Available Online at www.ijcsmc.com

International Journal of Computer Science and Mobile Computing

A Monthly Journal of Computer Science and Information Technology

ISSN 2320–088X
IMPACT FACTOR: 6.017

IJCSMC, Vol. 7, Issue. 11, November 2018, pg.159 – 166

Arduino-Based Speed Limit Detector with SMS Support: Its Applicability and Usability to Traffic Management Unit

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ABSTRACT: ***The road traffic accidents are becoming alarming in the Philippines. The number of fatalities increasing day by day is a real challenge for all concerned agencies to prevent it. Thus, this study aimed to develop an Arduino-Based Speed Limit Detector that will buzz motorcycle drivers exceeding a speed limit of 60 kilometers per hour. The system will automatically send SMS to the nearest Traffic Management Unit in order to reprimand drivers violating the policy. The study also determined the applicability and usability of the system to the Traffic Management Unit of Sagay City, Negros Occidental. The researcher used the descriptive developmental method of research in achieving the desired objectives. Rapid Prototyping model was used during the system development while the criteria in Mc Calls Software Quality Model was used to test the system according to its usability, applicability, and efficiency. As to the system's efficiency, a rating of 4.56 was given by the IT experts interpreted as Very Good. In terms of usability, the Traffic Management Unit of Sagay City rated the system with 4.50 interpreted as Very Good while the overall applicability of the system earned a grand mean of 4.36 interpreted as Very Good. The Arduino-Based Speed Limit Detector with SMS Support will be presented to the Office of the Sangguniang Panlungsod (law-making body) of Sagay City for the possible creation of an ordinance to implement and utilize the developed system.***

Keywords: Arduino, Magnetic Switch, Speed Limit Detector, Traffic Accident

I. INTRODUCTION

A road accident is commonly attributed to the collision of vehicles, pedestrian, or with an object that will result in death, disability and damage to property. Road accidents were caused by driver's errors, mechanical defect, over speeding, drinking spree before driving, and damaged roads. As of April 2018, the Cebuana Lhuillier news and events highlighted the top ten (10) causes of car accidents in the Philippines. On the list, overspeeding was recorded among the top three (3) reasons why vehicular accidents happen. Local City Ordinance and Resolutions somehow, enforced penalties for reckless driving but not all the time that these traffic offenders were caught in the act by the traffic enforcers. With the aforementioned reasons, the researcher conducted a study on developing a prototype that will help traffic enforcers monitor and reprimand traffic offenders. Specifically, this study aimed to develop a system that will help the Traffic Management Unit of Sagay City to monitor the motorcycle drivers who exceed the prescribed speed limit of sixty (60) km/h. When the motorcycle runs and its speed is above 60 km/h, the device will alarm, the LED will emit red light, and will automatically send SMS to the nearest Traffic Enforcer or Traffic Management Unit containing the plate number and the name of the driver. This study also determined the applicability, usability, and efficiency of the system in terms of its function and purpose. This study took place in Sagay City wherein a vehicular collision which took three (3) lives and injured the other five (5) happened before the year 2017 closed.

II. METHODOLOGY

System Design

This study used the Prototyping Model of System Development and the Descriptive Research method to achieve the desired objectives.

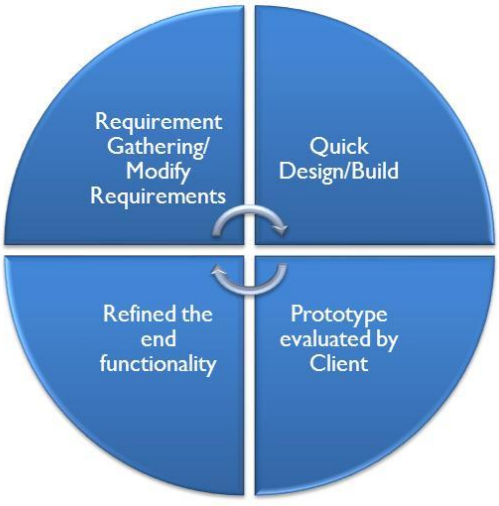

Figure 1. Prototyping Model

Prototyping model is a Systems Development Method (SDM) in which a prototype is built, tested, and then reworked as necessary until an acceptable prototype is finally achieved from which the complete system or product can now be developed.

Requirement Gathering

The researchers gathered the needed data about the existing problem through an interview. The researchers also determined the technical requirements to be used in building and designing the prototype.

Quick Design/Build

At this phase, the developer designed the system's architecture. Parts were assembled using the build tools like Arduino Uno, Magnetic Reed Switch Sensor, LCD, Battery, GSM shield, LED, and Buzzer. The codes for the basic data flow of the system was compiled through Arduino IDE and C++ programming language.

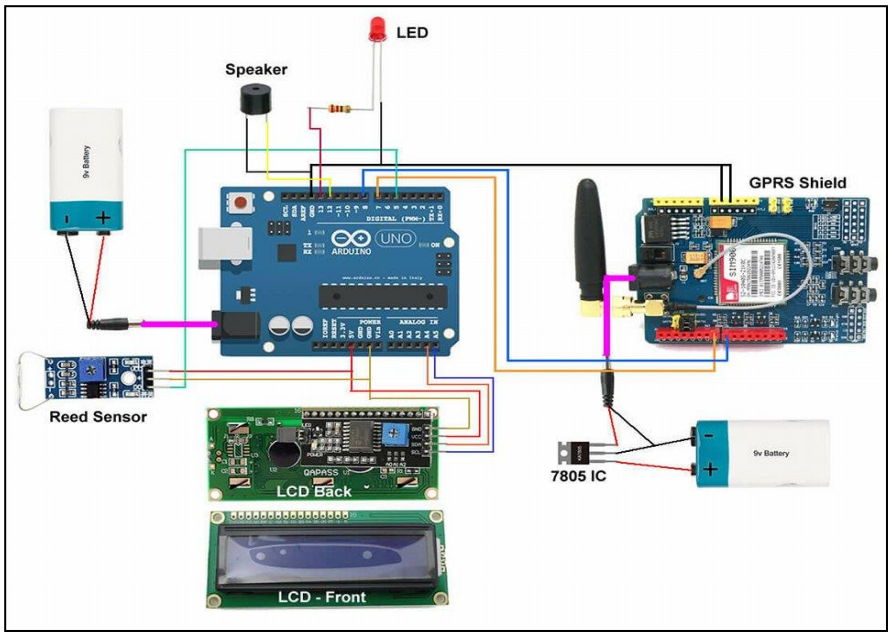

Figure 2. Technical Specification of the System

Prototype Evaluation

When the initial design was done, the system was tested by the IT experts and installed in two (2) motorcycle units for a dry run. The prototype was carefully examined, evaluated, and tested. The developer then fixed minor errors and defect in the system to make sure that everything will work and function according to purpose.

Refinement

Based on the findings and the result of the initial testing of the prototype, the developer carefully made some refinement and another round of debugging in the line of codes. All recommendations from the IT experts, the drivers and the Traffic Enforcers who participated in the initial testing were taken and applied on the final testing of the system.

Figure 3. The Arduino-Based Speed Limit Detector with SMS Support Prototype

Figure 3 shows the picture of the developed prototype. Once exceeding the speed limit of 60km/h, the device will alarm and red LED will blink to call the attention of the driver. It will then send SMS report to the nearest Traffic Management Unit.

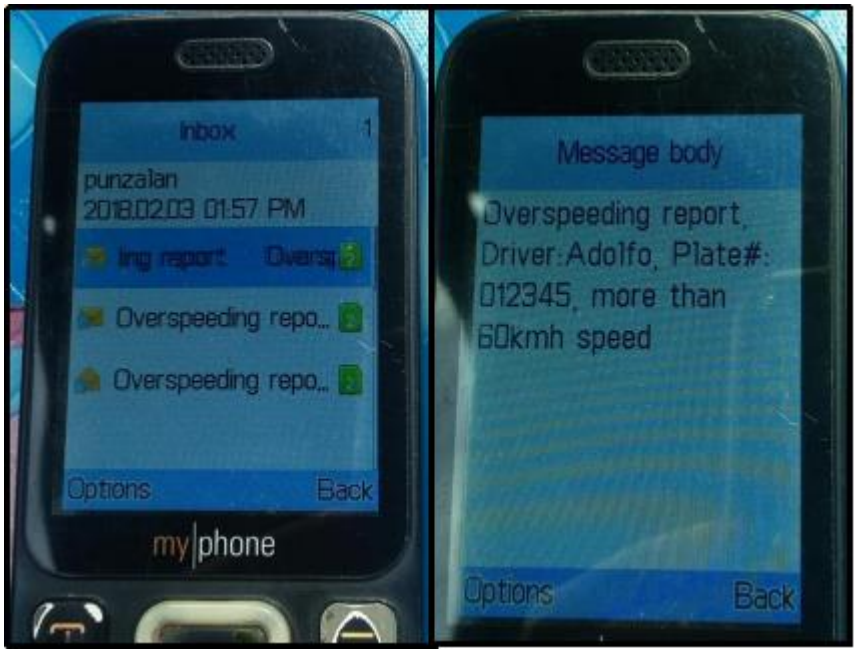

Figure 4. SMS sent to the nearest Traffic Management Unit

Once a driver exceeds the 60km/h speed limit, it will automatically send SMS about an overspeeding report containing the driver's name and the plate number of the vehicle as shown in Figure 4. Thus, making it easier for Traffic Officers to reprimand offenders.

Respondents of the Study
The respondents of the study are the members of the Traffic Management Unit of Sagay City and the members of Old Sagay Tricycle Operators and Drivers Association (OSTODA).

Table 1.0 Summary of Respondents

Categories	Sample Size
Traffic Enforcers	31
Motorcycle/Tricycle Drivers	100
Total	**131**

Sampling Technique
The researcher used purposive sampling since the system was developed for the Traffic Management Unit of Sagay City and pilot tested in OSTODA.

III. RESULTS AND DISCUSSION

After the series of tests conducted and the detailed evaluation of the system, the results are as follows:

Table 2. Evaluation Result given by the Respondents

Area	Grand Mean	Verbal Interpretation
Usability	4.50	Very Good
Efficiency	4.56	Very Good
Applicability	4.36	Very Good

Five-Point Likert Scale: 4.21 – 5.00 Very Good, 3.41 – 4.20 Good, 2.61 – 3.40 Average, 1.81 – 2.60 Poor, 1.00 – 1.80 Very Poor

Table 2 showed that the developed system is efficient in monitoring the driver that exceeds the 60 km/h speed limit thus, the respondents rated the system with a grand mean of 4.56 interpreted as very good. In terms of usability, the system got a rating of 4.50 while the system's applicability to the Traffic Management Unit was rated 4.36 also interpreted as Very Good.

On the System's Usability
The developed prototype is easy to install and to operate. Motorcycle units installed with Arduino-Based Speed Limit Detector with SMS support will be registered to the system including the driver's name, plate number, and or tricycle's body number.

On the System's Efficiency
The developed prototype is very efficient. It provides secure and accurate data by sending the real-time communication to the Traffic Management Unit thru an SMS.

With these, traffic management and driver monitoring scheme could be easier and a lot better.

On the System's Applicability

The developed prototype is very applicable in terms of the daily operation of the Traffic Management Unit. It provides a system of real-time monitoring of the drivers and the traffic offenders by detecting overspeeding motorcycles. This system will be a great help to the Traffic Enforcers once installed and utilized.

Table 3. Evaluation Result Given by the Experts

Criteria	Mean	Verbal Interpretation
Auditability	4.33	Very Good
Accuracy	4.33	Very Good
Completeness	4.67	Very Good
Communication Commonality	4.33	Very Good
Conciseness	4.33	Very Good
Consistency	4.67	Very Good
Operability	5.00	Very Good
Security	4.33	Very Good
Self-Documentation	4.67	Very Good
Simplicity	5.00	Very Good
Software System Independence	4.33	Very Good
Traceability	5.00	Very Good
Training	5.00	Very Good
Data Commonality	4.33	Very Good
Error Tolerance	4.33	Very Good
Execution Efficiency	5.00	Very Good
Expandability	4.67	Very Good
Generality	5.00	Very Good
Hardware Independence	4.67	Very Good

Instrumentation	4.33	Very Good
Modularity	4.67	Very Good
Total Mean	**4.62**	**Very Good**

Table 3 showed the result of the system evaluation using the criteria in McCall's Evaluation for Software Quality Model. The above-mentioned criteria determined the degree to which the developed prototype and system conformed to the standard in terms of its interface, features, characteristics, and control and mechanisms. The overall performance of the developed system is very remarkable in an overall rating of 4.62 which means Very Good.

CONCLUSION

The developed system is very applicable in terms of traffic rules and regulation management. It is easy to operate and has user-friendly features that can help the traffic authorities to monitor the tricycle drivers who exceed the 60km/h speed limit. The system provides real-time monitoring by detecting overspeeding motorcycles. It can send SMS to the nearest Traffic Management Unit or Traffic Enforcers with the drivers' name and plate number. This system will help lessen the cases and incidents of vehicular collisions and road accidents due to overspeeding.

RECOMMENDATIONS

1. The Sangguniang Panlungsod (law-making body) of Sagay City may consider creating an ordinance for the implementation and utilization of the developed system.

2. That further study may be conducted to improve the architectural design and the functionalities of the developed prototype.

3. That funding institution may consider the project as a potential for commercialization.

ACKNOWLEDGMENT:

Special thanks to Jackyline L. Villarin, Jeandy F. Mabilla, Renna S. Espelico, Eden B. Silvino, and Rosemie D. Punzalan for taking a big part on this research. Also, to the Traffic Management Unit of Sagay City thru SPO1 Orlando Alob and the members of Old Sagay Tricycle Operators and Drivers Association (OSTODA) for making the test of the system possible.

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