MOTOSENSE – INTTELIGENT MOTORCYCLE SAFETY AUTOMATION WITH BREATHE ALCOHOL CONTENT (BAC) AND IGNITION INTERLOCK DEVICE

Ezekiel R. Borja
Master of Information Technology
Graduate School – Centro Escolar University

Abstract

The study focused on preventing the rider from using the motorcycle type vehicle under the influence of alcohol. The Motosense device is attached in the ignition part and push button of the motorcycle. The alcohol sensor is attached in the motorcycle helmet to detect the alcohol fumes from the rider. To validate the hardware requirement of proposed system, the motorcycle riders and technology specialist were identified as group of experts were interviewed and surveyed regarding the effectiveness and the readiness of the proposed research for future implementation. The produced data used as basis for the implementation and other suggestion that can be added in the future.

Keywords: Motorcycle, Motosense, ignition system, alcohol sensor, rider

1. Introduction

In emerging cities, various means of transportation are introduced. Although people have PUVs (Public Utility Vehicles) such as jeepneys, buses, vans, tricycles, and the trains, some people own a vehicle to travel. These people own a car or a motorcycle. People also have the popular TNCs, another transportation option.

These private vehicles now come with intelligent systems. These components are now embedded to improve the experience of the vehicle owners. These components may include the implementation of GPS technology, proximity devices and communication between mobile devices. These maybe a list of devices but, the features implemented are ethically considered.

However, issues arise when these are used to motorcycles. Most people despise motorcycles and the riders, because of its tendency to be involved in accidents. This discourages others to use a motorcycle but some negate this because of some convenience it gives the rider or the owner.

But of course, there are efforts done to prevent undesired scenarios. This includes the heavy reinforcement of traffic laws and other road-related rules and regulations. There are even assigned motorcycle lanes that could possibly discipline all riders involved. Above all these, the primary concern is still the life of every road traveler in any place.

However, issues arise when these are used to motorcycles. Most people despise motorcycles and the riders, because of its tendency to be involved in accidents. This discourages others to

use a motorcycle but some negate this because of some convenience it gives the rider or the owner.

But of course, there are efforts done to prevent undesired scenarios. This includes the heavy reinforcement of traffic laws and other road-related rules and regulations. There are even assigned motorcycle lanes that could possibly discipline all riders involved. Above all these, the primary concern is still the life of every road traveler in any place.

2. Background of the Study

The current efforts for the minimization of road accidents still have a room for improvement. Vehicles with intelligent systems are getting common, and this is heavily applied on cars and other four-wheeler vehicles. The motorcycle does not get much benefit from this as implementation of this intelligent systems on motorcycles has heavy implications, especially, when it comes to undistracted driving.

Based on the MMRAS or the Metro Manila Accident Recording Analysis System of 2016 conducted by Metropolitan Manila Development Authority, motorcycle is the most involved vehicle in terms of fatal and non-fatal accidents in the highways of Metro Manila. With 218 fatal accidents and 11,456 non-fatal injuries with 11,431 damage to properties. 1 of the major cause of accidents is human error with alcohol-suspected riders. (MMRAS, 2016).

ing to Kimiko Sy of Rappler in his article "IN NUMBERS: Road crash incidents in the Philippines", The age ranges from 15-64 years old of those involved in accidents in the major highways. Majority of accidents in the highway involve motorcycle which is 69% nationwide. (Sy, 2017)

The proponent thought of developing an automation system for motorcycle riders that can to help the riders in a variety of ways and to ensure the rider's safety. Incorporating other features, the proposed system can be utilized without distracting the driver.

However, issues arise when these are used to motorcycles. Most people despise motorcycles and the riders, because of its tendency to be involved in accidents. This discourages others to use a motorcycle but some negate this because of some convenience it gives the rider or the owner.

But of course, there are efforts done to prevent undesired scenarios. This includes the heavy reinforcement of traffic laws and other road-related rules and regulations. There are even assigned motorcycle lanes that could possibly discipline all riders involved. Above all these, the primary concern is still the life of every road traveler in any place.

According to Kimiko Sy of Rappler in his article "IN NUMBERS: Road crash incidents in the Philippines", The age ranges from 15-64 years old of those involved in accidents in the major highways. Majority of accidents in the highway involve motorcycle which is 69% nationwide. (Sy, 2017)

The proponent thought of developing an automation system for motorcycle riders that can to help the riders in a variety of ways and to ensure the rider's safety. Incorporating other features, the proposed system can be utilized without distracting the driver.

3. Objective of the Study

3.1 General Objective. The General Objective of this study is to design and develop BREATHE ALCOHOL CONTENT (BAC) and IGNITION INTERLOCK DEVICE.

3.2 Specific Objectives. 1. To design a device that prevents riders from using their motorcycle when under the influence of alcohol; To reduce road accidents and incidents involving motorcycles; To examine the efficiency and effectiveness of Breathe Alcohol Content and Ignition Interlock Device; To design and create a device under the standards of IEEE and ISO9126; To innovate the technology for preventing motorcycle accidents.

4. Scope and Limitation of the Study

The proposed system was designed for motorcycle owners. The proposed system can promote safety and discipline among riders for it could reduce the likelihood of the accidents.

The alcohol sensor of the proposed system can detect alcoholic content in a specified range of alcohol levels. The alcohol sensor will be attached to the vehicle's handle bar. If triggered, the alcohol sensor will only automatically hinder the ignition from the start so as to prevent the events of drunk driving. The vehicle will only be allowed to start again after the refresh rate of 30 seconds.

The Ignition Interlock Device of the proposed system is primarily responsible for locking the motorcycle ignition engine and push start button, and in analyzing the alcohol content coming from alcohol sensor. The IDD is composed of relays and indictors for monitoring. The IDD is powered using 5v DC 2A Power supply. The relay switches are protected using diode to prevent power surges that cause burn to relay.

The Alcohol Sensor and IDD are connected using Bluetooth transmitter and receiver. The function of Bluetooth transmitter is to send the data from alcohol sensor.

The study did not include application for the proposed system for monitoring. There was no sensor included for detecting collision; the device has no GPS/GPRS for locating the motorcycle and lastly the device was only designed for motorcycle use only.

5. Significance of the Study

5.1 To the Motorcycle Riders. The motorcycle riders will benefit in the proposed system in a variety of ways. It will forcefully prevent the rider from using the motorcycle once confirmed drunk by the sensor of the proposed system. This will prevent the case of drunk driving. It also enhances the security of the motorcycle.

5.2 To the Law Enforcers. The law enforcers will benefit because the primary goal of the study is to reduce the accident rate involving motorcycles. Enforcers can focus more on their work of regulating the traffic flow and the driver's observation of the traffic rules and regulations.

5.3 To the Future Researchers. Future Researchers can use this study as a reference for their own study.

6. Related Literature

Related literature of the research are discussed. The literature included can be foreign or local, article, journal, or a book. The relevance of each literature is discussed and it will explains how it supports the concept of the proposed system.

Motorcycle Accidents in Metro Manila

In the Philippines specilly in the cities are also used motorcyles. (Robielos, 2012) reported that there is a continuous increase of motorcycle accidents in the Philippines for the last ten years. The significant causes to these accidents are driver's behavior, traffic movement, vehicle maneuver, weather and surface condition. and these are also the factors that cause accidents in Malaysia.

Smart Motorcycle System

The simulations are technically a collaboration of transportation and digital technology. Automation is heavily implemented. And during these times, the production of vehicles now comes with intelligent systems. That is why Patil (2016) developed a smart motorcycle system. It includes a helmet controlled safety system wherein the motorcycle ignition is enabled only when the helmet is put on. The system also incorporates other features like Global Positioning System, automatic head light control and real time display. The ICSwill then be less likely to occur because of this applications.

7. Conceptual Framework

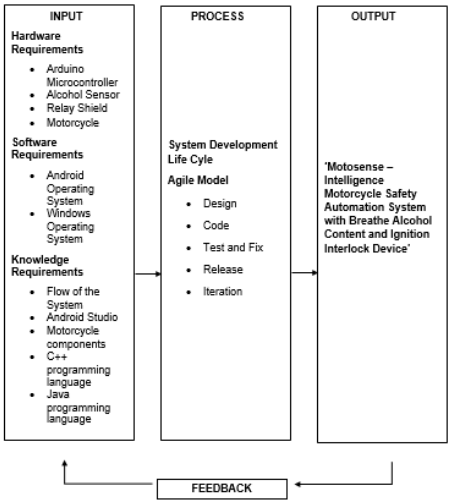

Figure 1 Conceptual Framework of Proposed System

In Figure 1 shows the Conceptual Framework of the proposed system. It requires the use of multiple sensors to be attached to the motorcycle. Following the Software Development Lifecycle, it produces the proposed System

8. Research Design

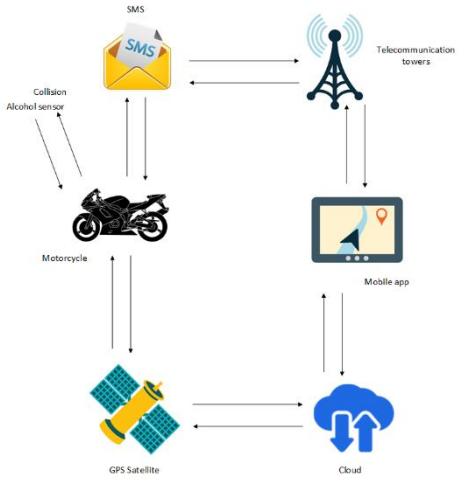

Figure 2. Software Architecture

In Figure 2, Illustrates Software Architecture of the proposed MotoSense app. The collision and alcohol sensor records event which is sent to telecommunication towers using SMS technology. The mobile application receives the information and using the internet and the GPS Satellite, the mobile app can procure a presentation of the location of the vehicle rider.

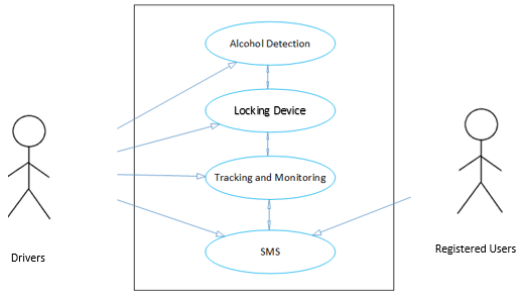

Figure 3. Software Architecture

In Figure 2 illustrates the proposed Use Case Diagram of MotoSense app. There are two user levels, the driver and the registered users.

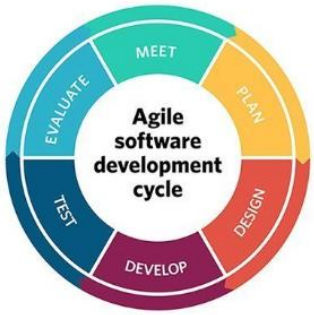

Figure 4. Software Development Lifecycle

In figure 4 The researcher used agile methodology because of reduced development time of the system, increases reusability of components, quick initial review occurs, and lastly, Integration from very beginning solves many integration issues.

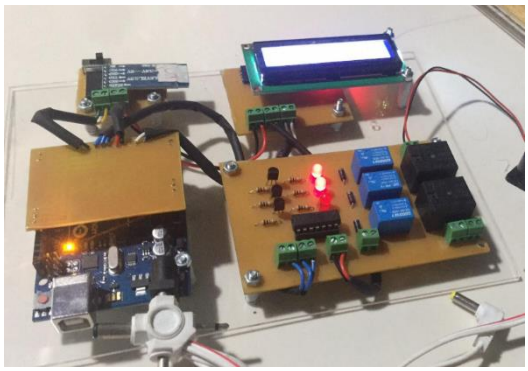

Figure 5. The MotoSense Device

In Figure 5. Shows the Motosense Motorcycle Device attached to the motorcycle. The function of device is to turn on and off the motorcycle depending on the read out from the alcohol sensor. The sensor is attached to the motorcycle helmet. The primary responsible for detecting alcohol fumes around the motorcycle riders helmet.

9. Methodology

The study will took place in the Malabon. It acquired the reputation of being the most disaster prone community in Metro Manila. As an urban area, there are many vehicles that come and go and motorcycles are common. Given that the motorcycle count in the area is high, the likelihood of a motorcycle related accident is high. The researcher strategically chose the area to survey and setting of the study. The users of the hardware components of the proposed system will consist of the selected motorcycle riders from Malabon. Selected motorcycle riders with varying degrees of motorcycle experience are used as samples for testing the proposed system. A total of 50 motorcycle riders and 10 Technical Specialist were asked to evaluate the proposed system. The motorcycle used for testing are the vehicles of the subjects. The

technique purposive sampling was used in the research. Using this technique, the researcher must relied on his own judgment whom to choose as participants of the study.

9. Presentation, Analysis and Interpretation

This section discusses the analysis and interpretation of the data as well as the findings of the conducted evaluation.

The researchers used the Likert scale as baseline for the purposes of evaluation of the developed system.

The researcher used the Analysis of the Variance to measure the comparison of results. To get the comparison of results, get the total sum of scores = total sum of squares within groups + sum of squares between groups. To get the F ration of each groups, the total sum of squares between groups / degrees of freedom, the total sum of squares within groups / degrees of freedom the divide the between group over within groups. Using the P-value chart, use the degrees of freedom to determine the P-Value rating. If the P-value rating greater than the standard value 0.05, the chances of getting a No Significant value rating is higher. The Anova was used to compare the demographic profile of the Specialists, Effectiveness of the proposed study, and the Readiness of the proposed study. And also to determine the significant difference of the variables. Based on the non-probability testing criteria of purposive sampling, the proponent relied on his judgment in choosing members of the population to be participant of the study. The proponent used a sample size of n in order for the probability to be at least 100%. The sample mean was within n standard deviation of the population mean.

Values	Equivalent
Strongly Agree	2.51 – 3.00
Somewhat Agree	1.51 – 2.50
Strongly Disagree	0.51 – 1.50
No Opinion	0.00 – 0.50

Table 1: Likert Scale Values for Respondents Perceptive Survey

Values	Equivalent
Very Good	3.50 – 4.00
Good	2.50 – 3.49
Acceptable	1.50 – 2.49
Needs Improvement	0.00 – 1.49

Table 2: Mean Range Values for Technology Specialist Survey

10. Presentation, Analysis, and Interpretation

Question	Mean	Std. Deviation	V.I.
1. Driving after drinking is a personal decision should not be illegal.	1.220	.9538	Strongly Disagree
2. One drink does not harm a person's driving ability.	1.480	.9947	Strongly Disagree
3. Everyone drives once in a while after they've drunk a little too much and that's okay.	1.180	.8734	Strongly Disagree
4. 4. People should not be allowed to drive if they have been drinking any alcohol at all.	2.400	.9897	Somewhat Agree
5. Technology of MOTORSENSE does not guarantee of safety on the road accident.	1.740	1.2257	Somewhat Agree

Table 3: Should Philippines to Enforce Drinking and Driving Laws?

Table 3 shows the responses of respondents about the strict implementation of drinking and driving laws in the Philippines on "Driving after drinking is a personal decision should not be illegal" gets a mean of 1.220 and standard deviation of 0.9538 with a verbal interpretation "Strongly disagree". On "One drink does not harm a person's driving ability." it obtains a mean of 1.480 and a standard deviation of .9947, which is Interpretation is "Strongly disagree". On question "Everyone drives once in a while after they've drunk a little too much and that's okay" gets a mean of 1.180 and a standard deviation of .8734, which is "Strongly Disagree".

Question	Mean	Std. Deviation	V.I.
1. Use helmet by motorcycle riders with MOTORSENSE device.	2.620	.8303	Strongly agree
2. Strict enforcement of traffic laws for motorcycle under intoxication.	2.340	1.1178	Somewhat agree
3. Imposed strict penalty to those violators.	2.740	.6642	Strongly agree
4. Motorcycle riders receive the training they need to drive safely.	2.800	.4949	Strongly agree
5. Motorcycle riders receive the training they need to drive safely.	2.860	.4046	Strongly agree
6. Support a helmet law installing with MOTORSENSE device for liquor of intoxication.	2.720	.5360	Strongly agree

Table 4: Should Philippines ensure the safety of motorcycles on roadways?

Table 4. Shows the responses of respondents about the safety of motorcycles on roadways. The respondents Strongly Agreed in wearing helmet with motosense device with a mean of 2.620 and standard deviation of .8303**.**

Hardware	Meter Tester			
	Not Complied	%	Complied	%
MQ3Sensor	0	0.00	10	100.0
LCD Display	0	0.00	10	100.0
Bluetooth Transmitter / Receiver	0	0.00	10	100.0
Ignition Interlock Device	0	0.00	10	100.0

Table 5: Hardware Calibration Table

Table 5 shows the Hardware Calibration table. Out of ten respondents, ten respondents answered that the Device Complied for each requirement for Hardware Calibration with the total of 10 Percent.

Hardware	Mean	Std. Deviation	V.I.
Read Sensors	3.700	.4830	Very good
Make Decisions	3.800	.4216	Very good
Display Output	4.000	.0000	Very good
PLC, C++ or Java Coding	3.800	.4216	Very good
PLC, C++ or Java Coding Test and Debug	3.900	.3162	Very good
Arduino Control Panel	4.000	.0000	Very good
Arduino Dynamic Link Library	3.700	.4830	Very good

Table 6: Hardware Testing

Table 6 shows the mean and standard deviation of hardware during the testing phase. Overall the value interpretation of the hardware device installed in the helmet and motorcycle is "Very Good".

Guide Questions	Mean	Std. Deviation	V.I.
Correctness	3.500	.5774	Very good
Completeness	3.500	.8498	Very good
Consistency	3.500	.8498	Very good

Table 7: Correctness

Table 7. Shows the mean and standard deviation of Correctness. Overall, the value interpretation of the hardware device installed in the helmet and motorcycle is "Very Good".

Guide Questions	Mean	Std. Deviation	V.I.
Reliability	3.7000	.24595	Very good
Consistency	3.700	.4830	Very good
Accuracy	3.800	.4216	Very good
Error Tolerance	3.600	.5164	Very good

Table 7: Reliability

Table 7. Shows the mean and standard deviation of Reliability. Overall, the value interpretation of the hardware device installed in the helmet and motorcycle is "Very Good".

Guide Questions	Mean	Std. Deviation	V.I.
Testability	3.5333	.47661	Very good
Modularity	3.500	.8498	Very good
Simplicity	3.500	.7071	Very good
Audability	3.600	.6992	Very good
Overall	3.5333	.47661	Very good

Table 9. Shows the mean and standard deviation of Testability. Overall the value interpretation of the hardware device installed in the helmet and motorcycle is "Very Good".

Overall, the total mean of Hardware Evaluation (Quality Factors) is 3.533 with a total standard deviation of .47661. The Interpretation of overall result is "Very Good". The device satisfies the perception of the Technical Respondents. It means the Device produces accurate and actual result.

Guide Questions	Mean	Std. Deviation	V.I.
1. Does it perform all required tasks?	3.500	.8498	Very good
2. Does it has an efficient and fast response time?	3.400	.6992	Good
3. Does it sense breathe MQ3 and alcohol level accurately?	3.300	.9487	Good
4. Does it has an accurate analysis?	3.300	.9487	Good
5. Does it has a storage for BAC data?	3.500	.8498	Very good
6.Does IID accept Bluetooth Transmitted to Bluetooth Receiver to CU to ignite lock?	4.000	.0000	Very good
Overall	3.5000	.33333	Very good

Table 10. Usability

Table 10. Shows the mean and standard deviation of Usability. Overall, the value interpretation of the hardware device installed in the helmet and motorcycle is "Very Good".

Overall, the total mean of Hardware Acceptance (Usability) obtains 3.500 a total standard deviation of .3333. The Interpretation of overall result is "Very Good". The device satisfies the perception of Technical Respondents. It means that the device is accepted and feasible for implementation in the future.

11. Summary of Findings

The researcher developed an application entitled, Motosense - Intelligence Motorcycle Safety Automation with Breathe Alcohol Content (BAC) and Ignition Interlock Device (IID) which aims to innovate the technology of motorcycles in terms of alcohol detection. The developed system covers all the motorcycle types of four stroke or two stroke engines. The developed system consist of Four (4) major parts; (1.) The bluetooth transmitter and receiver which responsible for transmitting data from alcohol sensor and receiving the data coming from the sensor; (2.) The alcohol Sensor with Arduino device. The function of device is to detect alcohol fumes from the rider. (3.) The alcohol sensor or the Breathe Alcohol Sensor attached to the helmet and the arduino device process the data from sensor before transmission. 4.) The Ignition Interlock Device (IDD) attached to the motorcycle push button starter and ignition device. The device is the primarily responsible for locking the engine by using relay swithing device with logic gates. The study has been done in City of Malabon.

12. Conclusion

Based on the findings, the developed device, The Motosense – Intelligence Motorcycle Safety Automation with Breathe Alcohol Content is considered helpful for the Motorcycle Riders in terms of avoiding the use of motorcycle under the influence of alcohol. The developed device has the capacity to turn off the motorcycle if the rider is in the influence of alcohol. The device also reduce the number of accidents in the Philippines. The device can be implemented with the help of law enforcement units, especially by the Metropolitan Manila Development Authority, the Philippine National Police and the Land Transportation Authority.

12. Recommendation

The researcher found out that there are still functions that can be listed and implemented in the application in order to be fully utilized by the stakeholders. Based on the results of the evaluation, majority found the application to be helpful based on the perception of the respondents. The following are the suggested and recommended functions in the future development and improvement of the system:

1. The system should include the Short Messaging System to notify the relatives or the law enforcement units in case of accidents;

2. Add collision sensors to detect collision and to prevent the rider from collision;

3. Strict implementation of laws with the help of law enforcement units of this kind of device to prevent or reduce the accidents because of alcoholic intoxication.

4. Future implementation of device in other types of vehicles running in the major highways.

5. Possible implementation of proposed device in the public transport section.

13. References

MMDA. (2016). *Metro Manila Accident Recording and Analysis System*. Retrieved from archive.org: https://archive.org/details/MMARASAnnualReport2016

Robielos, R. (2012). *Assessment of Motorcycle Driving on the*. Retrieved from IEEE: http://ieeexplore.ieee.org/document/6299578/

Sy, K. (2017, April 12). *IN NUMBERS: Road crash incidents in the Philippines*. Retrieved from Rappler: https://www.rappler.com/move-ph/issues/road-safety/166151-road-crashes-philippines-awareness-safety