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DEVELOPMENT OF A BLACK BOX MODEL FOR THE MONITORING OF VEHICLE ACCIDENT AND SPEED

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***Abstract*— In this paper, a novel method is proposed to develop a black box model to monitor the vehicle accident location and vehicle speed., when this black box model is installed in any vehicle, it will monitor the accident of vehicle by sending an automatic SMS with direct Google Map links with vehicle information to the family member and nearest police station based on nearest latitude and longitude of accident location. In addition to this feature the proposed model will also record the video of an accident and it will send by MMS. In addition to the accident monitoring, the black box model will also continuously monitor the speed and when speed exceeds the specified limit, it will send a warning message to the driver and still if speed increases, it will send a fine information to the driver (owner of the vehicle) and also to the police. In this way the proposed black box model will be helpful to help in time to the accident victims and also helpful in decreasing number of accidents by keeping an eye over reckless driving with dangerous speeds.**

Keywords— **Road Safety, Arduino Microcontrollers, GPS, GSM, SMS, MMS, Camera Modules, SD Modules, Radar, etc.,**

I. INTRODUCTION

"Speed Thrills but Kills", "Carefulness costs you nothing. Carelessness may cost you your life" this type of quotations, penalties against the violations of road safety rules and regulations are not completely eliminating the road accidents victims; it has been big hectic problem for the police and family members of accident victims. In every country road traffic crashes ranks among the top factors leading to disability and mortality. Every year, nearly thousands of persons die on the roads and lakhs are attending a hospital for further care and management. In these types of situations why we are unable to provide an appropriate solution for the safety of innocents, we know that for every problem there is a solution and every accident is a notice that something is wrong with men, methods, or material. Therefore as a technological people it is our empathy to investigate for the solutions of existing problems of Road safety measures. This is where; the proposed development of black box model will provide a complete emphasized solution for controlling of over speeding vehicles by careless persons and to provide in time help to save the lives of accident victims.

The recent technological developments such as microcontrollers, communication systems initiate the engineers to use and develop full pledged models for monitoring of Road safety and its negative corollary road traffic crashes. A Sustainable Safe road system aims to prevent crashes and if they still occur, to minimise their consequences. It is based on the idea that people make mistakes and are physically vulnerable. There are five main principles: functionality, homogeneity, predictability, forgivingness, and state awareness. The Sustainable Safety vision has a large influence on road safety work in practice, and has led and still leads to the implementation of effective and sustainable road safety measures.

What is meant by Black Box Model?

A black box model is consisting of a microcontroller along with SD module will interact with a GPS module, a GSM module and Camera modules for monitoring of vehicle speed and its accident.

Why this Black Box Model?

This black box model provides a comprehensive solution for the Road safety in the Sultanate of Oman against various accidents and over speed of vehicles.

With the rapid economic growth, modernization and infrastructure development over the last four decades, there has been massive increase in automobile usages and car ownership in the Sultanate of Oman, and road traffic accident (RTA) emerged as a serious public health problem. There is a dearth of literature on motorization problem in Oman owing to paucity and limited access to data in the past. This is an exploratory study, presenting a profile of recent growth trends of motorization and the pattern of related road traffic accidents in Oman. The study is likely to establish the baseline facts about the transportation system and RTA problems in Oman. Data for the study come from Royal Oman Police (ROP) record and World Health Organization (WHO) report for international comparison. On the average there are 230 vehicles per 1,000 population in Oman, which is higher than many middle income countries. Motorization level shows increasing trends in Oman, and between 2000 and 2009, it has increased by 26%. Private car and shared taxi services are the major modes of personal transport in Oman. In 2009, there were 2.67 accidents per 1,000 population or 9.59 accidents per 1,000 registered vehicles in Oman. RTA shows declining trends during the study period. About 70% of the accidents are due to collision: 48% with other vehicles and 22% with fixed objects. Young drivers over represents accident cases in Oman, as 70% of the RTAs happened to drivers aged 17-36 years. Excessive speeding is the main cause of road traffic accident (50%), followed by negligence or careless driving (29%). About 98% of the RTAs are related to human factors. Effective road transportation planning, and traffic safety programme, particularly speed monitoring system, need to be strengthened. The findings of the study may have important policy implications for transport and road safety planning in Oman [1]. These finding indicating that inaccurate of present system over road safety, in this type of situations our intended research work will provides a best solutions for the road safety measures.

The Sultanate of Oman is one of the most accident-prone countries in the world. The road traffic accidents (RTAs) draw serious concerns in Oman and demand urgent attention of local researchers and decision makers. Following a descriptive research design, this paper [2] investigates the attitudes and perceptions of people towards road safety and the causes of RTAs in Oman. This research suggests that in addition to raising the compliance to road safety measures, additional initiatives focusing on public policy issues such as public health, transport, urban planning, disaster management, and post-accident treatment can be contemplated to put an effective control over RTAs. A due consideration to these factors in the public policies will not only help in preventing accidents but also in mitigating the resulting loss, particularly in Oman and the Gulf Cooperation Council (GCC) in general. This latest research work supports the importance and urgent need of development our research work for the people of Sultanate of Oman.

II. RELATED WORK

Vehicle speed monitoring system comprises a vehicle speed monitoring device which enables a driver to enter a speed tolerance profile that represents the driver's personal travel speed preferences and which alerts the driver when the vehicle speed falls outside the speed tolerance profile. Specifically, the speed tolerance profile consists of a number of speed tolerance ranges, each associated with a particular posted speed limit. As the vehicle travels through various map zones, the applicable posted speed limit is determined using a customized GPS map [3]. The device determines the vehicle location, speed and the posted speed limit and then compares the vehicle speed using a running average to see whether vehicle speed is within the driver's speed tolerance profile and if not, the device provides the driver with a visual and/or audible warning according to the driver's operational preferences.

A method used for the detecting the speed of vehicle using a camera. The method automatically compensates an apparent speed determination for inaccuracies due to the position of the camera with respect to the vehicle. The invention also includes a method for calibrating a camera to compensate for inaccuracies due to the position of the camera. Speed Detection Camera System (SDCS) that is applicable as a radar alternative [4]. SDCS uses several image processing techniques on video stream in online -captured from single camera- or offline mode, which makes SDCS capable of calculating the speed of moving objects avoiding the traditional radars' problems. SDCS offers an inexpensive alternative to traditional radars with the same accuracy or even better.

The results from several reviews have been presented and the aspects of road safety associated with intelligent transport systems (ITS) applications have been addressed [5]. The attempt is to make a state-of-the-art regarding effects on accidents by categorizing systems according to levels of evaluations methods that have been applied. These categories are effects on behaviour, effects on accidents by proxy/surrogate methods, accident studies from real traffic, effects on accident types and finally by meta-analysis where weighted estimates of effects on accidents can be calculated. Thirty-three IT systems including driver assistance systems/advanced driver assistance systems, in-vehicle information systems, in-vehicle data-collection systems and road telematics have been listed. Effects based on meta-analysis are estimated for 11 systems, and single accident studies are found for an additional 2 systems. For the remaining 20 systems, no studies from real road traffic have been identified. Effects on accidents of ant locking brake systems and electronic stability control (ESC) are presented in more detail according to their effects on certain accident types. ESC appears to be very efficient in reducing the number of accidents. Behavioural adaptations to ITS are considered and

discussed, especially in terms of compensation mechanisms. Four hypotheses regarding prediction of effects on accidents are stated according to whether systems increase or decrease 'windows of opportunities' by calling upon a driver behaviour model where emotions play a central role.

The excellent combination of two important fields such as telecommunications, power of computing has propelled our capability even further, allowing us to communicate anytime and anywhere, improving our work flow and increasing our quality of life tremendously. The next wave of evolution we foresee is the convergence of telecommunication, computing, wireless, and transportation technologies. Once this happens, our roads and highways will be both our communications and transportation platforms, which will completely revolutionize when and how we access services and entertainment, how we communicate, commute, navigate, etc., in the coming future. Emergency Services in Future Intelligent Transportation Systems Based on Vehicular Communication Networks [6] presents an overview of the current state-of-the-art, discusses current projects, their goals, and finally highlights how emergency services and road safety will evolve with the blending of vehicular communication networks with road transportation.

Vehicular speeds have been identified to be at the core of road accident severity and frequency globally. Whereas speed control is a fundamental priority and the cornerstone of road safety in the developed world, the subject is at rudimentary stages in most developing countries thus making research into vehicle speeds in developing nations imperative. The results show that over 95% of vehicles travelled above the posted speed limit of 50 km/hr. Vehicles on an average travelled at 87 km/hr. Variation in speeds was wide, with a standard deviation of 18 km/hr for all classes of vehicles, and with a range of 40 to 187 km/hr. The highest vehicular speed was associated with the private car (97.6 ± 18.3 km/hr) followed by large buses (93.6 ± 13.3 km/hr) and the least was with heavy trucks (73.8 ± 12.9 km/hr) [7]. This type of proved research clearly indicating the violations speed limits which represent failure of present RADAR systems, but by using the proposed research work presented in this research proposal will give a complete solution for the Road safety problems.

Traffic accidents are one of the leading causes of fatalities in the US. An important indicator of survival rates after an accident is the time between the accident and when emergency medical personnel are dispatched to the scene. The work described in [8] is supporting some of the post-accident measures proposed in this research proposals, but not discussed the alternate methods to eliminate the present RADAR systems where as our proposed research work is the combination of monitoring of speed and accident.

The vehicle speed detection methods and importance of radars and other communication devices in reducing vehicle accidents are discussed in [9] – [16], in all these research works the speed detection was confined to particular places and in another places no control over the speed violations which were not able to detect by the radars, this drawback used by vehicle drivers making accidents. Where as in our proposed work, this draw will be overcome, that means the continuous monitoring of vehicle speed is possible at any place.

The patents mentioned in the [17] to [25], developed the different vehicle speed detection methods and accident information sending systems. All these methods are confined to particular places and utilising vehicle parts. For the new and costly vehicle this intervenes will create more inconvenience to the owner of vehicle. Whereas our research work isolated no way disturbs vehicle parts except using of vehicle battery.

III. EXPERIMENT AND RESULT

A. Proposed Methodology

The block diagram shown in Fig. 1 is used to develop the proposed black box model for monitoring of vehicle accident and its speed using Arduino Microcontrollers, Global Positioning System (GPS) module, SMS (Short Message Service) Module, Camera module, Secure Digital (SD) module with memory card and preloaded database with the phone numbers, latitude and longitudes of all Royal Oman Police (ROP) stations and major Hospitals in every city of Sultanate of Oman.

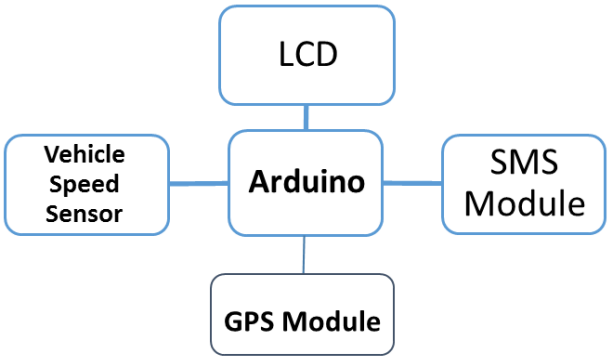

Fig. 1: Block Diagram of Proposed Black Box

The proposed black box model will also consists of an accident monitoring system using GPS module, VC0706 Camera module, SD module and SMS module. A brittle mechanical contact switch is used to detect an accident significantly, the vehicle accident location information will be detected by GPS and sent as Google Map link by automatic SMS and also accident picture by MMS (Multimedia Messaging Service) to the nearest police station, to family member along with the details of vehicle and distance between accident location and home, nearest police station. The photo of accident location and car details will be pop-up in the window box using the latest Android mobiles. In addition to

this, the camera modules arranged in front side, back side, left side and right side will continually starts recording when vehicle starts (The moving of vehicles detects by GPS), first one hours video streaming will be stored permanently in the SD and remaining timing video will be deleted. After an accident this video will be very much helpful to ROP to investigate accident.

In addition to the accident monitoring, as a black box model, when this project kit is installed in any vehicle, it can continuously monitor the speed and when speed exceeds specified limit, it will send a warning message to the driver in the form voice message and still if speed increases, it will send a fine information to the driver (owner of the vehicle) and also to the police (ROP). The detection of speed will be calculated from the GPS and Arduino microcontroller, therefore the proposed black box model will be used as an arbitrate and in any manner it will not intervene the vehicle parts and also assured that the proposed model will work independently except utilising the vehicle battery power supply to recharge battery of proposed model, which will work for 3 to 4 days in the absent of vehicle battery. The proposed black box model is fully sealed pack , any tampering and cutting of wires will be detected and send a message to the ROP and fine information to the owner of Vehicle. This proposed system would eliminate the present RADAR (RAdio Detection and Ranging) system in detecting the over speed beyond the specified limits.

As a test system, the proposed black box model can be implemented in the School buses, heavy load vehicles and 10 years old cars after rigorous verification of proper working of this proposed black box model. This type of project can be implemented in different type of vehicles with the different speed limits based on the condition and type of vehicles and particularly in the School vehicles, heavy load vehicles and old vehicles. Therefore irrespective of time and place, the vehicle speed and accident monitoring of different vehicle is possible using this project. In this way the development of Black box model will be more helpful for the Oman society in decreasing the number of accidents.

The circuit diagram shown in Fig. 2 is used to develop the black box model to monitor the accident location and speed of the vehicle.

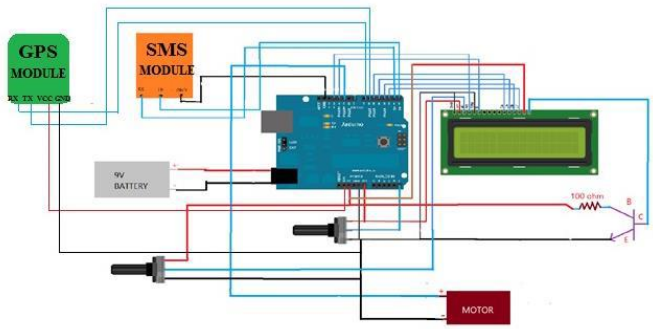

Fig. 2: Circuit Diagram of Proposed Black Box

Operation of the Project

Connections are made as per the circuit diagram as show in Fig.1, it is mainly consisting of Arduino, DC motor as speed sensor, GPS module, SMS Module, and LCD.

Step1: Controlling Speed of DC Motor using Arduino, the speed of DC Motor can be controlled using a potentiometer to sense the different speeds.

Step 2: LCD Display, when speed is changed as per step-1, the corresponding value of speed of DC Motor is shown in LCD.

Step 3: GPS Module, When the GPS module is powered with the Arduino and placed in the vehicle, it receives vehicle Latitude and Longitude positions from the Satellite.

Step 4: SMS Module

i. For GPS: When any Accident happens, sensors will be activated, so that an SMS with direct google map link will be sent to the nearest police station and to the family member using SMS module

ii. For Vehicle Speed Monitoring: When the speed is more than the specified limit, SMS module will sends an initial massage and then send warning for driver and to ROP when its exceeds specified levels as mentioned in the program.

B. **Results**

The project implementation pictures are shown in Fig. 3 and Fig. 4 are the finally developed based on the proposed methodology discussed in the section IIIA.

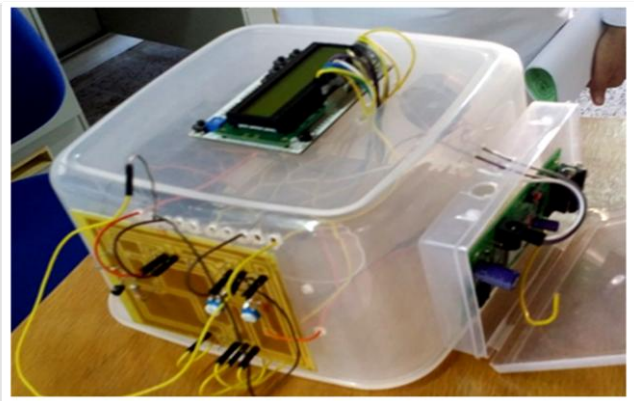

Fig. 3: Model of Project Black Box

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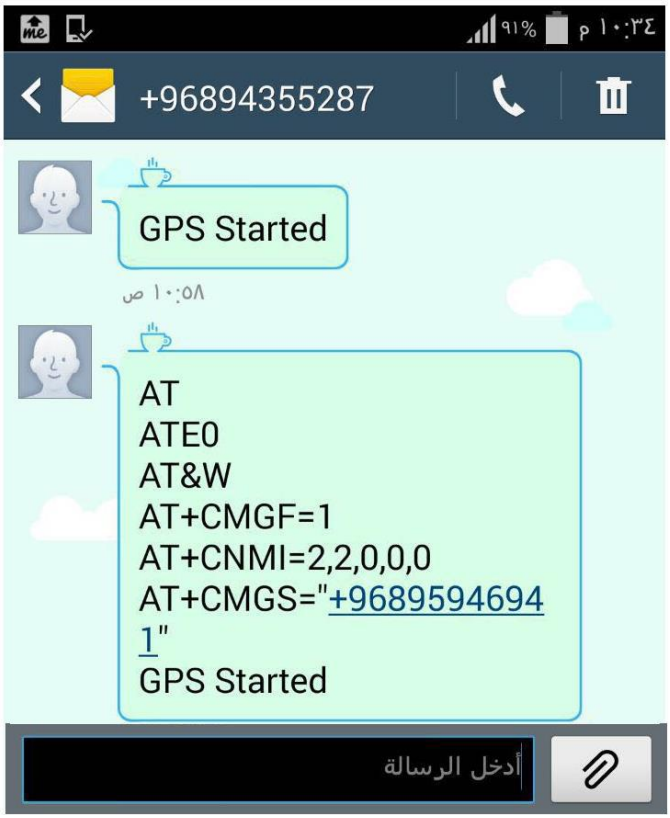
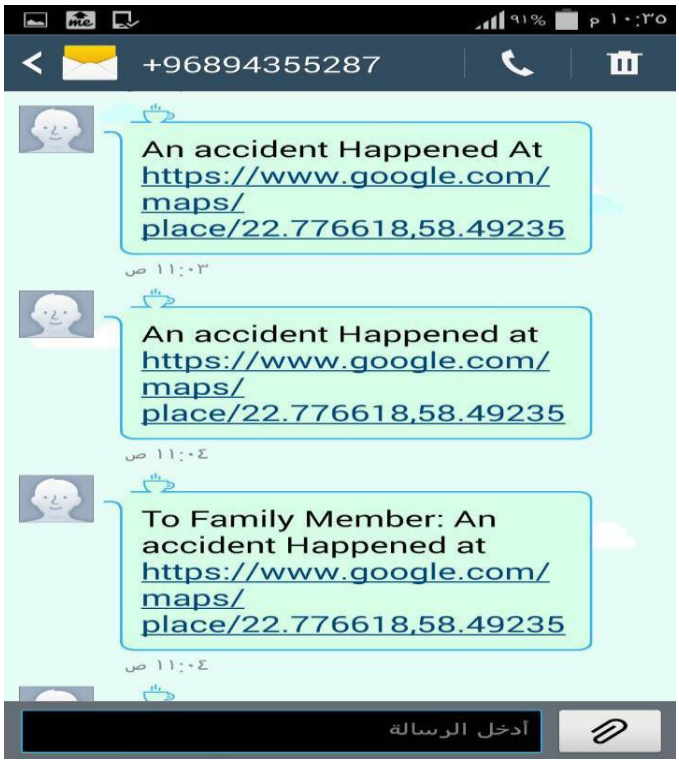
Fig. 4: Implemented Project prototype

Sample Result-1: GPS Initialization and Confirmation of working



Sample Result-2: Accident information by SMS



Sample Result-3: Speed Detection and Penalty Information in RO(Omani Riyal)

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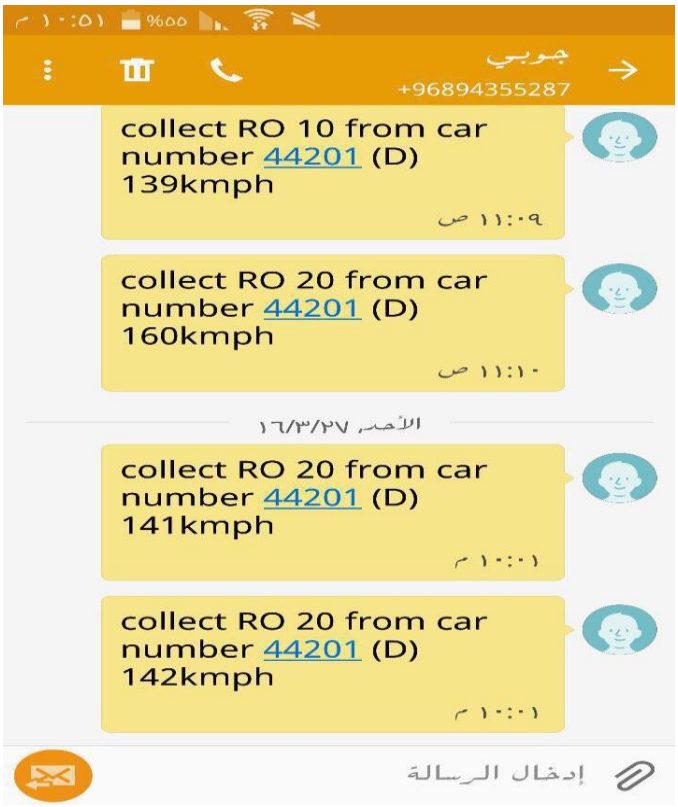

The sample result-1 will indicate the proper initialization and working condition of proposed black box model by receiving a SMS as "GPS Started" and AT (Attention) commands are the GSM initialization commands.

When an accident happens (Simulate with the push button switch) an automatic SMS will be received to Family member and police with direct Google Map link as shown in the Sample result-2.

Sample result-3 is related to the vehicle speed monitoring, when vehicle exceeds a dangerous speed, a penalty information will be sent to the driver or vehicle owner with vehicle registration number.

These sample results are indicating that accident and speed monitoring is possible when the proposed black box model installed in any vehicle with proper sealing and tampering measures.

IV. CONCLUSION

The proposed research work involves the several latest technological innovations. Therefore it will be more helpful to society and government because number of accidents will be reduced when this project is implemented in the vehicles and the cost of present RADARS, office staff will be reduced tremendously and also for the police the accident investigation time will be reduced. In addition to that the police will be obtained precise information about how the accident occurred along with the photos and video, so that post-mortem investigation time and hectic will be reduced in identifying the genuine and innocent person, so that proper justice will be done. In the laboratory different experiments will be conducted like detection of speed, sending SMS, MMS, getting data from satellite in the form of GPS coordinates. Therefore students at undergraduate level will enlighten with the latest technological innovations.

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