

DISTANCE WARNING DEVICE FOR MOTORCYCLE

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ABSTRACT

This research study mainly aimed to develop a distance warning device which works as a warning system for motorcycles. The device utilizes an ultrasonic sensor which serves as detecting device of the object in front. It can notify the driver using sound and light indicator when it reaches the distance covered in order to take immediate action.

This research study made use of a project development method. It also employed the descriptive research method, specifically, the evaluative research design.

The constructed device was evaluated by electronics technology experts and end-users who drive a motorcycle. They evaluated the device regarding its usefulness and effectiveness (functionality and reliability). To described the quality of the device, it was treated statistically by the use of mean.

The findings of the study reveal an "Excellent" overall descriptive rating on the quality of the distance warning device for motorcycles. This finding implies that the device is useful and effective to use for motorcycle driving.

Based on the findings, a conclusion about the device was formulated: The distance warning device for a motorcycle is useful, functional and reliable to use in order to assist the driver for his/her safety.

The following recommendations are forwarded: (1) Although the device was rated excellent quality, further improvement should be considered like replacing the proximity sensor to cover a long range distance; the device should encase in a water proof box; the sound should have chime that is comfortable to hear, and other features to be integrated like speed limiter of the motorcycle. (2) Motorcycle drivers should be encouraged to utilize the constructed device as assistance in driving to prevent a collision. (3) The device should also be installed to a four-wheeled vehicle to test its effectiveness.

INTRODUCTION

Background of the Study

The power of innovation has brought things better than its purpose before. With these creative innovations, human problems are resolved with ease. In particular, innovations brought by technology has carried out man's life hacks in every aspect from households, communication, and up to the transportation system.

Over the years, technology advanced to great heights which made human life more comfortable through easier and faster tasks accomplished than in the past. For instance, transportation significantly improved by cutting travel time from days into hours and minutes. Manufacturers continuously develop and innovate accessories for vehicles to make life more convenient and at pace with the fast demands of everyday

living. It could be said that life would not have been this wonderful world without technology.

Transportation technology can become disastrous especially with fast and irresponsible driving. In 2016, the statistics provided by the Philippine National Police-High Patrol Group (PNP-HPG) records 32,369 reported road crashes of vehicles in the whole country resulting in 549 deaths. Based on the police data, speeding, distance, and wrong overtaking are the most cause of road accidents. The vehicles involved are motorcycle 53%, pedestrians 19%, drivers of vehicles with four wheels or more 25%, cyclist 2% and others 1%. In this case, the motorcycles account for a big chunk of road accidents and tend to be the most vulnerable resulting to death. However, this is a partial report on road crash incidents in the country (Ager, 2016).

Every rider must account for a safe distance of the vehicle in front. This could not be avoided by riders especially during the rush or peak hours of the roads. The drivers could not easily stop their moving vehicle considering the close distance during traffic. Although there are now cities enforcing the use of safety gears, these could not completely protect riders from fatal collisions.

New vehicles nowadays have installed a device that assists in their safety, but some people prefer to use a motorcycle and old car because of its cheap maintenance cost. There are already accessories available on the market for safety assistance, but drivers are hesitant if these are cost efficient. These kinds of vehicle are more prone to commit accidents and would lead to fatal injuries. It is not enough for a driver to be defensive in driving in order to avoid accidents. There should be a reliable device to be installed in a vehicle to assist the driver for their safety.

To address the above-mentioned problems, the researcher thought of creating a distance warning device for motorcycles that could provide safety assistance to avoid accidents. This device could notify the distance of the rider to an object in front to prevent a collision. It is also an important device especially when a vehicle is turning in a cross-sectional area of the road or a blind spot area. It also considered usefulness when driving at night because the area illuminated by the headlight is not visible.

This research project is an innovation for the motorcycle drivers for safe travel. Furthermore, the advantage of the said device is its portability. It can be easily installed in any kind of vehicle because of its small size. Also, it requires only a low voltage supply. The researcher expects this device to prevent future motorcycle collision which will eventually lessen road accidents. It is further expected that after the device is improved, it will also be installed for to all types of vehicle for safety driving.

Statement of the Problem

This study aimed to design, develop, and evaluate the performance of distance warning device for a motorcycle.

Specifically, it sought to answer the following questions:

1. What are the steps/procedure in constructing and assembling the distance warning device for a motorcycle?
2. What is the performance of the device regarding the covered distance for the warning feature?
3. What is the quality of the device regarding the following criteria:
 - a. Usefulness
 - b. Effectiveness
 - b.1 Functionality
 - b.2 Reliability

Related Works and Studies

The following concepts are tools used by the researcher to construct the device.

On the Arduino Uno.

The Arduino Uno is a microcontroller board based and an open-source electronics platform based on easy-to-use hardware and software. Arduino boards can read inputs in order to; light on a sensor, a tweeter message, or a finger on a button and turn it into output like activating a motor, turning on a LED, publishing something online. Because of this features of Arduino, the researcher bears up of how to impose this outstanding feature so that it may be used as a switching device to lights on the ultrasonic sensor to detect the distance from the object in front. This nice idea inspired the researcher to incorporate this device to a distance meter or collision alarm. (<http://www.arduino.cc/en/Guide/ArduinoUno>)

On the Ultrasonic HC-SR04 Module.

The Ultrasonic HC-SR04 Module is a sensor ranging module that provides 2cm-400cm of non-contact measurement. This module includes ultrasonic transmitters, receiver and control circuit. The HC-SR04 module will operate using the Arduino uno to provide 10us high level signal and automatically sends eight 40 khz and sense whether there is a pulse signal back. In connection to this research study, since the device under study has a feature of detecting distance in an object in front, the researcher will use this as the sensor of the device under study for an accurate distance measuring to achieve the main feature of the device under study (<http://www.sainsmart.com/products/ultrasonic-ranging-detector-mod-hc-sr04-distance-sensor>).

On the TDA2003 Integrated Circuit.

The TDA2003 IC are electronically components that commonly used in car radio audio amplifier. The integrated circuit provides high output current capability (up to 3.5A). It can deliver 10W to a 4 ohms' load at 18V DC supply voltage. It can also be operated 12V and makes it applicable in car audio systems. The useful features include short circuit protection between all pins, thermal overload protection, low harmonic distortion, a low cross over distortion. (<http://www.circuitstoday.com/10w-amplifier-using-tda2003>)

In connection to the device under study, since the device has an alarm feature when a danger distance reached, the researcher will employ an amplifier circuit to modulate the sounds of the alarm. The amplifier increases the strength of electric signals in order to create a louder sound in the alarm of the device.

Conceptual Framework

The construction of the distance warning device proceeded through the following paradigm. The input includes the different materials used in the construction of the device. Other inputs of the study were the different tools and equipment needed. The process includes the overall quality of the device based on the evaluation of the experts and end-users. Moreover, the output includes the constructed distance warning device for motorcycles.

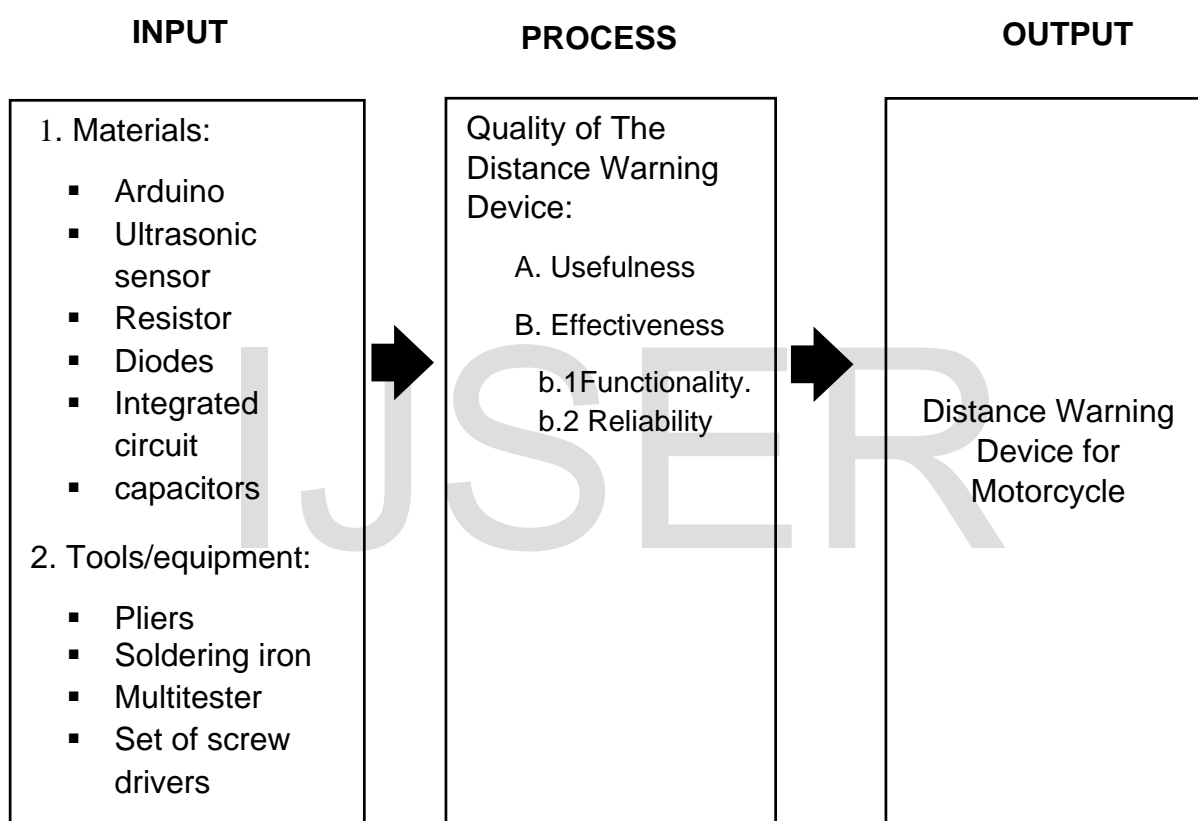


Figure 1. The Research Paradigm

RESEARCH METHODOLOGY

This study made use of Project Development Method of research. In constructing the device, the following process was made. This device will utilize an ultrasonic sensor as the sensing component of the device. This ultrasonic sensor will be connected to the Arduino uno as microcontroller of the system. The ultrasonic sensor will activate the Arduino of the device to sense the object in front. A set of codes will be programmed to the Arduino uno to control the ultrasonic sensor in generating ultrasonic sound. A row of the light emitting diode was connected to the Arduino as a distance indicator. This indicator consists of 6 light-emitting diodes. Every light emitting diode has its calibrated distance to measure. An alarm will be

incorporated to the device to notify the driver. The alarm consists of speaker, amplifier, and the switching circuitry. The 12 volts' battery of the motorcycle will be connected to power up the device. Below is the block diagram of the device.

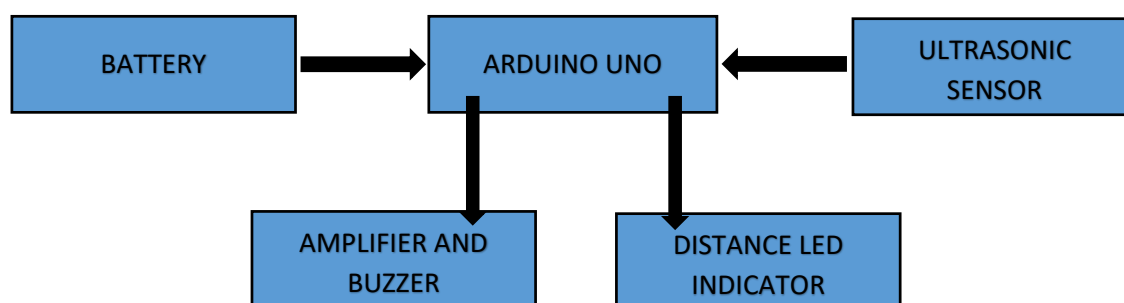


Figure 2. The block diagram of Distance Warning Device

As illustrated in the figure above, the constructed device will power up by the battery, giving a signal from the proximity sensor to detect an object in front. The device module will trigger the output devices (buzzer and distance LED indicator) to operate when the proximity sensor detects an object in front.

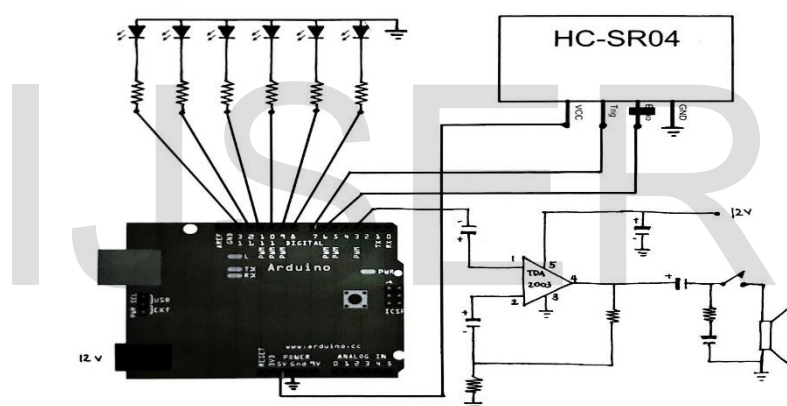


Figure 3. The schematic diagram of Distance Warning Device

From figure 3, it shows the proper connection of wires of the ultrasonic sensor, amplifier; distance LED indicator and the Arduino uno. The Arduino board is supplied by a 12v battery, and that will drive the circuit connected to it in order to perform its function.

RESULT AND DISCUSSION

The following are the answers addressed to each of the problems raised in the study.

Problem 1. What are the steps/procedure in constructing and assembling the distance warning device for a motorcycle?

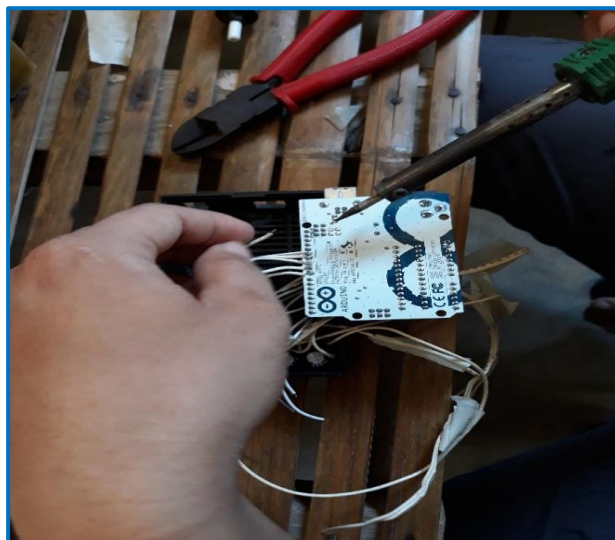
The following pictures present the steps/procedures in assembling the distance warning device for a motorcycle.

A. Design the schematic diagram of the device.



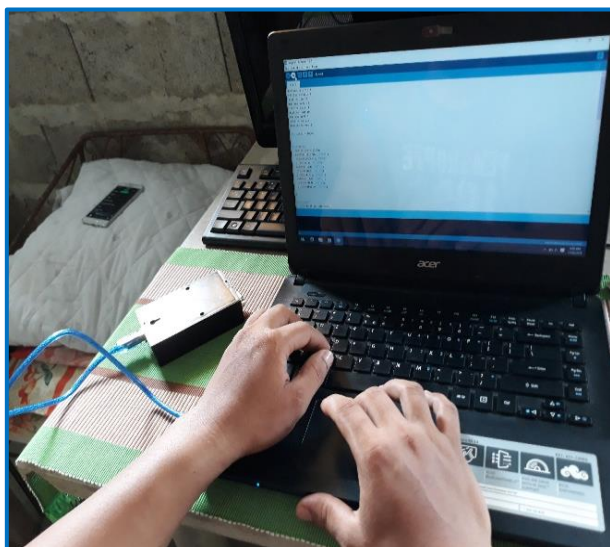
Design the schematic diagram of the device by consolidating the different circuits needed in the construction of the device considering each function. This schematic diagram served as the guide of the researcher in constructing the device.

B. Construct the device.



In the construction of the device, it includes the etching of CCB, soldering and mounting the components, and fabrication of the boxes for different circuits for isolation.

C. Formulate and Upload the program of the device.



In order to operate the device, a set of codes will be formulated by the use of IDE software from the computer. The codes will be uploaded to the Arduino board by connecting USB cable in the computer.

The Distance Warning Device for Motorcycle



The finished product of distance warning device consists of an ultrasonic sensor, Arduino uno, rows of LED, buzzer, switches, and fabricated cables. This device is ready to install in any motorcycle.

D. Install the Distance Warning Device in the motorcycle.








The device was installed in SZ Yamaha motorcycle for testing. The ultrasonic sensor was placed in front of the motorcycle for distance detection, and the rows of LED was placed in the dash board of the motorcycle for distance monitoring. The main circuit was placed under the seat of the motorcycle for water protection.

Problem 2. What is the performance of the device regarding the covered distance for the warning feature?

Table 1

Performance of the device regarding the covered distance for the warning feature of the device

LED INDICATOR	COVERED DISTANCE (cm)
	400
	350
	300
	250
	200

	150
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Based on the table above, the distance covered of the device is from a minimum of 150 centimeters up to the maximum of 400 centimeters. The light emitting diode will light, and a buzzer will sound when the calibrated distance is reached. This distance measurement shows that the rows of the light emitting diode will increase the light if the object is coming near and the light decreases if the object in front is keeping away. In that case, the driver should already take an immediate action to avoid a collision, if and when an unexpected sudden stopped may happen. The device will also notify the driver from a blind spot crossing area of the road and provide the distance using the rows of the light emitting diode. This data implies that the device can notify the driver to the distance of an object in front for a maximum of 400 centimeters covered distance. It further implies that the uploaded program on the device is accurate to the output of the device.

Problem 3. What is the quality of the device regarding the following criteria:

- a. Usefulness
- b. Effectiveness
 - b.1 Functionality
 - b.2 Reliability

Table 2

The assessment of the Experts and End-users on the Quality of the Distance Warning Device in terms of its usefulness.

Usefulness	Experts		End-users		Overall	
	\bar{x}	DR	\bar{x}	DR	\bar{x}	DR
1. The device can be used as a warning device to avoid a collision.	4.80	E	4.80	E	4.80	E
2. The device minimizes vehicular accidents, especially for motorcycles	4.70	E	4.30	E	4.50	E
3. The device meets user needs for their safety.	4.70	E	4.70	E	4.70	E
4. The device beautifies the motorcycle-as an additional feature and accessory	4.80	E	4.60	E	4.70	E
5. The device can be used to measure a distance of an object in front	4.80	E	4.70	E	4.75	E
Mean	4.76	E	4.62	E	4.69	E

Legend:
 4.21 - 5.00 Excellent (E)
 3.41 - 4.20 Very Good (VG)
 2.61 - 3.40 Good (G)
 1.81 - 2.60 Poor (P)
 1.00 - 1.80 Very Poor (VP)

Based on the above table, the device is “Excellent” in its usefulness as reflected by the mean of 4.76 on the evaluation of experts. Further, all the indicators in the criteria of usefulness were rated excellent. This implies that the expert in electronics technology finds the constructed device to be highly useful in the transportation system as a distance warning device for a motorcycle to avoid a collision. Due to the characteristics and feature of the device, experts also remarked that the device has potential use in minimizing the road accidents and lessens traffic due to vehicular accidents, especially for motorcycles. Even though the device was rated excellent by the expert regarding its usefulness, there is still a part to improve in the device to become completely excellent from the given standard. The item no. 1 and no. 2 which are rated lowest should be addressed by improving the device like adding the feature that could totally avoid a collision.

On the other hand, the end-user evaluation of the constructed device was revealed by the computed mean that the device is very useful. The end-user which are a driver of motorcycle finds that the device is very useful for driving. This indicates that the device can assist the driver for their safety. Moreover, with this device, the end-user meets their needs for their safety. Although the device was rated excellent ($\bar{x} = 4.62$) there is still much improvement in the device. There should also other feature of the device that minimizes accidents as it was rated lowest in the item no. 2 along usefulness.

In general, the overall mean rating of the constructed device along its usefulness yielded excellent with a mean of 4.69. Though it was rated excellent, there is still a lot to improve in some part of the device like adding a feature that avoids a collision in order to convince experts and end-users to rate the device completely excellent.

Table 3

The assessment of the Experts and End-users on the Quality of the Distance Warning Device regarding its effectiveness (functionality and reliability).

INDICATORS ALONG EFFECTIVENESS	Experts		End-users		Overall	
	\bar{x}	DR	\bar{x}	DR	\bar{x}	DR
A. Functionality						
1. The device was able to detect objects at a certain distance.	4.90	E	4.90	E	4.90	E
2. The device produces enough sound/siren to notify the rider.	4.80	E	4.50	E	4.65	E
3. The device is cost effective	4.60	E	4.50	E	4.55	E
4. The device is functional anytime.	4.70	E	4.50	E	4.60	E
5. The device does not modify the original set up of the motorcycle, especially the electromechanical parts.	4.70	E	4.40	E	4.55	E
Mean	4.74	E	4.56	E	4.65	E
B. Reliability						
1. The device may last for a considerable period.	4.60	E	4.70	E	4.65	E

2. The device is durable and serves its purpose quick and easy	4.60	E	4.60	E	4.60	E
3. The device is user-friendly. It is compatible with any motorcycle unit.	4.90	E	4.80	E	4.85	E
4. The device incorporates consistency of performance	4.90	E	4.70	E	4.80	E
5. The device consumes low power to operate.	4.90	E	4.90	E	4.90	E
Mean	4.78	E	4.74	E	4.76	E
Grand-Mean	4.76	E	4.65	E	4.70	E

Legend:

4.21 - 5.00	Excellent (E)
3.41 - 4.20	Very Good (VG)
2.61 - 3.40	Good (G)
1.81 - 2.60	Poor (P)
1.00 - 1.80	Very Poor (VP)

The experts rated the device as “excellent” regarding its effectiveness along functionality. The expert evaluators find the device to be functional as it gives warning to the driver when a distance of an object in front is already near. They also remarked the device to provide distance to the object in front by the rows of the light emitting diode. The evaluator gave the lowest rate in the item “The device is cost effective” because as of now there is no commercial device that has the same concept intended for a motorcycle with the device constructed. However, the rating of 4.74 further implies that the device still needs improvement. The device should have been used a wide and long-range sensor for highway purposes. Although the device has enough sound, a chime should be made in the sound of the device to hear comfortably.

On the other hand, the end-users’ evaluation regarding its effectiveness along functionality earned a total mean of 4.56. This implies that the constructed device is functional as it can notify drivers for their safety. However, the device still needs to be improved to some items that were rated lowest by the end-user. The device should have already a holder intended for any kind of vehicle in order to address the item no. five along functionality on the evaluation of the end-users.

The overall rating of the constructed device by the experts and end-users was yielded excellent with a mean of 4.65. This implies that the group of evaluators find the constructed device as functional. However, it also implies that the group of evaluators wants something to improve in the device from the given standard for it to be completely excellent.

The device was also rated “Excellent” along reliability with a mean of 4.78 by the experts. This implies that the device constructed is reliable to be used as a warning device for distance. However, there is still a lot to improve in the device in its durability. The device should have been encased in a more durable material and water resistant for it to be completely reliable. The device was also rated excellent with the mean of 4.74 along reliability. The end-user finds that the device is reliable to use as a warning device for a motorcycle as it does not affect the operation of the motorcycle because it only consumes a low power to operate.

Taken as a whole, the grand mean on the indicators of effectiveness shows that the experts rated the functionality and reliability ($\bar{x} = 4.76$) “Excellent.” The grand mean rating of the end-users regarding functionality and reliability was also rated

excellent with a mean of 4.65. The experts have the highest evaluation on the device constructed. This implies that experts are more technically knowledgeable in rating the quality of the device. Even though end-users rated the lowest regarding the device effectiveness it was consistently rated excellent ($\bar{x} = 4.70$) with the combined evaluation of experts and end-users.

FINDINGS

This research study came out with the following salient findings:

1. The procedure in constructing/assembling the device.

There are four (4) general procedures to be followed in constructing the device; these are as follows:

- a. Design the schematic diagram,
- b. Construct the device based on the schematic diagram
- c. Write a program in the IDE software and Upload the program in the device
- d. Install the device in the motorcycle for testing

2. Performance of the device regarding the covered distance for the warning feature of the device.

The distance covered of the device is from a minimum of 150 centimeters up to the maximum of 400 centimeters. The light emitting diode will light, and a buzzer will sound when the calibrated distance is reached. This shows that the rows of light emitting diode will increase the light if the object is coming near and the light decreases if the object in front keeping away. In that case, the driver should already take an immediate action to avoid collision, if and when an unexpected sudden stopped may happen. The device will also notify the driver from a blind spot crossing area of the road and provide the distance using the rows of the light emitting diode. This implies that the device can notify the driver to the distance of an object in front for a maximum of 400 centimeters covered distance. It further implies that the uploaded program on the device is accurate to the output of the device.

3. The evaluation on the quality of the device regarding usefulness and effectiveness (functionality and reliability).

The device was consistently rated "Excellent" ($\bar{x} = 4.76$) by the experts regarding its usefulness and effectiveness (functionality and reliability). The expert finds the device useful and reliable as they highly rate in every indicator of the criteria. Though it was consistently rated excellent; there is still a part to improve specially to its functionality as it was rated the lowest.

On the other hand, the evaluation of the end-user resulted in an overall score of "Excellent" with a mean of 4.64. However, some of the indicators was rated low because end-users are not technically knowledgeable to appreciate some indicators of the device rating scale.

Nevertheless, the overall rating of the device constructed was described excellent with the combined evaluation of experts and end-user. This implies that the device is highly acceptable and can be used as a warning device for a motorcycle rider to assist for their safety in order to avoid accidents due to a collision.

CONCLUSION

Based on the findings presented, below is the conclusion of the device.

The constructed distance warning device is useful, functional and reliable to use for a motorcycle in order to avoid a collision. Though the device was rated excellent with a grand mean of 4.7, it further implies that there is still to improve the device from the given standard.

RECOMMENDATIONS

Relative to the findings and conclusions made in the study, the following recommendations are forwarded.

1. Although the device was rated excellent quality, further improvement should be considered like replacing the proximity sensor to cover a long-range distance; the device should encase in a water proof box; the sound should have a chime that is comfortable to hear, and other features to be integrated like speed limiter of the motorcycle.
2. Motorcycle drivers should be encouraged to utilize the constructed device as assistance in driving to prevent a collision.
3. The device should be installed to a four-wheeled vehicle to test its effectiveness.

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