PEAT

Proposed Design of Disabled Parking Management System using RFID Sensor Technology

Muhammad Adlan Zarif Jamarudin[1], Rahmat Muslim[1]*

[1]Department of Civil Engineering Technology, Faculty of Engineering Technology, Universiti Tun Hussein Onn Malaysia, 84600 Pagoh, Johor, MALAYSIA

*Corresponding Author Designation

Abstract: Violation of the rights of the disabled has become one of the much-debated issues in the local community today. Today, the community is less aware of the abuse that is taking place around them. In the context of disabled-parking spaces, abuse of the reserved spaces without guilty has become normal. Having this situation is a total catastrophe as parking at the disabled-parking spaces is now becoming a norm for the non-disabled. The purpose of this project is to design and develop alarm systems to secure parking spaces for the disabled using current sensor technology. The project also aim to determine the capabilities of the prototype design so that the disabled parking system is veritable. Next, to obtain data in this study, there are two important things that need to be there such as the study of appropriate sensors based on the situation and needs and make the prototype of the system. The modules that are used are Arduino Uno, RFID and the buzzer. Arduino IDE software are used to connect all the module and gain data from the test. The results obtained has shown that, the system function as desired and manage to detect only the right car for the disabled parking. This product system provides an understanding of how parking spaces with disabilities can be protected. This study can also add some improvements such as more use of sensors to make the process smoother.

Keywords: Disabled Parking Management System, Radio Frequency Identification (RFID)

1. Introduction

The searching of parking space in a parking lot in public areas such as institution, hospital or university is so irritating for many drivers. The numbers of cars (or personal motor vehicle) are ever increasing in the world, especially in developed areas where there are many people afford to buy own car for their convenience. The number of populations increase especially in the urban area and everyone want to fulfill their needs. According to United Nation prediction that population will increase to 9.7 billion in 2050 and thus make it 2 billion more people than current population.

However, there is one crisis that come along with urbanization that is limited parking due to high density population [1]. Some people tend to break the rule and violating disabled right as the demand for parking space increasing nowadays. As the parking space become limited, the violation of the disabled rights has become worse and the community nowadays is less concern of the abuse that occurs in their surroundings. The proliferation of Internet of Things (IoT) technologies and their increasing utilization within the building [2] can help to secure parking for disabled and enhance the parking experience.

Parking space design is considered as one of the essential elements of building design and one of the significant challenges when addressing people with lack civic consciousness. Thus, parking space design should be planned properly to enable us to reduce violation of others right such as disabled parking. People tends to misuse other rights because handicapped parking so close to a building or store entrance and the parking space 30.00 % - 60.00 % wider than regular parking [3]. It is difficult or impossible to park if drivers who are wheelchair users cannot find handicapped parking spaces and they want to park in regular parking spaces.

Based on the Figure 1 from Social Welfare Department (JKM), there was an increment of about 100,000 disabled people in 2010 until 2014. It means, an increase in the number of handicapped people, more facilities should be provided and more community awareness in helping these group.
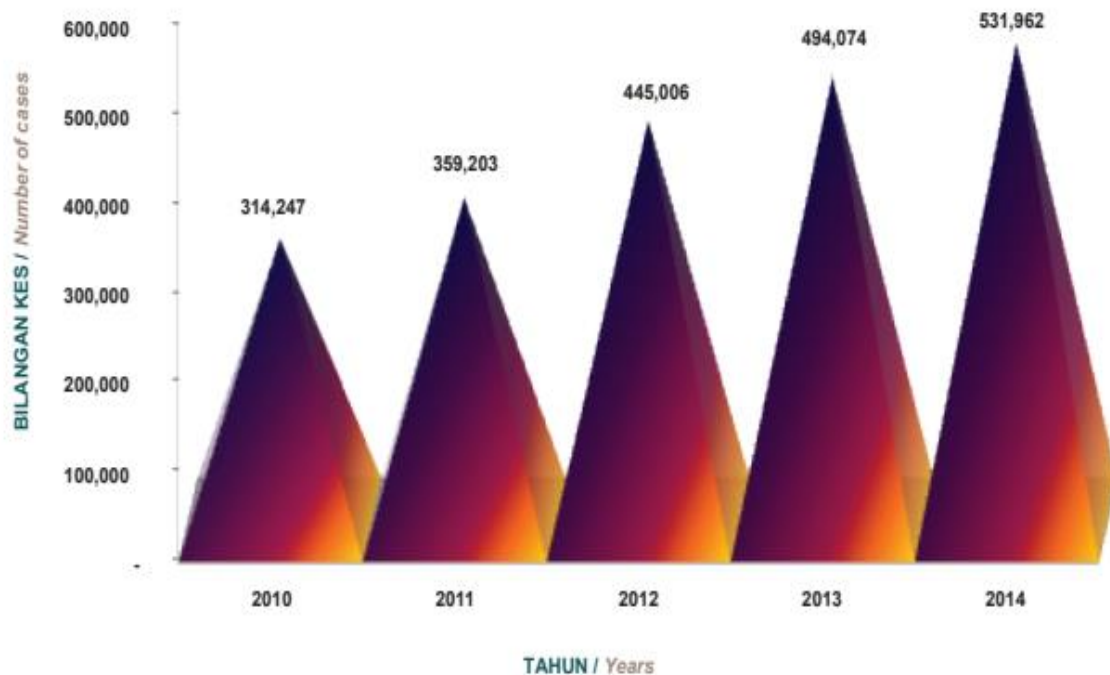

Figure 1: Registration of person with disabilities (PWD), 2010 – 2014

2. Materials and Methods

The building of methodology is a crucial part to provide flow and guidance to a study. There are several methods to archive the objective in the study. These are literature review and data collection, prototype preparation and observation of the location. To see the overall procedure and analysis of this study can be referred to the methodology flow chart in Figure 2 to enhance the understanding of the study.
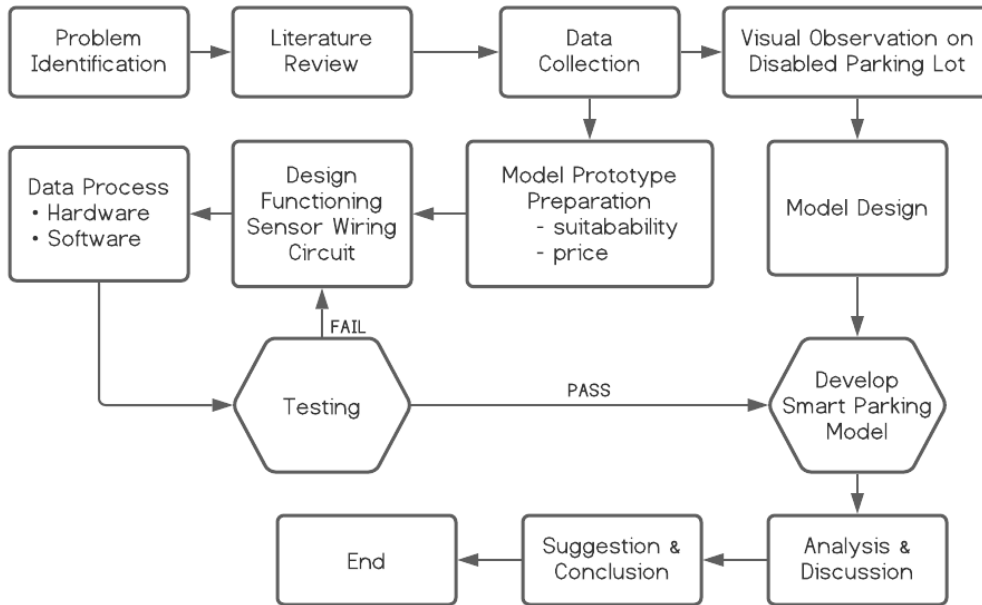
Figure 2: Flow chart of methodology

2.1 Materials

Electrical components consist of several rules and understanding. The process of wiring must be done precisely by going through the calculation of how much voltage for each component and the flow of wiring with a connection to Arduino pin. Otherwise, the components will be damaged because of the overpower supplied to them. Below is the list of components that were identified and used for this project. :

- Arduino Uno - microprocessor as the main components
- RFID RC522 reader - passive RFID reader
- Buzzer - sound alarm for the system
- Red and Green LED - indicator for the disabled or not
- Breadboard - additional pin connector for Arduino Uno
- Jumper wire - connect components
- Servo Motor - raise and lower the barrier
- RFID card - identification badge for disabled

2.2 Methods

The design and development of the study involve in three development sub-phase aimed to design a functional prototype as illustrated in Figure 3:
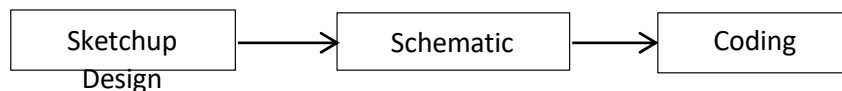

Figure 3: Phased involved in the development of the system

2.2.1 Sketchup Design

In this step, Sketchup software was used to design the disabled parking spaces before designing and creating the prototype scale model, as in Figure 4(a) and 4(b). From this design, it illustrates the suitability of the sensor location on the parking space and estimate the material needed to build the prototype. The sensor resided at the in front of space as to detect any car entering the parking while barrier at the center of the parking lot in order to prevent cars that do not have PWD sticker from parking there.
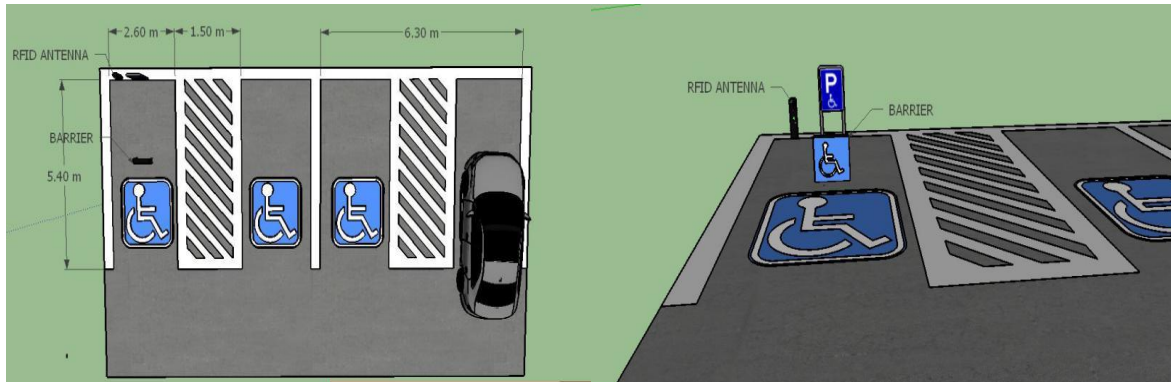
Figure 4: (a) Design of disabled parking (from top); (b) Design of disabled parking

2.2.2 Schematic

The next part is to draw a schematic that can be implement on the prototype of the Disabled Parking System. Schematic is important because it supports the comprehension of the system during the assembling part. The Frietzing software is used to draw the schematics as it was the perfect tool that developers used for their project. In this software, there are lot of Arduino components, sensors and other related tools that can be used. Figure 5 illustrates the connection to the breadboard for all components.
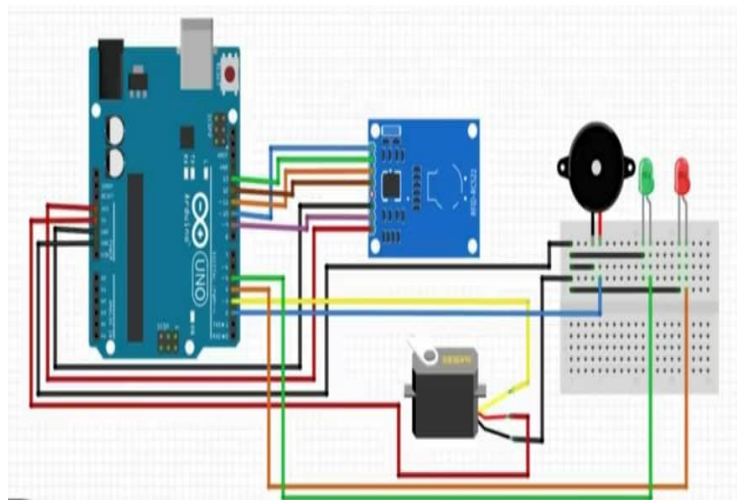

Figure 5: Schematic drawing of circuit

2.2.3 Coding

The commanding of Arduino was done after the assembled part had completed. Program written using Arduino Integrated Development Environment (IDE) are called sketches and connected to the Arduino Uno using USB cable. The Arduino IDE software is a collection of instructions that tell the hardware what to do and how to do it [4]. The software also includes a wiring project software library, which provides several standard procedures for input and output.

In Figure 6, the program segment shows the RFID 'false' process. Once it detects the 'false' state, it then sounds up the buzzer and active the green LED until the car leaves the parking space. In Figure 7 is the program segment of 'true' state of RFID tag. Delay for this project was put 60,000 milliseconds which equal to 1 minute where the sensor and RFID reader taking a new reading for every 1 minute.

```
else   {
Serial.println("Access denied");
digitalWrite(LED_R, HIGH);
tone(BUZZER, 3000);
delay(1000);
```

Figure 6: Segment of 'False' on RFID Tag

```
Serial.println("Authorized access");
Serial.println();
digitalWrite(LED_G, HIGH);
tone(BUZZER, 500);
delay(300);
noTone(BUZZER);
myServo.write(55);
delay(10000);
myServo.write(0);
digitalWrite(LED_G, LOW);
}
```

Figure 7: Segment of 'true' RFID tag

3.   Results and Discussion

3.1 Results

Different cases have been explained and showed through the figures in the following sections. All those two figures correspondent to each other while occurring an event. The test has already been performed and the working flow are explained in Figure 8.
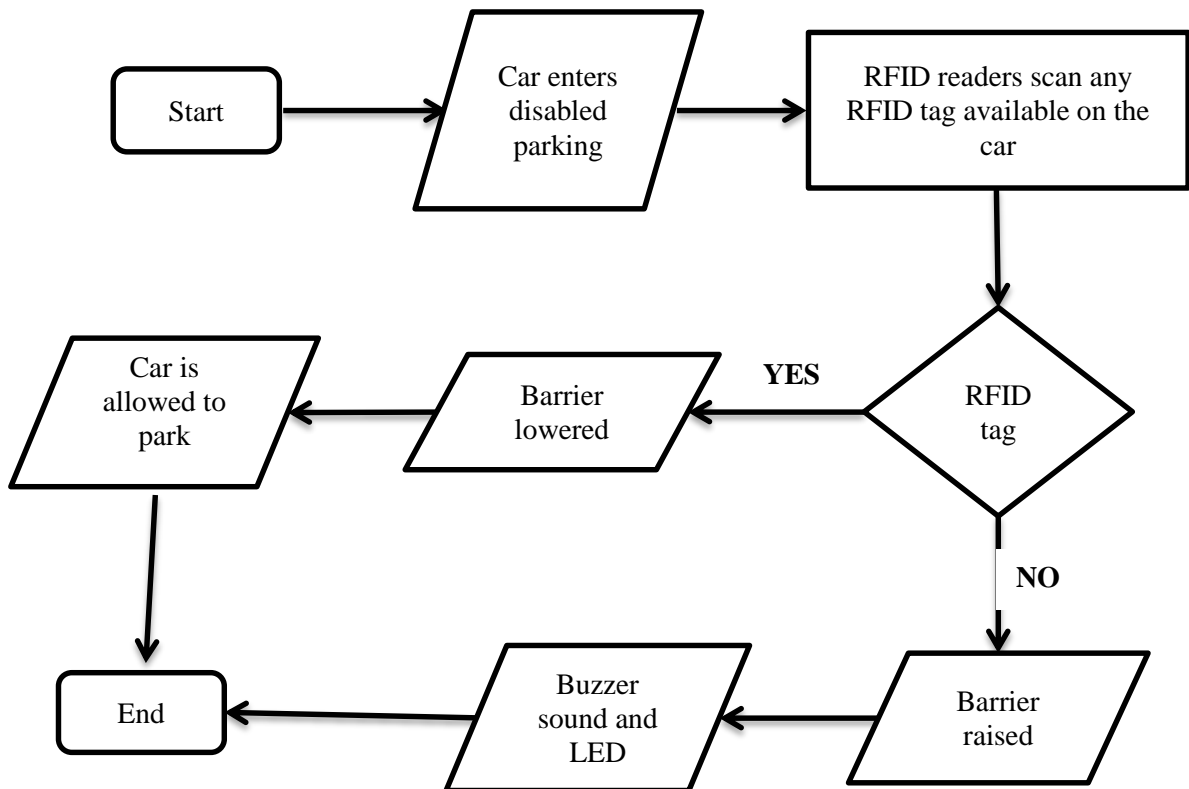

Figure 8: Flowchart of Disabled Parking Management System working flow

3.1.1 Case one

This case shows that the car attempts to park there without a disabled sticker, but the barrier is still raised, and the system does not give any response as there is no RFID tag detected from the car as shown in the Figure 9.
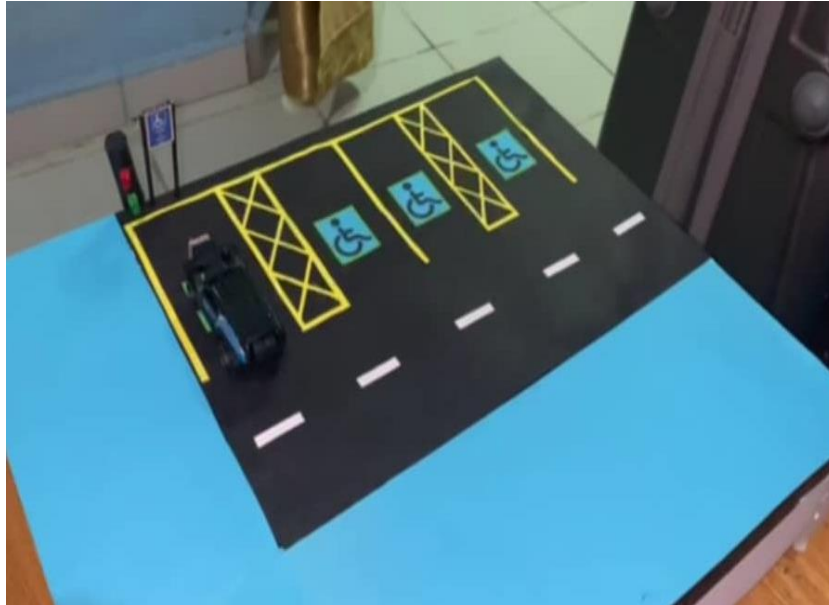

Figure 9: Test case one

The serial monitors as in the Figure 10 shows that no data is recorded because the RFID reader / antenna does not detect any RFID tag's UID number from the coming vehicle.

Figure 10 : Case one on serial monitor

3.1.2 Case two

This case shows that the car with a forged disabled sticker or other RFID tag is attempting to park there but the barrier is still raised as the unverified UID number is identified. As shown in Figure 11, a green light means that a violation has occurred and the alarm will sound before the driver exits.
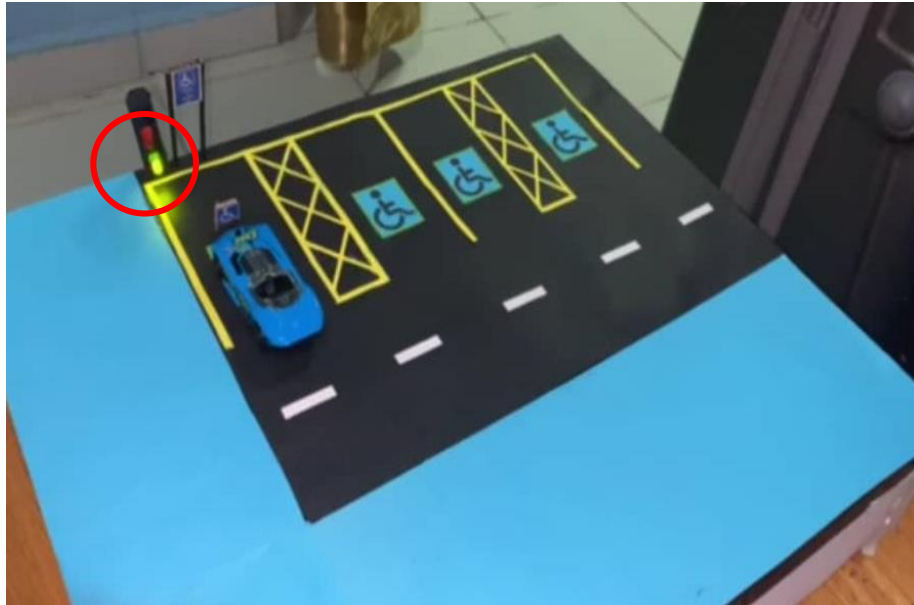
Figure 11 : Test case two

The serial monitor shows that the RFID tag's UID number is not in the database and that entry to the parking lot is denied, as shown in Figure 12.
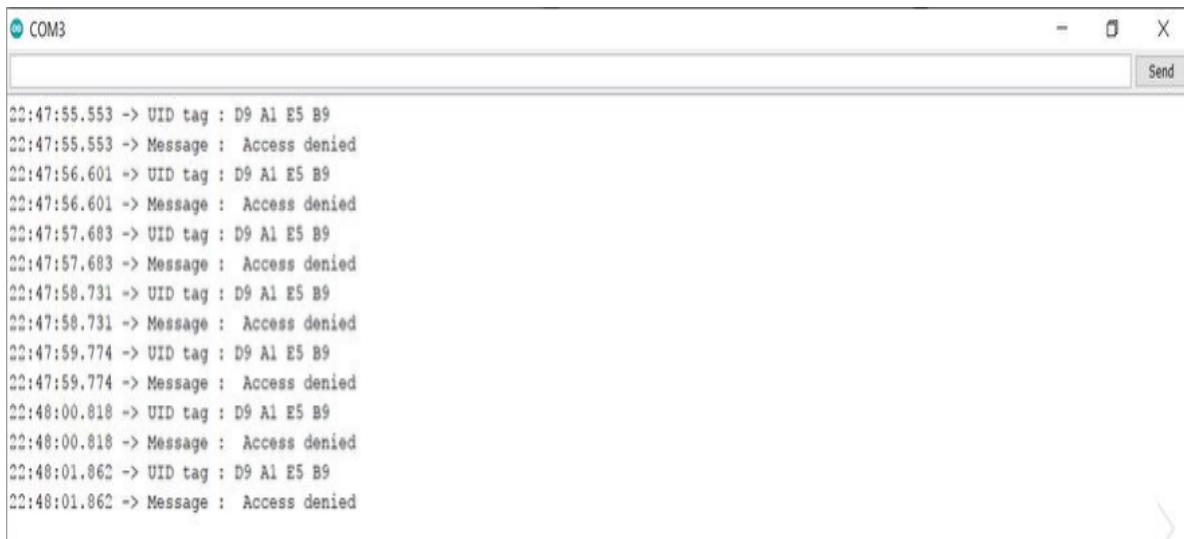

Figure 12: Case two on serial monitor

3.1.3 Case three

This case shows that the right disabled sticker car tries to enter the parking lot, so the barrier is lower and allows the car to park there, as seen in Figure 13. The RFID reader will detect the RFID tag implemented in disable sticker and send the signal to data base for verification. It will turn on a red light showing that the right vehicle has been parked there.
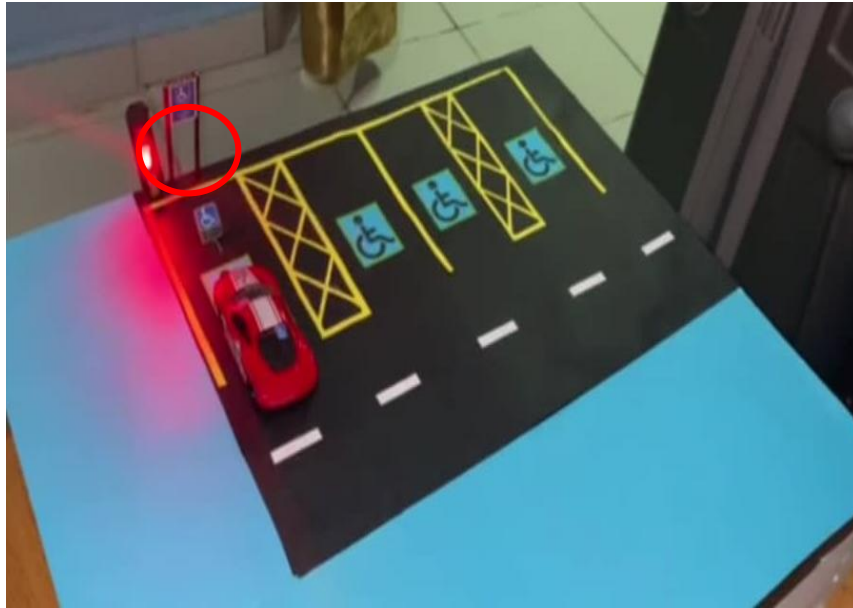
Figure 13 : Test case three

The serial monitor indicates that the RFID tag's UID number is checked and successfully accessed as shown in the Figure 14.
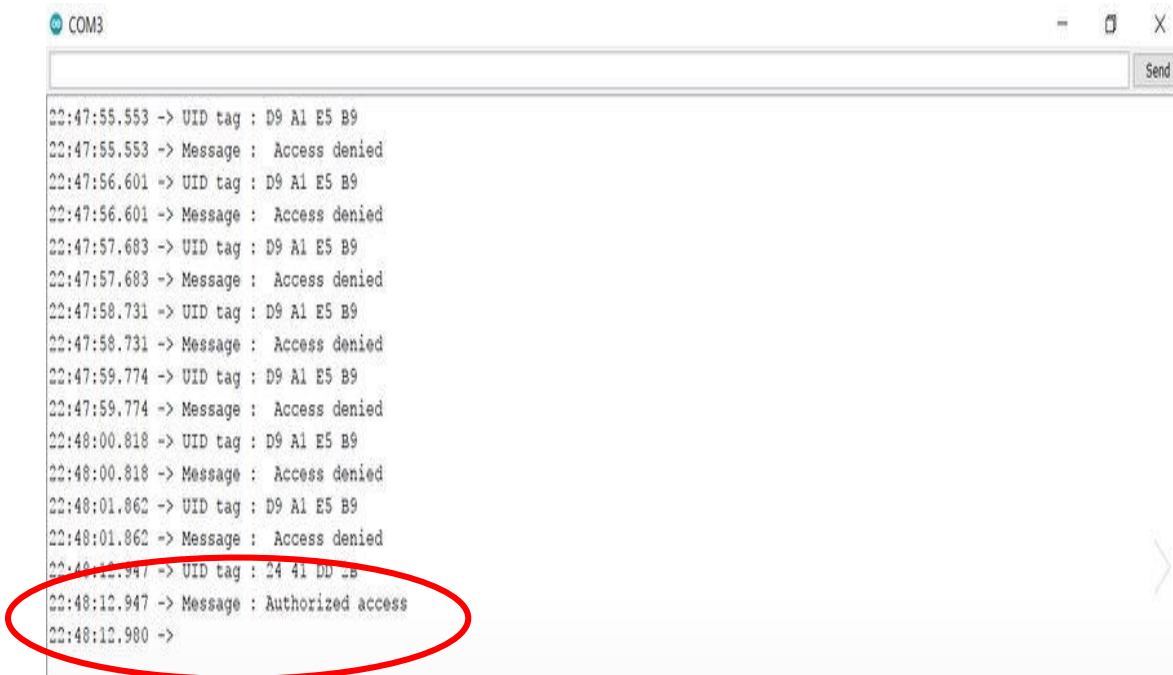

Figure 14 : Case three on serial monitor

3.2 Discussions

The developed system can be implemented in disable parking lot mainly for detecting the presence of cars where each and every disable driver would have a RFID tag attached to their disable stickers. If there is a walk-in driver parking in the parking lot, Arduino Uno will read from the RFID sensor and update the data in the database server. Low Frequency RFID Device is used for this project, but in the actual simulation, this system will use Microwave Frequency RFID Technology that can operate on 2.45 GHz, even faster than UHF tags and has good reader rate [5]. The barrier will not be active if no RFID tag is detected and the buzzer would sound until the car that violates the disable parking is moved.

Once the parking lot is empty again and no RFID tag is detected, the barrier will be raised so that the initial process can be started again.

As of now, the prototype is now able to detect and alarm the unverified vehicle with accepted accuracy and precision. Besides that, the software used that is Arduino IDE is able to display the data, real time regarding the status of parking lot and detect verified UID number in RFID tag. The system also can give alarm in case of violation of disable occurred at the parking lot. As a conclusion, the prototype passes the tests that are done to it and able to satisfy the objectives. By using a parking management system, handicapped cars or vehicle will spend less time moving around the car park and will be able to drive directly to the correct parking space [6]. Navigating around car parks can be particularly hazardous for the handicapped with poor visibility as the driver's vision is blocked by other vehicles making it difficult to see other cars coming out of the car park or people moving between cars. This scenario can lead to various minor accidents and harm others.

4. Conclusion

As a conclusion, an advanced system of parking system needs to be introduced to overcome the limitation of current system that unable to prevent the violation of the rights of the disabled from occurring. With the introduction of Parking System for Disabled based on IOT in the parking lot, the use of sensor will greatly improve the quality and security of the parking lot. The parking system that is designed must be able to update the car's with legal disabled sticker presence in real time and have the ability to give warning in case violation occur there. The study that is done aimed at producing a prototype with the abilities.

The appropriate technique, hardware and software needed to develop the prototype were identified, which is the Arduino Uno, RFID sensors and also the Arduino IDE to develop the interface and the system. The main role of Arduino IDE is to check the parking space and update the data in the server of the database and loop the process at all times. SketchUp software was used to design the prototype parking lot layout and the author also used Fritzing software to create schematic drawings of wire connections with other hardware. Other than that, the lab-sized prototype of the parking lot was also successfully built using the SketchUp design to implement the framework. The integration of the system and the implementation of the system were successfully completed after the prototype was completed.

In conclusion, the prototype developed is a success. The parking system is able to gather data and detect the right car for the parking lot. However, there are some changes that can be made to the project's effectiveness, which are have more sensors, such as ultrasonic or infrared sensors, which are capable of detecting other objects, such as humans and bikes, so that there is no object stopping a disabled vehicle from entering its car park. Other than that, use an open sources platform that able to send the notifications to the user via email or mobile phone based on Android or IOS.

Acknowledgement

References

[1]   Gining, R. A., Fauzi, S. S., Hadi, A. F., Razak, M. Z., & Jamaluddin, M. N. (2018). Design and Development of Disabled Parking System for Smart City. Journal of Physics: Conference Series, 1019, 012016. doi:10.1088/1742-6596/1019/1/012016

[2]   Sanchez et al., "SmartSantander: The meeting point between Future Internet research and experimentation and the smart cities," Proc. of Future Network & Mobile Summit (FutureNetw), 2011, pp.1-8

[3]   Yousaf, K., Durairajah, V., & Gobee, S. (2016). SMART PARKING SYSTEM USING VISION SYSTEM FOR DISABLE DRIVERS (OKU).

[4]   Badamasi, Y.A., "The working principle of an Arduino," in Electronics, Computer and Computation (ICECCO), 2014 11th International Conference on, vol., no., pp.1-4, Sept. 29 2014-Oct. 1 2014

[5]   Application Notes, "Introduction to RFID Technology" CAENRFID: The Art of Identification (2008). IJCSI International Journal of Computer Science Issues, Vol. 7, Issue 1, No. 3, January 2010

[6]   Yan, G., Olariu, S., Weigle, M. C., & Abuelela, M. (2008). SmartParking: A Secure and Intelligent Parking System Using NOTICE. 2008 11th International IEEE Conference on Intelligent Transportation Systems. doi:10.1109/itsc.2008.4732702