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Smart Pedestrian Crossing System in Campus with the Internet of Thing

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Abstract: In Malaysia, there have been few attempts to develop a pedestrian road crossing system focusing on disabled people. The objective of this project is to design a system for pedestrian crossing using the Internet of Things (IoT). It is another sort of crosswalk utilizing sensors to guard pedestrians while crossing. Therefore, a smart pedestrian crossing should be developed especially for disabled people. A pedestrian crossing, often known as a crosswalk, is an area where pedestrians can cross a road, street, or avenue. The PIR sensor will act as a motion detector to detect any motion from vehicles and pedestrians at the crossing site. The LCD and the alarm systems are capable of giving signals to both users of the crossing site. The prototype is capable of detecting the motion of both vehicles and pedestrians. The alert system is very important for the drivers as well as the pedestrians to be aware of the surrounding condition. In conclusion, the prototype of Smart Pedestrian Crossing in Campus with IoT has been successfully developed and validated. This project is proposed to provide a safe area for pedestrians, especially for disabled people to cross the road with minimal dependence on manpower.

Keywords: Pedestrian Crossing, Disabled People, Internet of Things (IoT)

1. Introduction

Pedestrian crossings are commonly found at crossroads and other spots on major highways and are regarded to reduce road traffic congestion. However, there are high possibilities that, when crossing the road or using crossing facilities, the pedestrians are always in danger [1], either due to the pedestrians themselves being inebriated, or the car driver is driving too fast without regard for other people's safety [2].

In Malaysia, there have been few attempts to develop a pedestrian road crossing system, especially focusing on disabled people. For example, in the campus area, such as in Universiti Tun Hussein Onn

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Malaysia (UTHM), when the number of vehicles is high on the road, few problems may exist for a pedestrian to cross the road safely [3]. The university may provide a painted crosswalk for pedestrians. However, the driver may not realize this, especially if the lines are fading or if there is no pedestrian warning sign. Hence, the project aimed to design a prototype for a smart pedestrian crossing system on campus using the Internet of Things (IoT) in order to provide a safer environment for pedestrians including disabled people (i.e., blind and deaf) [4].

The objectives of the project are to design a smart pedestrian crossing warning system in the campus area, integrate the pedestrian crossing warning system with IoT, and analyse a system that incorporates the concept of smart sensing to detect the presence of pedestrians and in turn, automatically controls the crosswalk traffic.

The designed system guides the blind disabled people by the sound released by the buzzer while the deaf disabled people are guided by the LED light and the LCD display. The captured data from the vehicle that has a speed of more than 30 cm/min which include the image of the vehicle, timestamp and location, will be stored in the Blynk cloud for monitoring purpose by the related UTHM officer.

2. Materials and Methods

The design system is made up of several units, each of which includes an Arduino Mega Microcontroller, Passive Infra-red Sensor (PIR sensor), relay module, red and green LED to represent vehicle/pedestrian warning lights, and 16x2 Liquid Crystal Display (LCD) as depicted in Figure 1. For easier testing and handling, a mechanical manual switch is added to the power source circuit. The IoT is utilized to upload the captured photos to Blynk cloud storage.

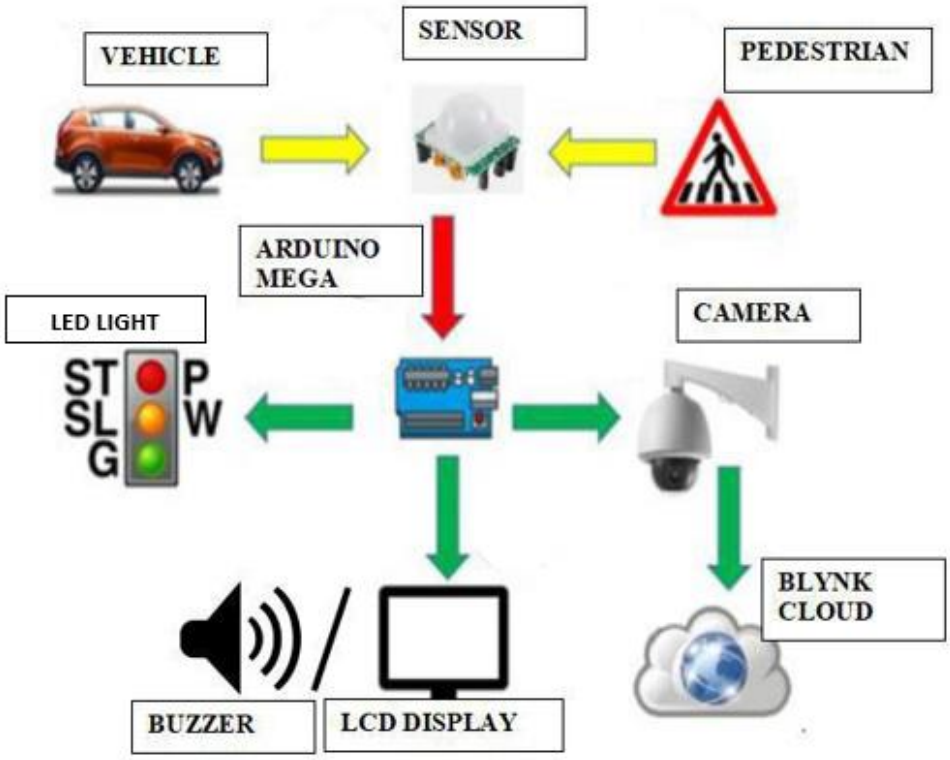

Figure 1: Block diagram of the proposed system

The PIR sensors have been used to detect any pedestrian or vehicle that drives through the crossing. The Arduino Mega receives the signal from the PIR sensor and activates the LCD display to alert both pedestrians and drivers. On the pedestrian side, the LCD displays a text as “Careful, Vehicle Is Approaching”. While on the driver’s side, the LCD displays a text as “Careful, Student Crossing”. The

buzzer turns on indicating the pedestrian can cross safely. The LED light turns green for pedestrians and red for drivers. If the IR sensors detect the speed of a vehicle above 30 cm/min, the microcontroller generates a signal to the camera to capture the vehicle image along with the time stamp and location of the violation. The captured data are uploaded and stored in the cloud using Blynk for the use of the UTHM officer.

3. Results and Discussion

This section analyses and discusses the results obtained from the project works. The developed prototype is completed and its functionality has been fully tested which strives to achieve the main objective of the work

3.1 Motion Detection

Table 1 shows the status of the PIR sensor used in this project. It is used to detect any vehicle approaching the crossing site.

Table 1: PIR Sensor Detection Status

Distance from sensor (cm)	Sensor	Alarm	LCD
15	**ON**	**ON**	**ON**
20	**ON**	**ON**	**ON**
25	**ON**	**ON**	**ON**
30	**ON**	**ON**	**ON**
40	**ON**	**ON**	**ON**
50	**ON**	**ON**	**ON**
60	**ON**	**ON**	**ON**
70	**ON**	**ON**	**ON**
80	**ON**	**ON**	**ON**
90	**OFF**	**OFF**	**OFF**
100	**OFF**	**OFF**	**OFF**

Based on the results, the PIR sensor only manages to detect motion up to 80 cm and starts to not detect any motion when the distance is up to 90 cm and above. Since PIR sensors sense heat signatures in the room, they are also not very sensitive if the room itself is warm. The PIR sensor only supports a shorter range and hence its performance degraded with a longer distance. For this reason, it is almost impossible for the PIR sensor to reach the perfect condition.

3.2 Speed Detection

Table 2 shows the status of the camera used in this project. In this analysis, the distances between IR 1 and IR 2 are fixed at 10 cm. The speed of the vehicle that drives through the crossing is measured based on the distance over the time that the vehicle passes the sensor. Once the speed is detected by more than 30 cm/min, the camera is then activated. Based on the results, the camera activated when the vehicles reach the speed of 35 cm/min and above. The camera was deactivated at 30 cm/min because the prototype already includes the error of 5 cm/min in the calculation.

Table 2: Camera Activation Status

Speed (cm/min)	Camera Status
15	OFF
20	OFF
25	OFF
30	OFF
35	ON
40	ON
50	ON
60	ON

3.3 IOT using Blynk Platform

The code was designed so that the camera will only turn on when the vehicle is overspeeding in the area of sensor operation. The data then be stored in Blynk in a form of pictures displaying the vehicle as shown in Figure 2. The image of the vehicle was captured by the camera that appeared in the application using the Blynk platform. Other than that, information such as the type of violation, the time, and the location is stored in the cloud and appeared in the application.

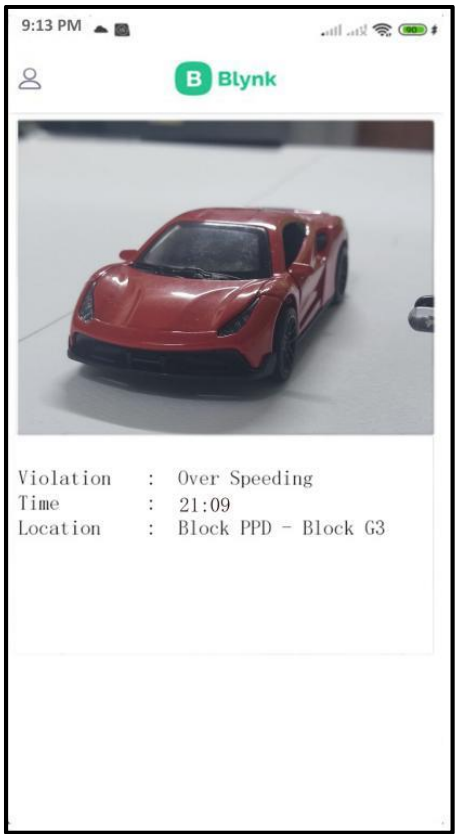

Figure 2: Blynk display application

4. Conclusion

Overall, in this project, the prototype of a smart pedestrian crossing on campus with IoT has been successfully developed according to the proposed mechanism in both two and three-dimensions. Based on the analysis of the results, the PIR sensor is capable to detect motion in a shorter range and hence its performance degraded with longer distances. Since PIR sensors sense heat signatures in the room, they are also not very sensitive if the room itself is warm. For this reason, it is almost impossible for the PIR

sensor to reach the perfect condition. Therefore, further research with various forms of materials can be done to improve the level of performance with longer distances.

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