SMART VEHICLE IDENTIFICATION SYSTEM USING RFID TECHNOLOGY

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Abstract

With increase in number of vehicles in Bhutan, some of the major problems faced are the waste of the time and effort of drivers and concern officials on duty for doing manual registration of the vehicle details at the checkpoints and also it is difficult to keep track of the records related to vehicles passing through these entry points for national security reasons. This report presents the development of a prototype of a Smart Vehicle Identification System using RFID technology and its key functionalities. This smart system is proposed as a solution to be used for providing effective and efficient services of vehicle registration at the entry gate of any organization's premises or at the immigration checkpoints along the national highway in Bhutan. A prototype of the proposed smart system was developed as a web based application using Medoo Framework and Raspberry Pi for automatic identification of vehicles passing through the gate with RFID reader. All information related to vehicles including their owners and drivers are stored and managed using MySQL database server. The functionalities of the proposed smart system prototype are tested successfully on the development platform.

Keywords: RFID Reader, RFID Tags, Raspberry Web Application

1. INTRODUCTION

With the advancement of the world, everything is becoming automated. RFID is one such technology that is used to automatically identify the objects. The objective of the project is to reduce the manual entry of data into the system which will greatly reduce the work of the security guards at the checkpoints and college gate of CST and there will be high accuracy of the records. It will also reduce the traffic congestion formed at the checkpoints. For the project, the MFRC522 RFID reader will be interfaced with Raspberry Pi. The Raspberry pi is going to be used as the processor for the system. Details of vehicles, owners and driver will be maintained. Every vehicle and driving license will be attached with RFID tag, each tag will have unique identifier number.

2. LITERATURE REVIEW

The paper by Akash and Charitra (Akash Sharma, 2015) talks on the sensors that are used to identify the authenticated vehicles. The RFID reader first reads the RFID tag, then information is sent to the database. If the information matches the database entry of the system, it will allow the vehicles to enter the premises. Those having invalid RFID tags are not permitted to enter the premises.

The paper by Sahil (Sahil, 2016) focuses on the Electronic Toll Collection using RFID technology. RFID tags are attached on every vehicle, and the amount he/she had paid in advance for the TOLL PLAZA is also written on the tag. The payment amount will get deducted from the prepaid balance and by doing this, the vehicle doesn't need to stay in the queue and it saves them time and fuels.

The paper by Murtadak (Murtadak, 2016) tells us about the collision sensors that are used to exchange information during the vehicle's collision. This is primarily done to know which vehicle has led the collision. Whenever accidents occur the tag will exchange information between the two vehicles. Then the information of location will be sent to relatives and the health center.

The paper by Bachuwa (Bachuwa, 2020) is about the growing challenges of locating the area to park the vehicles due to the increase in the number of vehicles. There are three basic operations being carried out: Identification of the vehicles with the help of RFID technology, detection of empty slot which is completed using display and calculation of fee which is based on the duration of parking. All the sensors are connected to Raspberry Pi and RFID tags are used to detect the vehicles and collect the parking fee.

3. THE EXISTING SYSTEM

In the current system, the college has implemented a rule where the faculties have to paste the logo of the college on their vehicles, so that the security guard can identify their vehicles. The records are all maintained manually in a register book. This not only makes the work of the security guard hard but also takes time in registering the details of the vehicles.

4. PROPOSED SYSTEM

Prototype Model

The prototype consists of Raspberry Pi and RFID reader. The vehicle and the driving license is attached with RFID tag. As the vehicle with the RFID tag reaches the scanning antenna, it will send data in radio waves. The antenna will send radio waves to RFID reader, the radio waves will then be decoded as information. The RFID Reader needs to be set up on the raspberry pi where the data received will be interpreted using the central processor. The data received will be stored in its memory card, the processor will then access and decipher the data using its I/O peripherals. The database will store the deciphered data. The stored data will then be displayed on the web application which will be monitored by the Security Guards as shown in the Figure a) Block Diagram
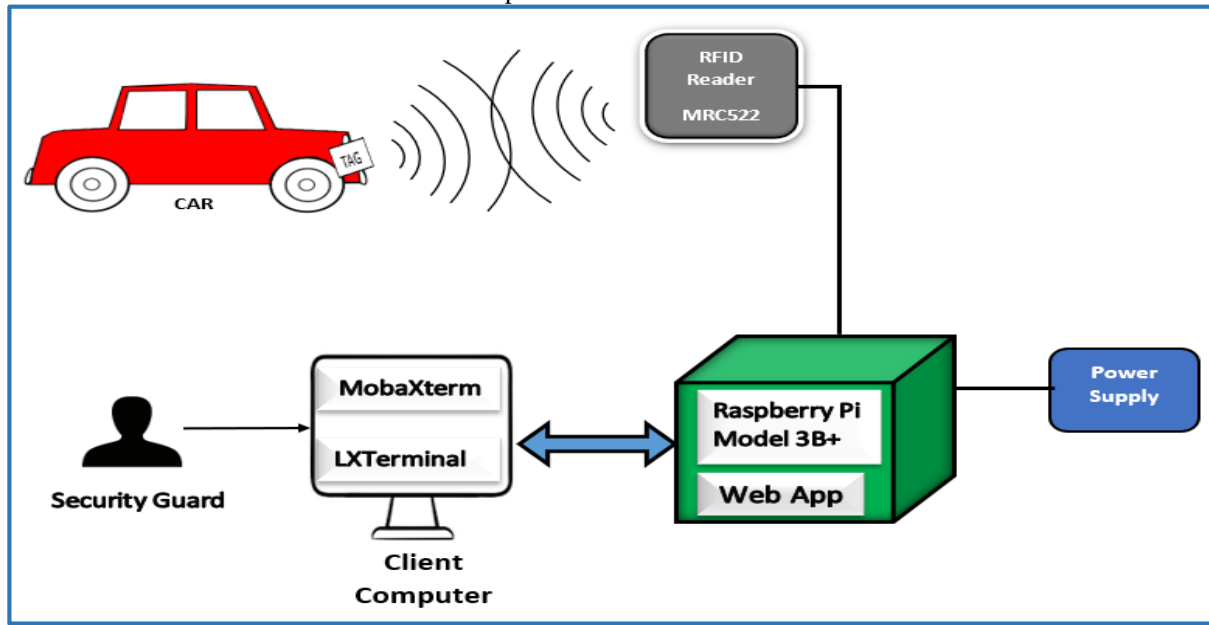

Figure a) Block Diagram

5. HARDWARE REQUIREMENTS

A. Raspberry Pi

It was basically derived from the fruit name Raspberry and pi from python lang. It is a small sized mini-computer, popular for its size and low price. It is a fully functional computer as it runs several versions of the Linux operating system. It has built in ram and CPU in the Broadcom chip.

Raspberry pi makes use of the SD card to load the operating system. It supports few Linux distros but the most popular one is Raspbian. For the project, Raspberry pi 3B+ model is being used. It supports many programming languages like Python, Java, Ruby, Scratch, C and C++.

Figure b) Raspberry Pi

B. RFID System

RFID technology is a short form for Radio Frequency Identification and it works on radio waves. It is used to

identify or track the objects automatically. RFID technology contains two components: the RFID reader and the RFID tag or card. The object to be tracked is attached with the RFID tag. The radio waves are generated by the RFID reader.

i. RFID Reader

RFID reader comes in several size and shapes. It could be either handheld or of the door size. It primarily comprises of three components: the microcontroller, the signal detector and signal generator.

For the project, Mfrc522 RFID Reader is used. It can read the tag at a distance of 5cm and 13,56 MHz. It is relatively cheaper compared to the other readers. It is also compatible with the MF S50 proximity card and Mif1 S50 tag.

Figure c) MFRC522 RFID Reader

ii. RFID Tag

RFID tag is of three types: An active tag, passive tag or semi passive tag. The RFID tags come in various forms: they could either be in the size of a credit-card, key chain or in the form of a label. The RFID tag consists of the controller, the rectifier circuit and the transponder. For the project, MF S50 proximity card and Mif1 S50 tag are used because they are compatible with the Mfrc522 RFID reader. They fall under Low frequency range of 125kHz to134 kHz.

Figure d) RFID tag/card

6. SOFTWARE REQUIREMENTS

A. Medoo Framework

The word 'Medoo' was derived from the Latin word 'med' which means middle, as it serves as a medium between the database and PHP. It is the lightest non-MVC framework which contains only a single file, easier to use, learn and enhance development skills and user experience in case of web application. It is appropriate for any project related with PHP and MySQL database. It is primarily used for interaction with the database and it does not need helper and controller. (Ancheta, 2014).

B. PHP

The full form for PHP is Hypertext Pre-processor. It is open for everybody and used as a scripting language at the server-side. It basically creates web sites or web applications. The PHP code is executed at the server-side, where the HTML is written and then directed to client-side. On the client-side, the results of the script would be generated without the underlying codes It can contain HTML, text, JavaScript, CSS and PHP code. The version used for the project is 7.2.25 as it is much faster compared to the previous versions, the error handling is also improved and new operators like the spaceship operator is also made available. It is simple, secure, efficient, flexible and familiar scripting language (Morris, 2020).

C. MySQL

MySQL is a system which manages and communicates with the database. It enables users to add, modify and perform join operations of the tables in the database. It has got many advantages as compared to others. MySQL is open-source where anyone can use it and modify free of cost. It is broadly available; anyone can install it on any platforms. It is relatively easier to use and work with as it is compatible with PHP language (Herawan, 2020).

D. Nginx

Nginx is a software that is available to everyone. It is a web server that is basically used for load balancing, caching and reverse proxying. It offers HTTP server abilities and designed to have maximum firmness and performance. It makes use of the approach known master-slave. Nginx web server is preferred over other web servers since it is easy to install and maintain. It reduces the waiting time of users and greatly enhances the performance. It is not only load balancing but also offers greater scalability. It can upgrade without affecting the business, unlike other web servers. It was created as a means to resolve the problems faced by the Apache web server. One of the advantages of the Nginx is, it can easily absorb heavy spikes in traffic. (Aldwin, 2019).

E. MobaXterm

MobaXterm is the ultimate toolbox that can be used for remote computing. It provides many functions that are intended for programmers and users to better handle the works remotely in a simpler way. It provides all the tools such as SSH, FTP, X11, VNC, RDP and MOSH which are required for remote network (Pundit, 2019).

7. METHODOLOGY

The project followed the methodology process in order to accomplish its aims and objectives. The project started by first finding the problems, then reading related papers and doing requirement gathering. Design of the system was done, which was divided into software and hardware design. Under the software design, database design and GUI design was done.

Under hardware design, complete circuit diagram of RFID sensor was done. Unit testing was performed on every components of the hardware to make sure that they work completely fine. After that, integration testing was done to make sure the application worked fine with all the components. This process was followed until every component worked perfectly fine when integrated with other components.
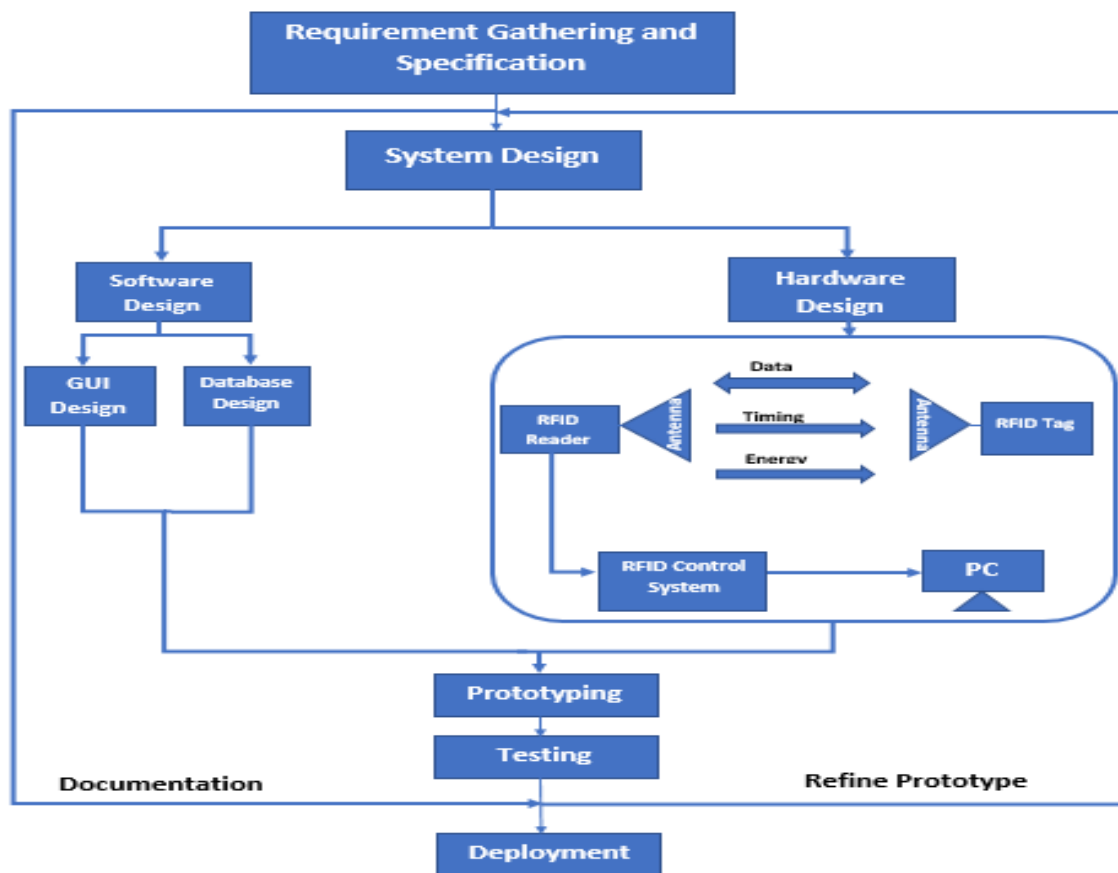

Figure e) Methodology

8. CIRCUIT DESIGN

There are eight pins on RFID MFRC522 and they are 3.3v, SCK, SDA, MISO, MOSI, RST, IRQ and GND, all the pins except for the IRQ pin must be wired to the Raspberry Pi. The pin SDA is connected to GPIO8, SCK pin to GPIO11, MOSI pin to GPIO10, MISO pin to GPIO9, GND pin to Ground, RST pin to GPIO25 and 3.3v pin to 3.3 VDC power of the raspberry pi. Power will be supplied to the raspberry pi through the USB adapter.
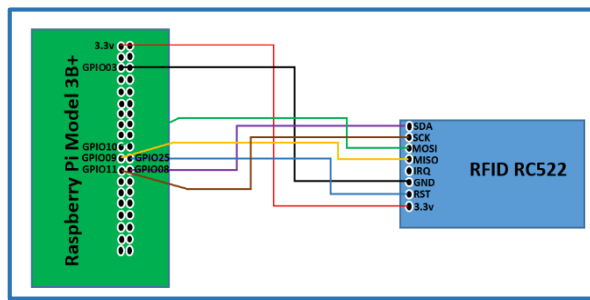
Figure f) Circuit Diagram

9. FINDINGS

Figure g) Integration of Hardware

9. CONCLUSION

The project done on the "Smart Vehicle Identification System using RFID technology" came to a success. After the integration of all the hardware components, the system could detect the vehicle, driver and owner and display the information. With the help of this system, the manual entry of the vehicle information could be reduced. This system can be useful for the security guards at the college gate, or any other organizations to monitor any movement of vehicles in and out of the particular premises.

REFERENCES

Ancheta, W. (2014). *Getting Started with Medoo*. https://www.sitepoint.com/getting-started-medoo-examples-use/

Arthikeyani, V. K., Kirubhasudha, N., Kiruthika, S., Monisha, T., & Sivasankari, B. (2018). *Raspberry Pi Based Intelligent Autonomous Campus Mobility Services*. *3*(1), 1457–1461.

Bhosale, S., Chavan, R., Bhadvan, S., & Mohite, P. (2016). Automatic Vehicle Identification and Toll Collection Using. *International Research Journal of Engineering and Technology(IRJET)*, *3*(2), 1500–1504.

et al., A. (2019). Secure vehicle tracking using RFID. *International Journal of ADVANCED AND APPLIED SCIENCES*, *6*(10), 1–6. https://doi.org/10.21833/ijaas.2019.10.001

Jeevagan, N., Santosh, P., Berlia, R., & Kandoi, S. (2014). RFID based vehicle identification during collisions. *Proceedings of the 4th IEEE Global Humanitarian Technology Conference, GHTC 2014*, *2*, 716–720. https://doi.org/10.1109/GHTC.2014.6970362

Lam, T. (2020). *Annual report (july 2019-june 2020)*. *July 2019*.

The database and web application that had been created were imported inside the Raspbian OS. To read the data from RFID tag, python code was written. The data from the RFID tag was automatically checked to see if the tag's ID existed in database. If the tag's ID was found, the information related to the RFID tag was recorded in the database and was automatically showed on the web application.

Patil, S. K. (2018). *Implementation of Advance PCA Algorithm for Security System using Raspberry Pi*. *4*(1), 578–580.

Priyanka, S. (2017). RFID based vehicle access control and tracking with IoT Abstract : *Int. J. Eng. Tech.*, *3*(5), 5.

Rajesh, T., Arunpandian, M., Indhumathi, A., & Pratheepa, B. (2017). *Multipurpose Vehicle Detection System Using RFID*. 30–32.

Swetha, B., Prasuna, A. V. L., & Meenakshi, B. (2020). *EasyChair Preprint RFID Based Money Wallet for Parking Lots*.

Tayade, P. A., Dhule, S. S., & Bang, R. A. (2015). *Available Online at www.ijeecse.com CAPTCHA System Using Click Available Online at www.ijeecse.com*. *2*(6), 20–22.