INTELLIGENT RAILWAY SAFETY DETECTION DEVICE AT RAILWAY PLATFORM

Sunitha V. Doraisamy[1] and Izwah Ismail[2]

[1,2]Politeknik Ungku Omar, Malaysia
[1]suni7624@yahoo.com
[2]izwahismail@gmail.com

Abstract: Railway stations are often linked with accidents and have safety issues at the track or platform edge. The number of passengers usually rises during the peak hours which causes the railway platform to be packed and crowded. People with disabilities who use commuter as their basic mode of transport are also at risk for accidents at the platform edge. To prevent any accidents or hazards from happening, an improvement method was identified to improvise the safety at the railway platform. The objective of this study is to develop a detection device which is able to alert passengers at the platform edge of the railway station. Once the prototype of the intended device was developed, it is further validated with experts. The study has led to the development of a railway safety detection device which uses a type of sensor called ultrasonic sensor. The instruments used to develop the sensor are Arduino UNO R3, male to male dupont cable, buzzer, LED light, USB cable, breadboard, 220K ohm resistor and battery connector. The end result shows that the desired objectives for this study has been achieved. The development of this railway safety detection device contributes towards the safety at the platform edge of the railway station. Such device gives more safety awareness to public where this is able to reduce accidents.

Keywords*: platform edge; commuter; detection device; Arduino*

1. Introduction

The rail transport system in Malaysian includes the monorail transport network, light rail transit (LRT) and commuter train (KTM) which provides routes to travel within a metropolitan area, connecting commuters to a central city from adjacent suburbs or commuter towns (Ahmed et al., 2016). Generally, commuter rail systems are considered heavy rail, using electrified or diesel trains. KTM commuter is a S-train, commuter rail system in Malaysia operated by Keretapi Tanah Melayu (KTM). It was introduced in 1995 to provide local rail services in Kuala Lumpur and the surrounding Klang Valley suburban areas. Services were later expanded to other parts of Malaysia with the introduction of the Northern and Southern sectors. KTMB accepts many commuter users to this date (Ahmed et al., 2016). The number of passengers usually rises at peak hours resulting to crowded situations at the railway platform. People with disabilities also tend to use the commuter as their basic mode of transport. The overcrowding of commuter users at the railways platform contributes towards the risk of accidents to happen (Hirsch et al., 2018). This is mainly due to the overstepping of the yellow safety line at the

platform. Therefore, as a solution, railway safety detection device is developed for the safety at the platform edge and in the commuter coach (Lawson, 2015).

The yellow safety line or also known as tactile paving at the platform edge was first developed by a Japanese engineer and inventor in 1967 (Bosso, 2018). Following a few years later, the tactile paving was highly used in all countries. Tactile paving is classified into two types. One type has small, round bumps upon the surface of the block, which could be felt through the sole, meanwhile the second type is a directional aid with long slender bumps that are being installed on the surface (Yamada, 2014). The tactile that is usually used for platform edge is offset blister tactile which known as platform edge warning surface (Hamid, 2015).

Over the past years, the number of commuter passengers have rised which substantially have led to the overcrowding at the railway platform (Hunter-Zaworski, 2017). This situation effects the safety of the people where they tend to ignore the safety line at the railway platform. The current safety measure instilled at the railway platform is a yellow safety line situated 1 metre from the platform edge. When people tend to overstep the safety yellow line it is not easy to detect and alert them especially when the platform is overcrowded with people. Any alert regarding the overstepping of the yellow safety line is made through an announcement using the PA system by the railway workers who observes through a booth which seems to be ineffective. This definitely does not help either for people with hearing and visual impairment. This situation is hazardous to commuter passengers waiting to commute the train at the railway platform as this sort of situation is able to cause accidents at any time (Coffey, 2018) due to the lack of awareness and disregard on the existence of the yellow safety line at the platform edge.

2. Materials and Methods

In this study, the methodological process that was carried out were the system study, problem identification, design, model development, testing prototype and improvisation of the ultrasonic sensor that is to be installed at the platform edge. This process led towards achieving the aim of the study which is to develop a detection device that alerts passengers at the platform edge of the railway station.

A detailed study was conducted on the existing warning sign for safety that is tactile paving at the platform edge. The tactile paving is analysed to know how far it is helpful in giving clear sign to the passengers at the railway platform. The issues surrounding the platform edge of the train station was identified in order to find solutions. The best method that was though off was innovating an intelligent safety device at the railway platform to overcome and as well as increase the level of safety and awareness among passengers waiting at the platform edge.

The prototype design of the intelligent railway safety detection device was made by using the AutoCadd application. Figure 1 shows the sketching of the ultrasonic sensor circuit that was later developed.

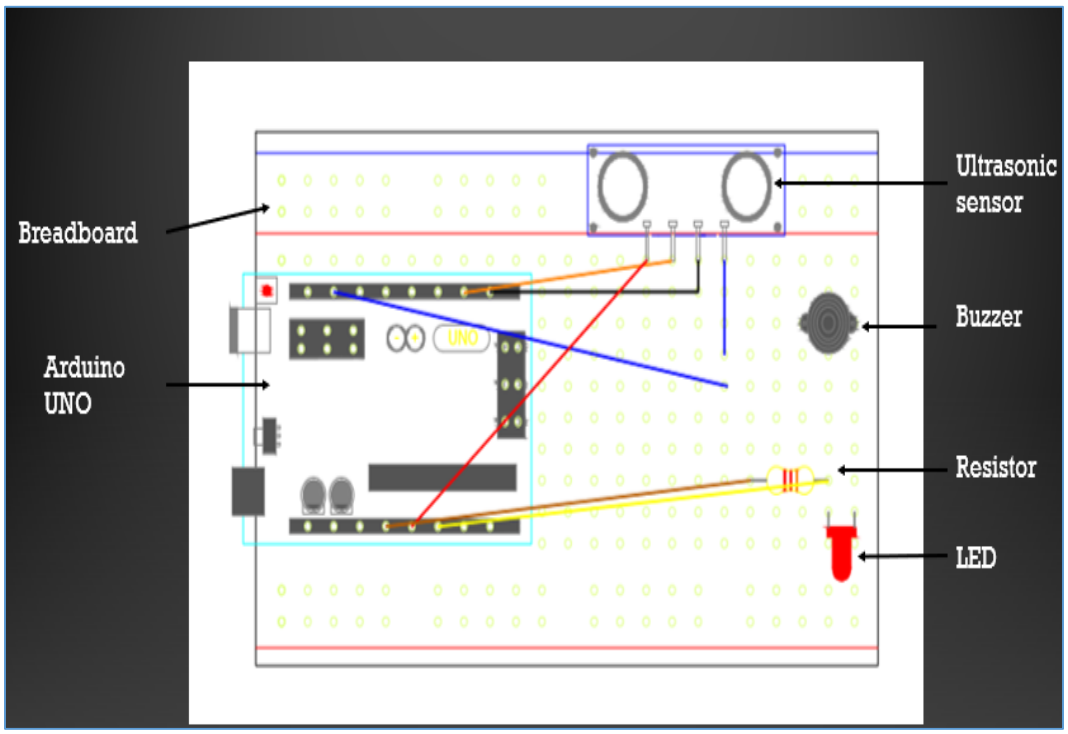

Figure 1. Ultrasonic Sensor Circuit.

Instruments applied for the development of the Railway Safety Detection Device are ultrasonic sensor, Arduino Uno R3, Breadboard, USB Cable Type A/B, Resistor, LED Light, Buzzer and Male to Male Dupont Cable.

For the testing of the prototype, the ultrasonic sensor was switched on to test the yellow line at the platform edge. The installed ultrasonic sensor device works by detecting the situation where it produces lights that blink through the installation of LED and as well as noise through the installation of buzzer, which is an immediate warning to the passengers who crosses over the safety yellow line at the railway platform.

Once the test-run was completed, the prototype was validated by the experts from *Keretapi Tanah Melayu Berhad* (KTMB). Based on the outcome of the validation by the experts from KTMB, the function of the prototype towards enhancing the safety level and as well as the level of awareness was mostly agreeable by them. Their advice and guidance on the part of improvisation of the innovation was further given by them which is discussed in the conclusion and recommendation section.

3. Results and Discussion

The effectiveness of this study is to ascertain whether a security system that uses ultrasonic sensors is effective in improving the safety level at the platform edge. In addition, safety systems are influenced by several factors such as passenger capacity, physical characteristics of passengers, type of devices and physical features of the commuter itself. An ultrasonic sensor is chosen to for this innovation due to its' many advantages. The ultrasonic sensor contains high frequency and high sensitivity level which means its' ability to detect external or deep

objects easily. It also has greater accuracy level compared to the other types of sensors (Baldwin, 2011). They are also convenient to use and are not harmful when using during the operation of the sensor for nearby objects, person, equipment and as well as materials. An obstruction detection system for a vehicle generally employs sensors such as ultrasonic sensors mounted on the vehicle body for detecting surrounding obstacles using ultrasonic waves. Conventionally, the ultrasonic sensors transmit sound waves around the vehicle and sense an obstacle through waves reflected by the obstacle (Erick, 2014). Figure 2 shows the current position of the yellow safety line at the railway platform.

Figure 2. The Yellow Safety Line (KTM Rawang, 2019)

Figure 3 shows the proposed situation on how the sensor is installed at the yellow line with the distance of 1 meter from the railway track.

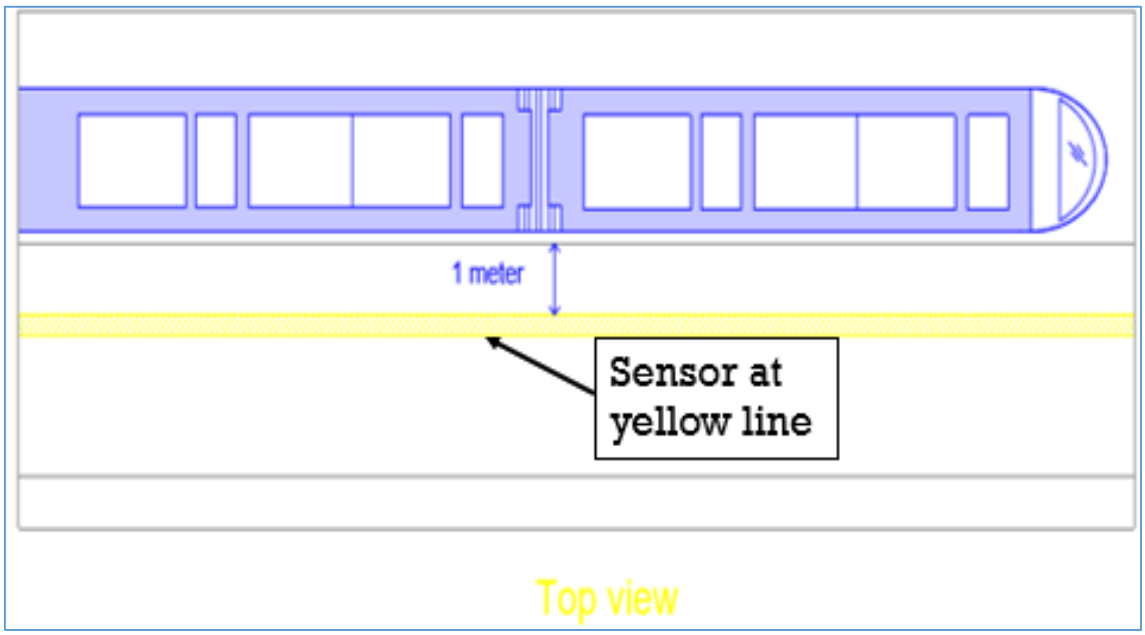

Figure 3. Top view of sensor at yellow line

As a result of the study, there are various things that was learnt, such as information and knowledge regarding the railway system, the length and width of yellow line at platform edge, the current safety measures at the platform edge, current issues that related to railway system and methods to resolve the problem/issue that occurs at the railway station.

In terms of knowledge and learning, the knowledge gained is about the various components of the material used to make the Arduino, which is the detection device and the methods and process to make the Arduino's coding so that the detection device is able to work successfully. The detection device development contributes to the use of KTM authorities. The detection device developed for the platform edge contributes to the public, especially those who are visually and as well hearing impaired, where the device is equipped with LED and buzzer sound. Here, the device works for the visually impaired people with the buzzer sound, while those with hearing impairment are alerted with the LED light. Figure 4 shows the completed railway safety detection device prototype which functioned successfully after several trials.

Figure 4. The developed railway safety detection device prototype

This study at the end found the railway safety detection device developed for the platform edge at the railway station is effective and important. This is because the development of the railway safety detection device helps to ensure the safety at the platform edge of the railway station. With this, the accident at platform edge's rate could be controlled and reduced. The passengers could be more aware and alert on the safety at the platform edge when they are waiting for the arrival of the train.

However, there were some recommendations from the experts in KTMB Ipoh after the intelligent railway safety detection device was validated by them. It is suggested that the intelligent railway safety detection device should be added with a voice over announcement right after the buzzer goes off detecting cross over the safety yellow line. It is also suggested that the device should be specially alerted to KTM staff so that they staff are able to receive the information that happens at the platform edge. This enables the situation at the platform edge to be more secured and controlled.

4. Conclusion

As a conclusion, the development of the intelligent railway safety detection device at railway platform have been educational as where the civil engineering knowledge was applied and played an important role towards developing the safety railway detection device. The objectives of this study are achieved, where firstly, to design an intelligent railway safety detection device at the platform edge, secondly to develop it. Both of the objectives were successful because the detection device that was developed works well as planned. The last objective was also successfully achieved where the detection device was validated with experts from KTM.

Overall, the railway safety detection device contributes to the transportation field, especially the railway system. It is hoped through this innovative study and idea could be an effort towards improvising the safety and awareness level at the railway platform.

Acknowledgments

The author would like to convey her gratitude to experts from KTMB, Perak, Malaysia, for their support, guidance and advice throughout this study.

References

Ahmed, M.M et al., (2016). A New Approach to Solve Transportation Problems. *Open Journal of Optimization*. DOI: 10.4236/ojop.2016.51003. No. 5, pp. 22-30, 4th March, 2016.

Baldwin, D.E, (2011). Priority Claims and Cross-Reference. *Vehicle Detection and Compass Applica tions using AMR Magnetic Sensors*,pp. 29.

Bosso, N. et al., (2018). Design and Simulation of a Railway Vehicle for the Transport of People with Reduced Mobility. *Department of Mechanical and Aerospace Engineering, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Torino, Italy*, pp. 14.

Coffey H (2018). One in Four Disabled People Don't Use Public Transport Due to Negative Attitudes from Other Passengers, New Research Finds. (Independent) Retrieved April 25, 2020, from https://www.independent.co.uk/travel/news-and-advice/uk-disabledtravel-accessibi.

Erick, M. L. (2014). Method and system for compensation of ultrasonic sensor. *Ford Global Technologies* , pp. 6.

Hamid, N. A. et al., (2015). Safety and Security Need of Commuter Rail Service. *Journal of the Eastern Asia Society for Transportation Studie.* Vol. 11, pp. 2-12.

Hirsch, J.A. et al., (2018). Impact of New Rapid Transit on Physical Activity: A Meta Analysis. Elsevier. https://doi.org/10.1016/j.pmedr.2018.03.008. Vol. 10, pp. 184-190, June 2018.

Hunter-Zaworski, K. (2017). Analysis of Passenger Incident Data from 5 Railway Transit System School of Civil and Construction Engineering, Oregon State University, Corvallis, OR 97331, USA. https://doi.org/10.3390/safety3030021. No. 3, vol. 3, pp. 21. 12th. September, 2017.

Lawson, N. (2015). Step change: Network Rail's Neal Lawson talks platform safety https://www.railway-technology.com/features/featurestep-change-network-rails-neal-lawson-talks-platform-train-interface-strategy-4557886/. 27th April, 2015. (Retrieved on the 25th. August, 2019).

Yamada, (2014). Safety Performance Measures for Railway Stations. Transportation Research Board 93rd. Annual Meeting, Washington DC. No. 14-1868. 27th January, 2014.