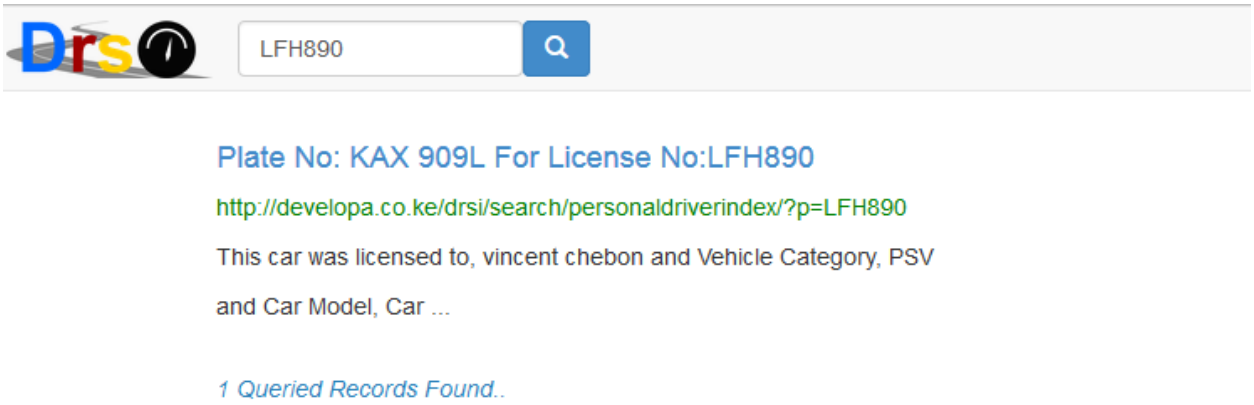

Figure 22: Information display

The identified drivers' details associated with the car registration and the license number is displayed as shown below in figure 23 below.

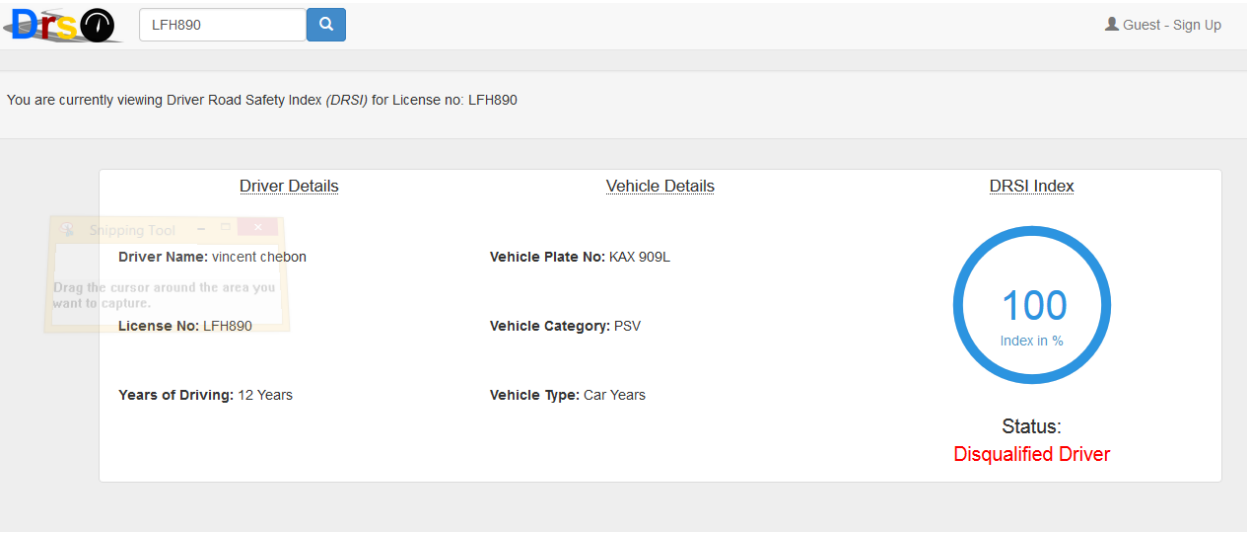

Figure 23: DRSI index rating

Registered enforcement officers and the guests who are the members of the public in an accident scene can enter the accident details using a form as shown below in figure 23 and 24 respectively.

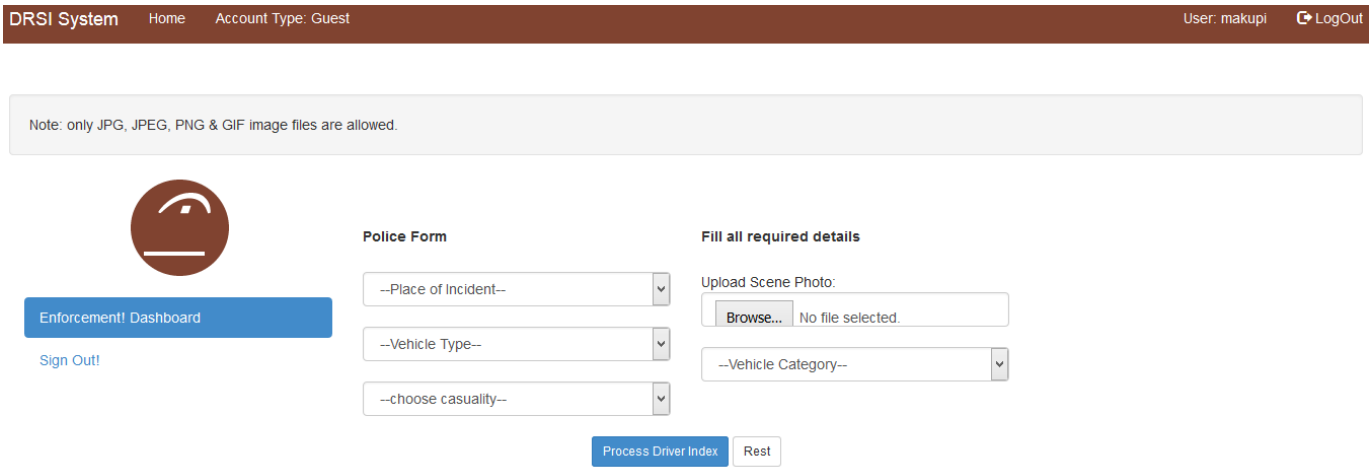

Figure 24: crime entry process by Guests

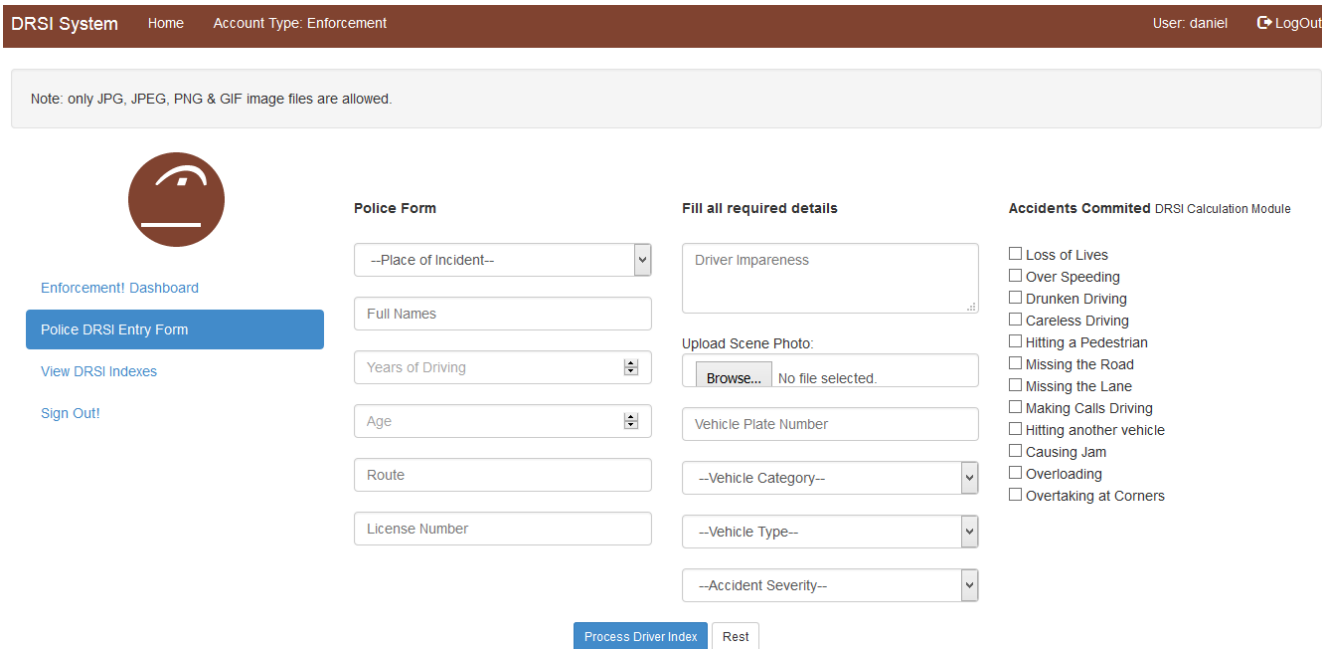

Figure 25: crime entry process by law enforcement officers

5.2.6 Driver road safety index processing

The crime is processed depending on the number of crimes committed and also the intensity of the crime. The index can be accessed by searching vehicle number plate and the driver license number.

5.2.7 User removal

The user is removed from the system by deletion and his details get to be dropped by the system. A successful removal takes away their ability to enter details of an accident scene and enter the system.

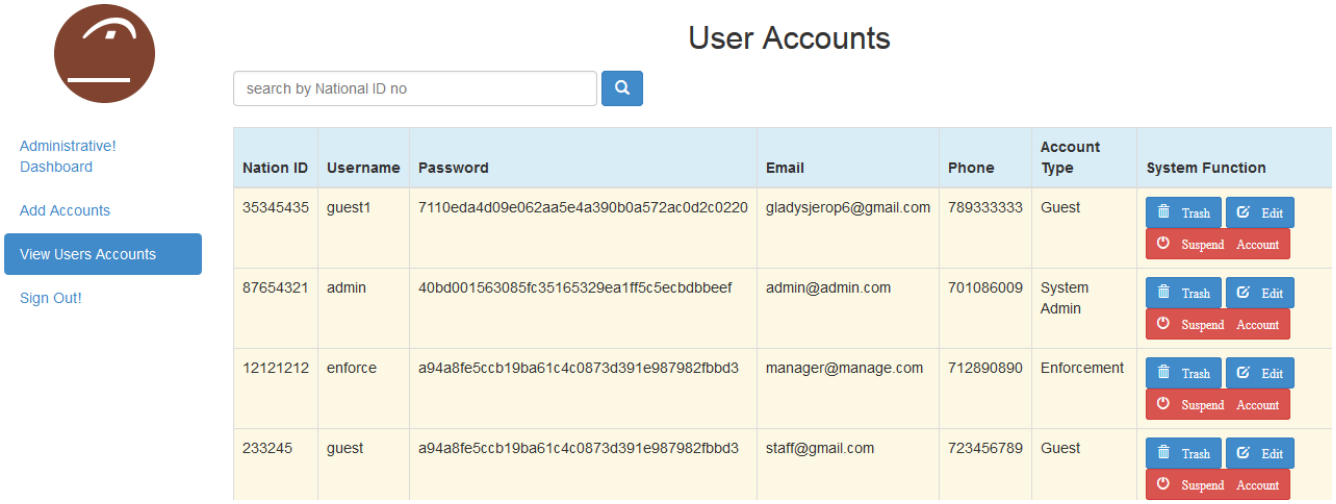

Figure 26: User de-registration process

5.2.8 Performance evaluation

This aspect of the evaluation was purely technical in nature and sought to examine how robust the solution was. Two evaluation measures, system responsiveness and system dependability, adopted from the work of Rahimian and Habibi, (2008), were used to evaluate the performance of the system.

The system responsiveness was tested using the average time it took from when a user initiated the search process by entering the car number plate or driver license number. In one search trials performed the system achieved an average process time of 10 seconds. The lower average hop time observed can be attributed to the less time taken to query the MySQL database for the display of driver index and the information search. The database in use for the prototype was indexed and optimized due for timely responsiveness. This shows that the system is optimal in its performance and therefore has an efficient database design.

While system dependability was measured by the percentage of times it failed to complete the information search process during the testing exercise. Out of a total of 100 trials 1 did not end

successfully constituting 1% failure rate. This rate of failure occurred due to bugs, system errors on the prototype as well as timeouts attributed to the time it took to query the database because of poor hosting platform. Extensive system testing and efficient web hosting solution prior to a commercial rollout can help to eliminate errors attributed to programming errors and efficient hosting facility respectively. A more robust web hosting platform with optimized services would help to reduce search response time during information searches.

5.2.9 Conclusion

In this section a Web based model to reduce road carnage was designed, implemented and tested successfully. The results from the system test show that it is indeed feasible to reduce road carnage without having to use relatively advanced solutions and system access technologies such as RFID, web GIS, MANETS.

5.3 Evaluation, Limitations and challenges in implementing Web based road carnage monitoring to reduce accidents.

This section presents an evaluation of the performance, limitations and challenges of the Web based road carnage monitoring prototype.

5.3.1 Goal based evaluation

The evaluation adopted to evaluate the Web based prototype to Reduce Road carnage is the 'Goal-Based evaluation of IT systems as such use'.

Table 1: Evaluation of IT systems as such use'

Objective	Evaluation
Guest registration process: The prototype should be able to capture the details of the guest or the member of the public and facilitate privacy check.	• The prototype captured the details of the Guest enabling sending of accident scene occurrence. • The prototype facilitated a privacy check process by implementing a password and a user name.
Enforcement officer registration process: The prototype should be able to register an enforcement officer details and also facilitate privacy check.	• The prototype captured the enforcement officer details enabling him to enter the accident scene occurrence. • The prototype facilitated a privacy check process by implementing a password and a user name check.
Submission of driver details: Allow the members of the public to enter the details of the accident scene. And especially allowing provision of an easy to use interface to enter	• The prototype allowed the users to enter details of accident scene with ease.

through a checklist of crimes that have occurred.	• Provided an easy to use interface and allowed users to submit information for calculating the driver road safety index.
Index information search process: it should provide an easy to use interface and provide the driver road safety index.	• It provided an easy to use interface by providing a search bar to enter driver's license number or a car registration number. • Upon search process it displayed the driver road safety index of a particular driver.

5.3.2 Limitations of the Web Based Road Carnage Monitoring System.

The limitations include network availability especially in remote places like lowland areas are sometimes limited taking a longer processing time and also submission time of an accident scene. The limitation is significant when trying to connect from remote places were a failed connection occurs. This approach would require extensive involvement of network service providers to ensure network availability for easy information submission.

Another limitation comes in during capturing of an accident scene by a law enforcement officer or a Guest that's a member of public sometimes it becomes cumbersome for example entering the details in a mobile interface taking the details like, car registration number, license number, the place of accidents and judgment of crimes committed by the driver. An extensive sensitization and interactivity with the application would enable them to enter the details at ease.

5.3.3 Challenges facing the Web Based Model to Reduce Road Carnage

The main challenge encountered with system testing was issues concerning its adoption for use. This was established from the pilot study that revealed that however the members of the public and the enforcement officers liked the idea the drivers cited there security concerns that may specifically be targeted on them and worried that the system use may dangerous and detrimental in that enforcement may record a wrong information therefore sited that corruption sky rocketing.

However the members of the public and enforcement officers were responsive and never worried on security concerns. There were also some concerns however few on cost in internet access.

5.3.4 Conclusion

The process of reducing road carnage by controlling the driver behavior through provision of a driver road safety index is indeed feasible but its adoption and use could be hampered by provision of enough network availability by service providers and widely user sensitization. However the major challenge in the use of the system lies in security in its adoption and use raised by the drivers in fear of criminals also utilizing the system to fulfill their negative ends. The prototype was evaluated based on the initial objectives and it achieved most of them.

5.4 Other incidental application areas of the Web based Road carnage monitoring system to reduce road carnage.

The Web based road carnage monitoring to reduce road accidents was initially hypothesized to provide the driver road safety index to be utilized the enforcement officers and members of the public. In adding, a number of other possible areas of application emerged in the course of the model development, system design and especially the pilot study. These additional application areas proposed by users confirm Kelly's (2007), observations that people often use innovations in ways not originally envisioned.

5.4.1 Accident statistics

The idea of 'accidents statistics' was brought about by divers and vehicle owners over concerns for their insurance claims and insurability. The key question asked by respondents in the pilot study, is what if the system could be utilized by insurance companies to determine the premiums payable. Therefore the insurance provider will search the accident index of a particular car or a driver. The system can thus be extended to allow insurance companies to what extend to insure and insurance premiums to be paid by a car owner.

5.4.2 Driver index information

The system captures a lot of information at the point of registration and on an ongoing on accident scenes and crimes that can be used for advertising by public service vehicles and also bodaboda taxi operators. The information regarding there driver road safety index of their vehicles and there

drivers can be used to attract customers to use their vehicles. This information includes driver's details and Driver Road safety Index.

5.4.3 Total accidents

As part of the information search and driver index details the system captures detailed information on the number of accidents, location and casualties. The information can be utilized to provide proper estimates for government planning and budgeting. It can also be utilized for emergency service such as ambulances for rescue operations. The system can be further developed to avail this information from a search process. Examples of questions that can be answered using the system are;

a) **How many people have been killed in a certain section of the road?**
b) **Who has been involved in an accident scene in Nakuru- Nairobi road today?**

This information can be further broken down to reveal the car and the driver details and also faster information in regard to loved ones who might be involved in an accident.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.0 Introduction

In this thesis the provision of DRSI to reduce road carnage is discussed. The Web based road carnage management provides law enforcement officers details of DRSI of an individual driver also the search bar enables members of the public upon request for license number of the driver to search driver rating before boarding the vehicle. In this solution the information sought by the user is provided through a web based interface. The choice of simple, affordable and widely system access methods for the development of the model and prototype was informed by the technological and economic limitations experienced by the main target group for the system i.e. members of public and law enforcement officers. The law enforcement officers have limited knowledge to comprehensively utilize Web based services while the members of public may be limited to network access. This chapter presents the conclusions and recommendations from the study that comprised of a survey, model development, prototype development, and a performance evaluation.

6.1 Conclusions

The premise upon which this study was based is the lack of a DRSI to compute the rating of a particular driver. The solution is therefore delivered through an affordable, accessible and easy to use system access technologies utilizing web based tools. An extensive survey of literature and solutions existing revealed that a majority of existing solutions are developed using Java and Android, GPS and GPRS for geo-location, RFID, Bluetooth and NFC for system communications, browsers and applications for system access. These technologies are available to a greater extent incorporated into smartcards and some handheld devices and to a limited extent utilized as a web based services which effectively limits their use. A majority of stakeholders who can access Web based services are thus not able to utilize applications that require these advanced technologies.

A Web based road carnage prototype implementing a model using web based tools as an alternative delivery technologies was thus developed. The solution was able to effectively handle law enforcement registration and driver registration and de-registration, information search and provision as well as computation of DRSI. The use of system to capture images and location information was explored and found to be practical albeit with challenges.

Conclusions related to the specific objectives are discussed in sections 6.1.1 to 6.1.2.

6.1.1 Research Question 1: What are the main causes of road carnage in Kenya and the efforts that has been put in place to manage road carnage?

The study established that the major causes of road accidents in Kenya is attributed to human error such as drunken driving, overlapping and poor eyesight. This human errors are the resultant crimes that lead to loss of life. Therefore the need for the adoption and use of a DRSI to control the driver behavior by computing the index of a particular driver based on accident involvement respectively is achievable through Web based tools.

6.1.2 Research Question 2: What is the most suitable model for the development a Driver Road Safety Index?

A Driver road safety index (DRSI) model to compute the driver accident rating was developed based on linear mathematical approach. The model is implemented using a web based prototype and captures crimes for computation of DRSI. The model uses information from traffic ACT cap 54 laws of Kenya on the different penalties assigned to various crimes. Therefore the weights represented penalties and the crimes represent offences respectively. Therefore the development of a Driver Road Safety Index requires a complete concurrence with the traffic act laws of Kenya. The traffic act provided straightforward guide has originally proposed and adopted for the study. It instead required a number of collaborations between the different stakeholders for its adoption and potential use in making decision in courts.

6.1.3 Research Question 3: How can the prototype and a model for managing road carnage be implemented.

A Web based road carnage prototype that implements DRSI was developed. The model highlights the roles and interactions of enforcement officers, guests and administrators in provision of Web based road carnage management services. The model relies on the use of a database to store user's details. The data contained in the database is used for displaying the information to law enforcement officers and the members of public in the information search process. Therefore the delivery of DRSI requires the extensive use of a database to store location, details, license numbers, accident severity, scene images and general data.

6.2 Areas for further study

The positive reception and potential applications of the web based model to reduce road carnage identified during the study point towards the need for further investigation to establish its challenges, limitations, impacts and potential for further utilization.

Additional areas for further study are discussed in detail in sections 5.2.1 to 5.2.14.

6.2.1 The commercialization of the WBRM

The Web based road carnage management WBRM prototype developed was not subjected to user acceptance testing due to the lack of cooperation from some of the drivers. The reasons cited by the operators included the sensitivity of user information and the lack of research activities within their operations. Their cooperation and involvement will be required in order to undertake an extensive field study.

The findings from this study will therefore serve as a basis for the following future research undertakings with the sole objective of launching it as a commercially viable service.

- Developing partnerships with hosting service providers for further development, testing and commercialization of the WBRM system.
- The field testing of the WBRM to establish the factors influencing potential use and adoption.
- The development of an infrastructure relying on SMS and USSD for provision of the same service for real time delivery.
- The development of a business model to ensure the sustainability of the WBRM service.

These activities require significant amount of time and resources and could not be undertaken within the time allocated for this study.

6.2.2 The role of risk, convenience and perceived benefits in influencing user intention for adoption and use of DRSI

It was established in this study that the respondents were willing to take higher levels of risk if the associated convenience and benefits were significant enough. There is need to further investigate the relationship between the risk involved in using a service or system in relation to the convenience and perceived benefits that can be gained from it. This is a useful direction for further exploration.

6.2.3 A security model for the delivery of DRSI via a web based platform.

The model does not explicitly address the issue of security in the use of the system. Security in this regard refers to the assurance that user's information like driver details would not be utilized by criminals to achieve other ends. Therefore there's a need to establish how genuine the persons are when searching for information and confirming driver road safety index. There is need towards extending this model to factor in security features both in the actual technical aspects as well as in the actual use procedures lying outside the system. These could come in the form of user and business registration processes.

6.2.4 Towards an effective delivery of Web based road carnage management.

The system prototype for the delivery of Web based and android based road carnage management via a web interface to compute the DRSI is feasible. The reason for the use of a web based road carnage monitoring interface is to standardize the inquiry and provision of DRSI given that the user enters license number and car registration number. It would be worthwhile to investigate how the same information search process can be achieved using SMS and USSD. The challenge here would be how to ensure that users get information on DRSI and receive driver rating at real time.

6.2.5 Investigating the user trust development process for Web based road carnage monitoring.

Significant barriers were found to exist in the process of piloting the system prototype. It is therefore important to examine the role of security, privacy, cost and credibility in the adoption of Web based and mobile based services in general and computation of DRSI in particular. The order in which trust is built is also a fruitful area of investigation. Respondents in the study began by understanding the service, questioning the security of the system and then the credibility of the enforcement officers entering details of the accident scene. The issue of cost did not arise but would probably be the next issue in the sequence of concerns once they agree to adopt this service.

6.2.6 A business model for the sustainable delivery of DRSI using Web based interface.

The lack of suitable business models has in the number of instances on partners to provide information on various accident scenes, licensing and enforcement officers and innovative IT solutions to close down in the first few months or years of operation. In order to make the proposed solution sustainable, a suitable business model will be required to ensure that the service is affordable and available for users and significant to stakeholders.

6.2.8 Using a Web and android based identity confirmation model to address security challenges among public transport operators.

A major challenge experienced by drivers specifically motorcycle taxi operators who were interviewed during the pilot study were that of security. This arises in cases where passengers hire these taxis only to assault the operators and steal their motorcycles. In a good number of these incidents, according to the motorcycle operators, the victims have been murdered. Investigations are often difficult to initiate and conclude given that the identity of the passenger is unknown to the taxi operator. As a result these operators opt to serve only known clients, especially in the evening hours, for fear of their safety. The use of a mobile based identification model can be explored to see if information on passenger details and also the driver can be send to a third party and can easily be traced back for investigation in cases of crime therefore the exchange of confirmation leading to ID confirmation can help to deter and reduce crime or identify abductors.

6.2.9 Using Web and android based identity confirmation model for passenger identification and manifest in public service transport

Mobile based identity verification can be used to build an accurate record of people's interactions through the exchange of details. This proposed functionality has possible applications in public sector transport that faces challenges in insurance claims processing or crime investigation due to the lack of accurate passenger manifests. The actual adoption process as well as the impact of such a technology application in a sector largely regarded as lawless and informal would be a very fruitful area for further investigation.

6.3 Recommendations

6.3.1 Central repository identity management system

The lack of access to existing Driver license numbers and police identification details led to the proposal for the fresh capture of driver's information and police identity numbers as part of the mandatory registration process in this study. This exercise has been done before by many other bodies and organizations such as the Kenya Police Services, the National transport and safety authority (NTSA) and the Kenya Revenue Authority (KRA) during the issuance of driver license number and employment contracts for the enforcement officers. However, all these different organizations treat the data they collect as confidential and thus do not share it with each other or anyone else for that matter. This causes each of them to incur costs collecting the same information

afresh when they need it. This is a costly and tedious affair which many smaller organizations cannot afford to undertake.

There is thus need for a government mediated effort to integrate these different databases for consistency and cost savings. The availability of such a database, accessed through the right legal channels can go a long way in encouraging the development of solutions such as Web Based Road Monitoring carnage to reduce accidents whose credibility is derived from accurate and verifiable user identities.

6.3.2 Development of acceptable and safe access of user's identity information.

The development of the Web Based Road Carnage Management Application requires details on car registration number and driver license number. This information either in the form of accident scene submission or to compute driver road safety index by the members of the public is regarded sensitive given the potential for its abuse in criminal activities. The lack of a suitable and acceptable approach to sharing this information has led to the lack of its commercial application in many settings.

The growing need for Web Based applications by the same users is making it necessary for such information be accessed by application developers and solution providers. It is therefore necessary that policy makers develop appropriate technical and legal frameworks for the commercial access and utilization of this information with all stakeholders concerns in mind. Such a solution would have to specify what constitutes legitimate access and use as well as a clearly spelt out user opt-in policy and process.

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APPENDIX A

DRIVERS QUESTIONARE

Cause of road accidents and the need for a driver road safety index (DRSI) among stakeholders

SECTION A: *CAUSES OF ROAD ACCIDENTS*

1. In a scale of 1 to 5 where 1= strongly disagree, 2= agree, 3 = neutral, 4= disagree, 5= strongly disagree, please indicate your agreement with the following statements

Statements	**Rating of agreement**				
	1	**2**	**3**	**4**	**5**
Human error and careless driving are the main causes of road accidents in Kenya					
Bad weather conditions are the main causes of road accidents in Kenya					
Poor conditions of road are the main causes of road accidents in Kenya					
Mechanical problems are the main causes of road accidents in Kenya					

2. Tick were appropriate on the causes of road accidents where: strongly Agree (1), Agree (2), Not sure (3), Disagree(4), Strongly disagree(5)

Causes of road accidents	1	2	3	4	5
1) Driving while calling cause road accidents					
2) Overlapping in roads cause road accidents					

3) Unavailability of road signs and traffic control lights cause accidents					
4) Status of the road such as tarmacked or rough road cause road accidents					
5) Poor eyesight cause road accidents					
6) Drunken driving or intoxication is a cause of road accidents					
7) Heavy rains cause road accidents					
8) Speed limit contribute to road accidents					
9) Eating while Driving cause road accidents					

SECTION B: *SYSYETEM USAGE*

3. Consider the following description:

"A system that can store drivers names, license number, driver rating, route of operation, type of the vehicle and car registration number. This information will be accessed by members of the public and the law enforcement officers via a web based and mobile based platforms respectively. Once the driver license number is known it can show details on driver road safety index and accident involvement and also the vehicle type either private or PSV and route".

Tick where appropriate on the system need: where Agree (1), strongly agree (2), Not sure (3), Disagree (4), strongly disagree (5).

	Agree	Strongly Agree	Not sure	Disagree	Strongly Disagree
1. Would you like to use such an application?					
2. Can the application reduce road accidents?					
3. Would you like to know more about the application?					
4. Would you like to use the service?					
5. Can the application be of benefit?					
6. Can you spend money to accesses the service.					
7. Being listed on such a service might associate me with illegal activities or crime if it is misused.***(drivers only)***					
8. I fear that making my personal details public is risky by using such an application ***(drivers only)***					

APPENDIX B

APPLICATION LOGIC SOURCE CODE

```
<?php

$hold="";
//connection to the server and DB

include("config/config.php");

//isset button name to capture sign up details..
$target_dir = "uploads/";
$target_file = $target_dir . basename($_FILES["fileToUpload"]["name"]);
$uploadOk = 1;
$FileType = pathinfo($target_file,PATHINFO_EXTENSION);
// Check if image file is a actual image or fake image
if (isset($_POST["create"]))

{

    $check = filesize($_FILES["fileToUpload"]["tmp_name"]);
    if($check !== false) {
        $uploadOk = 1;
    } else {
        echo "File is not an image.";
        $uploadOk = 0;
    }
// Check if file already exists
if (file_exists($target_file)) {
    $uploadOk = 0;
}
// Check file size
```

```
<?php

$hold="";
//connection to the server and DB

include("config/config.php");

//isset button name to capture sign up details..
$target_dir = "uploads/";
$target_file = $target_dir . basename($_FILES["fileToUpload"]["name"]);
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   if($check !== false) {
      $uploadOk = 1;
   } else {
      echo "File is not an image.";
      $uploadOk = 0;
   }
// Check if file already exists
if (file_exists($target_file)) {
   $uploadOk = 0;
}
// Check file size
if ($_FILES["fileToUpload"]["size"] > 5000000) {
   echo "<p style='color:red;'>Sorry, your file is too large.</p>";
   $uploadOk = 0;
}
```

```
        $place = $_POST['place'];

        $name = $_POST['name'];

        $yrsOfDriving = $_POST['yrsOfDriving'];

        $age = $_POST['age'];

        $route = $_POST['route'];

        $licenseno = $_POST['licenseno'];

        $impareness = $_POST['impareness'];

        $plateno = $_POST['plateno'];

        $vcategory = $_POST['vcategory'];

        $vtype = $_POST['vtype'];

        $aseverinty = $_POST['aseverinty'];


        //calcuations for driver safety index.

$overSpeeding = $_POST['overSpeeding'];
        $drunkenDriving = $_POST['drunkenDriving'];
        $carelessDriving = $_POST['carelessDriving'];
        $hittingPed = $_POST['wrongWay'];
        $missingTheRoad = $_POST['obstruction'];
        $missingTheLane = $_POST['bodyOut'];
        $makingCalls = $_POST['calling'];
        $hittingAnotherVehicle = $_POST['footpath'];
```

```
$causingJam = $_POST['others'];
$overloading = $_POST['overloading'];

// addition function


$dIndex =  $overSpeeding + $drunkenDriving + $carelessDriving + $hittingPed + $missingTheLane + $missingTheRoad + $makingCalls + $hittingAnotherVehicle + $causingJam + $overloading ;

$insert = mysqli_query

($con,"INSERT INTO driver (place,name,yrsOfDriving,age,route,licenseno,impareness,image,plateno,vcategory,vtype,aseverinity,dIndex)

VALUES

('$place','$name','$yrsOfDriving','$age','$route','$licenseno','$impareness','$target_file','$plateno','$vcategory','$vtype','$aseverinty','$dIndex') ");

if (!$insert)
{
    echo"<center><p style='color:red;'>An Error has occured while saving details</p></center>";

} else{

    echo"<center><p style='color:rgb(5, 59, 10); font-size:1.4em;'><span class='glyphicon glyphicon-dashboard'></span> DRSI Sucessfuly Calculated <a href='viewdrsi.php?license=$licenseno'>View Driver Index</a></p></center>";


}
```

```
}

// Allow certain file formats
if($FileType != "jpg" && $FileType != "png" && $FileType != "jpeg"
&& $FileType != "gif" ) {
   echo "Note: only JPG, JPEG, PNG & GIF image files are allowed.";
   $uploadOk = 0;
}
// Check if $uploadOk is set to 0 by an error
if ($uploadOk == 0) {
// if everything is ok, try to upload file
} else {
   if (move_uploaded_file($_FILES["fileToUpload"]["tmp_name"], $target_file)) {
      echo "<p style='color:green;'>The file ". basename( $_FILES["fileToUpload"]["name"]). " has
been uploaded.</p>";
   } else {
      echo "<p style='color:red;'>Sorry, there was an error uploading your file.</p>";
   }
}

?>
```

```
if ($_FILES["fileToUpload"]["size"] > 5000000) {
   echo "<p style='color:red;'>Sorry, your file is too large.</p>";
   $uploadOk = 0;
}

            $place = $_POST['place'];

            $name = $_POST['name'];

            $yrsOfDriving = $_POST['yrsOfDriving'];

            $age = $_POST['age'];
```

```
        $route = $_POST['route'];

        $licenseno = $_POST['licenseno'];

        $impareness = $_POST['impareness'];

        $plateno = $_POST['plateno'];

        $vcategory = $_POST['vcategory'];

        $vtype = $_POST['vtype'];

        $aseverinty = $_POST['aseverinty'];


        //calcuations for driver safety index.

$overSpeeding = $_POST['overSpeeding'];
        $drunkenDriving = $_POST['drunkenDriving'];
        $carelessDriving = $_POST['carelessDriving'];
        $hittingPed = $_POST['wrongWay'];
        $missingTheRoad = $_POST['obstruction'];
        $missingTheLane = $_POST['bodyOut'];
        $makingCalls = $_POST['calling'];
        $hittingAnotherVehicle = $_POST['footpath'];
        $causingJam = $_POST['others'];
        $overloading = $_POST['overloading'];

        // addition function
```

```
                    $dIndex =  $overSpeeding + $drunkenDriving + $carelessDriving +
$hittingPed + $missingTheLane + $missingTheRoad + $makingCalls + $hittingAnotherVehicle +
$causingJam + $overloading ;

        $insert = mysqli_query

        ($con,"INSERT INTO driver
(place,name,yrsOfDriving,age,route,licenseno,impareness,image,plateno,vcategory,vtype,aseverinity,dI
ndex)

        VALUES

        ('$place','$name','$yrsOfDriving','$age','$route','$licenseno','$impareness','$target_file','$platen
o','$vcategory','$vtype','$aseverinty','$dIndex') ");

        if (!$insert)
        {
                echo"<center><p style='color:red;'>An Error has occured while saving
details</p></center>";

        } else{

                echo"<center><p style='color:rgb(5, 59, 10); font-size:1.4em;'><span class='glyphicon
glyphicon-dashboard'></span> DRSI Sucessfuly Calculated <a
href='viewdrsi.php?license=$licenseno'>View Driver Index</a></p></center>";



        }

}

// Allow certain file formats
if($FileType != "jpg" && $FileType != "png" && $FileType != "jpeg"
&& $FileType != "gif" ) {
```

```
    echo "Note: only JPG, JPEG, PNG & GIF image files are allowed.";
    $uploadOk = 0;
}
// Check if $uploadOk is set to 0 by an error
if ($uploadOk == 0) {
// if everything is ok, try to upload file
} else {
    if (move_uploaded_file($_FILES["fileToUpload"]["tmp_name"], $target_file)) {
        echo "<p style='color:green;'>The file ". basename( $_FILES["fileToUpload"]["name"]). " has
been uploaded.</p>";
    } else {
        echo "<p style='color:red;'>Sorry, there was an error uploading your file.</p>";
    }
}


?
```

APPENDIX C

Traffic Act Cap 403 laws of Kenya

	SECTION OF THE ACT OR RULE OF THE TRAFFIC RULES	NATURE OF OFFENCE	PENALTY
1.	Section 42(1) and 43(1)	Exceeding speed limit prescribed for class of vehicle:-	By 1 – 5 kph – 500 By 6-10 kph – 3000 By 11-15 kph - 6,000 By 16-20 - 10,000
2.	Sec 44(1), (2)	Drinks intoxicating liquor during any period of duty in connection with driving of a vehicle. A person giving	100,000
3.	Sec 61(1)	Except for the purpose of testing or repairing a motor vehicle no person shall be carried on the footboard, step, mudguards canopy roofing or elsewhere	10,000
4.	Sec 33(c)and 41	Driving a PSV while being unqualified	7,000
5.	Section 42(3), (4) and 43(1)	Exceeding speed limit of 50 kph or as prescribed by a traffic sign	

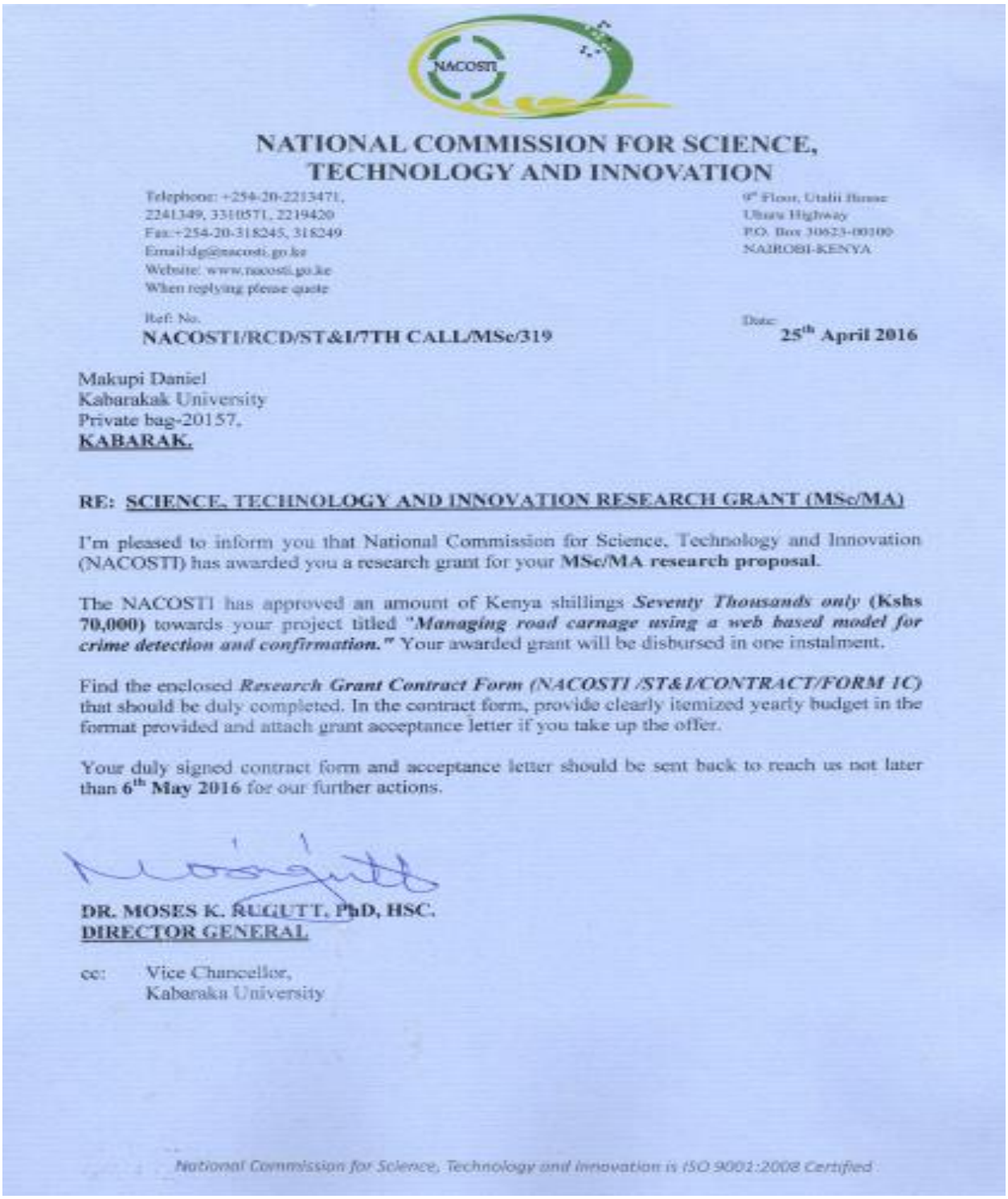
			By 1 – 5 kph – 500 By 6-10 kph – 3000 By 11-15 kph - 6,000 By 16-20 - 10,000
6.	Rule 59A(1)	Driver using a mobile phone whil e vehicle is in motion	2,000
7.	Section 45A(1) and (2	Driving on or through a pavement or a pedestrian walkway	5,000
8.	Section 90(2)(a) and 94	Driving a vehicle on a footpath	5,000
9.	Section 53(1) and 67.	Causing obstruction by allowing a vehicle to remain in any position on the road so as to obstruct or cause inconvenience or to other traffic using the road.	10,000
10.	Sec 52(1)(b) and (2).	Failure of a driver to conform to the indications given by any traffic sign.	3,000
11.	Sec 52(1)(c) and (2)	Failure of a driver to stop when required to do so by a police officer in uniform	5,000
12.	Sec 52(1)(a) and 52(2)	Failure of a driver to obey any directions given, whether verbally or by signal, by a police officer in	3,000

		uniform, in the execution of their duty	
13.	Section 30(1) and (7)	Driving without a valid driving license endorsement in respect of the class of vehicle	7,000
14.	Rule 59A(1)	Driver using a mobile phone while vehicle is in motion	2,000
15.	Sec 33(c)and 41	Driving a PSV while being unqualified	7,000
16.	Sec 130C(1) and (3)	The driver of a PSV driver who lets an unauthorized person to drive	5,000
17.	Rule 130C(1) and (3)	Person who while not being the designated driver of a PSV drives the vehicle	5,000
18.	Sec 98(1) and 104	Unlicensed person driving or acting as a conductor of a PSV	5,000
19.	Sec 98(1) and 104	Owner or operator of PSV employing an unlicensed PSV driver or conductor	10,000
20.	Sec 103A(1) and (7)	Failure of a PSV driver or conductor to wear special badge and uniform	2,000

21.	Rule 65(f) and 72	The driver of a motor omnibus or matatu picking or setting down passengers in a place that is not authorized as a bus stop or terminal	3,000
22.	Sec 103(1) and (2)	Touting	3,000
23.	Rule 80	Travelling with part of the body outside moving vehicle	1,000
24.	Rule 68(1)(x) and 72	A passenger alighting or boarding any omnibus or matatu at a place which is not authorized as a bus stop or terminal	1,000
25.	Rule 54A	A person driving or operating a PSV with tinted windows or windscreen	2,000
26.	Sec 60(1) and 60(2)	Driver of Motor Cycle carrying more than one passenger	2000
27.	Sec 103B(1) and (7)	Motorcycle passenger riding without protective gear	1000

APPENDIX D

RESEARCH GRANT FROM THE NATIONAL COMMISSION FOR SCIENCE INNOVATION AND TECHNOLOGY (NACOSTI)



NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

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NAIROBI-KENYA

Ref: No.
NACOSTI/RCD/ST&I/7TH CALL/MSc/319

Date:
25th April 2016

Makupi Daniel
Kabarakak University
Private bag-20157,
KABARAK.

RE: SCIENCE, TECHNOLOGY AND INNOVATION RESEARCH GRANT (MSc/MA)

I'm pleased to inform you that National Commission for Science, Technology and Innovation (NACOSTI) has awarded you a research grant for your **MSc/MA research proposal.**

The NACOSTI has approved an amount of Kenya shillings ***Seventy Thousands only*** **(Kshs 70,000)** towards your project titled "***Managing road carnage using a web based model for crime detection and confirmation.***" Your awarded grant will be disbursed in one instalment.

Find the enclosed ***Research Grant Contract Form (NACOSTI /ST&I/CONTRACT/FORM IC)*** that should be duly completed. In the contract form, provide clearly itemized yearly budget in the format provided and attach grant acceptance letter if you take up the offer.

Your duly signed contract form and acceptance letter should be sent back to reach us not later than **6th May 2016** for our further actions.

DR. MOSES K. RUGUTT, PhD, HSC.
DIRECTOR GENERAL

cc: Vice Chancellor,
Kabaraka University

National Commission for Science, Technology and Innovation is ISO 9001:2008 Certified