Automated vehicle access control system using RFID and IoT

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***Abstract*—The current parking management systems needs human resources for controlling access and recording on-paper the entries and exits which can lead to many errors such as unauthorized users access, public security, fraud to pay parking fees, etc. In this paper we propose the use of Radio Frequency IDentificacion (RFID) technology to authorize or deny vehicular access depending on its RFID tag using PIC16F877A and Arduino UNO micro-controller. Users will not have to wait for the identification of their vehicles as it will be done automatically by the tags that are attached to them. This will also ensure security as only the registered vehicles are allowed to access into the parking lot, We also use propose the use ESP32 to communicate with a local server which indicates the current parking slots status (Available/Not Available). This will be done using IR sensors in the parking slots.**

***Index Terms*—Access control, Automatic ,Parking system, Radio Frequency IDentification, PIC16F877A,ESP32, Arduino UNO**

I. Introduction

Most of the existing parking managing systems, either require expensive equipment, infrastructure and deployment or they are semi-automated requiring human interventions for monitoring access of vehicles which can lead to many parking problems such as unauthorized users access, public security, fraud to pay parking fees, etc.

This paper propose an automated access control system using RFID technology, PIC16F877A, Arduino UNO and ESP32. RFID (Radio Frequency Identification) is an automatic identification and data capture technology, in which the data transfer between the reader and tagged module is done by radio frequency waves. The objective of the use of RFID technology is to identify, track and monitor objects.

The rest of this paper is organized as follows: Section II provides a brief description of the main parts of the project. Section III discuss the results of the the working prototype of the proposed system. Conclusions are finally drawn in Section IV.

II. System Description

The objective of this paper is to propose automated vehicle access control system using RFID and IoT that authorizes entrance only to vehicles previously registered and deny access to unregistered vehicles. It can also monitor the status of the parking slots in real time. The system consists of three main parts:

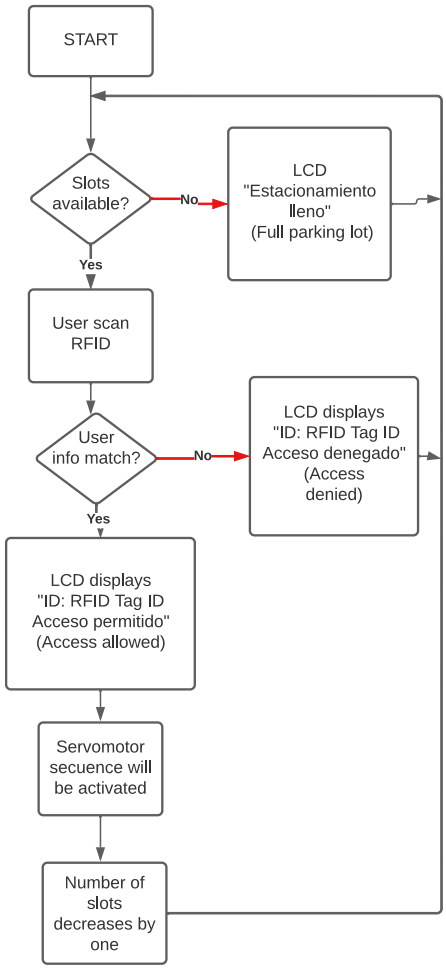

Fig. 1. Flow diagram of Entry System.

A. Entry System

The working procedure of this system are pointed out using a flow diagram shown in Fig. 1. The registered ID tags are stored in an array in PIC16F877A data memory. When the vehicle approaches the parking entry, the RFID reader will

check for a tag. When it detects a tag, it will compare its ID to the array located in data memory. If the ID does not match with any in the array, the entrance will be denied. If the ID matches with any in the array, the system will check for slot availability. If there is not any slot available, the access will be denied and the system will restart. If there is a slot available and the tag ID is correct, the access will be authorized and the servomotor will raise the entrance gate. At last, the number of slots available will decrease in one.

B. Exit System

The working procedure of this system are pointed out using a flow diagram shown in Fig. 2. When the vehicle approaches the parking exit, the ultrasonic sensor will check for an object at a certain distance. When it detects an object at less than 5cm a LED will activate and the Arduino UNO micro-controller will activate the servomotor and it will raise the exit gate. At last, the number of slots available will increase in one.

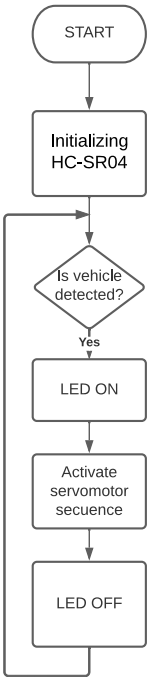

Fig. 2. Flow diagram of Exit System.

C. Parking Slots Monitoring

The working procedure of this system are pointed out using a flow diagram shown in Fig. 3. ESP32 will host a local web page that will show the parking slots status in real time. We will use the IR sensors to determine a slot status. Because the IR sensors don't work well under the sun light, the parking slots will be under a sun blind. We can also check the web page in mobile devices. The web page was made using Full-Stack technologies (HTML,CSS and JavaScript).

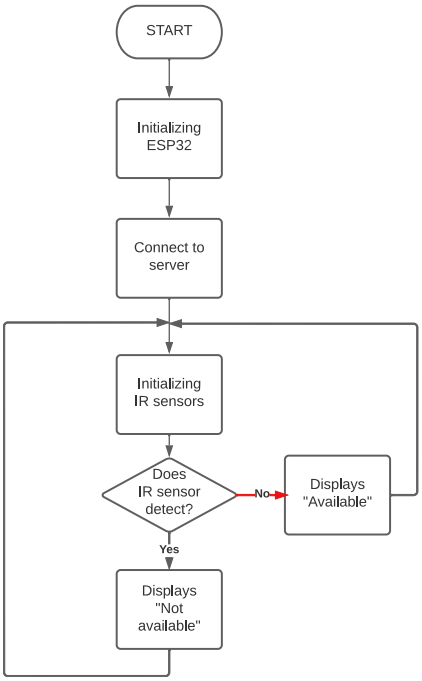

Fig. 3. Flow diagram of Parking Slots Monitoring

III. Results

A. Hardware

We have developed hardware for the prototype of the parking system shown in Fig. 4. The devices are powered by a laptop.
In Fig. 5. is shown the use of hardware such as a RFID reader, RFID tags, PIC16F877A, servomotors, LCD 16X2 and LEDs at the entrance system.
In Fig. 6. is shown the use of hardware such as Arduino UNO, an ultrasonic sensor, a servomotor and a LED at the exit system.
In Fig. 7. is shown the use of the ESP32 microcontroller in the parking slot monitoring system. In Fig. . we can see the IR sensors connected to the ESP32.

Fig. 4. Working prototype

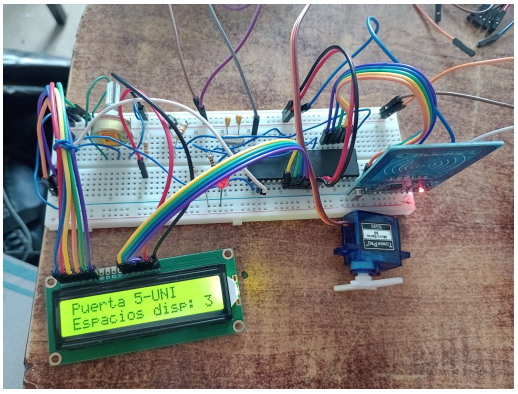

Fig. 5. Entry System

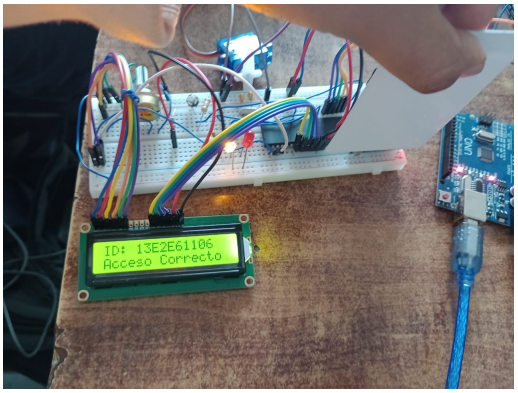

Fig. 6. Access Allowed

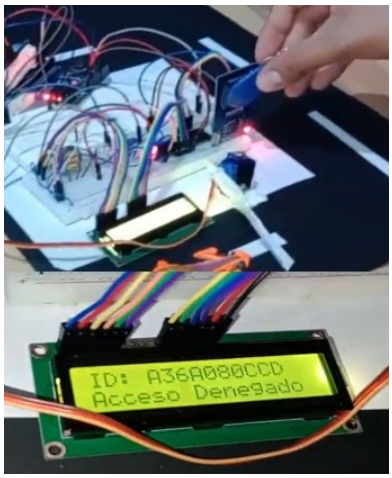

Fig. 7. Access Denied

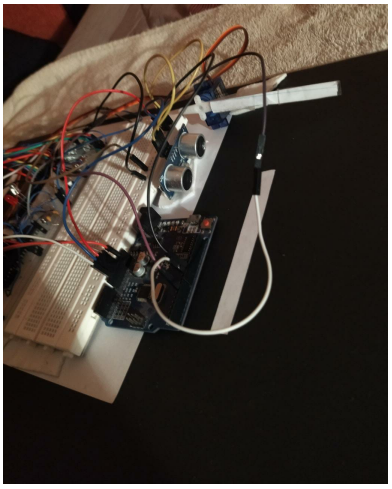

Fig. 8. Exit System

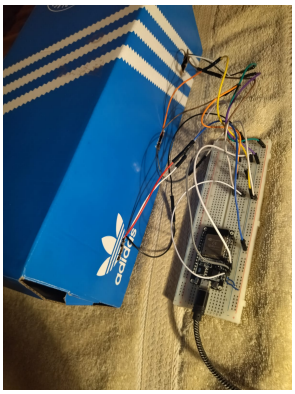

Fig. 9. Parking Slot Control System

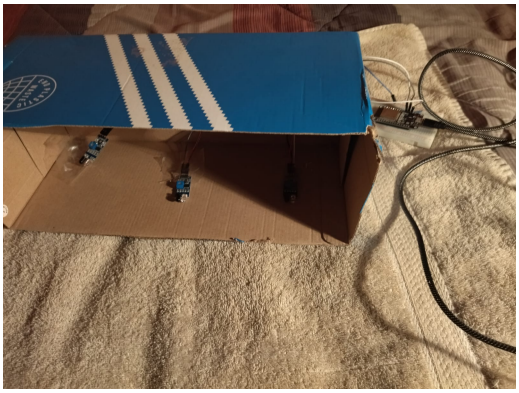

Fig. 10. IR sensors and ESP32

B. Web Page Development

This project provides the user with a web page where he/she can check in real time the status of all the parking slots. You can access the website through mobile devices. ESP32 host locally the web page.

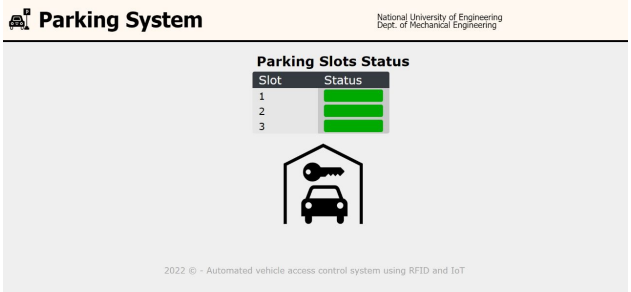

Fig. 11. Parking Slots Control Dashboard

IV. Conclusions

Nowadays, the smart cities have proposed an effective and optimized parking systems that manage vehicle traffic that are being implemented all over the world. The great advancement of IoT and Cloud Technologies helped this growth. This paper showcases a RFID-based Smart Parking System that can be monitored using IoT. The project is broadly divided into two parts: Entry/Exit System and Parking Slot Monitoring. The first system help avoiding wasting time at the entry and exit terminals and increase the security in the parking area by allowing the access only for the authorized commuters which provides a reliable means of granting or denying access in a restricted area. It also provides a cheap and efficient monitoring system while remain providing real time information about users. The second system help informing about the available parking spots to the user through the website, avoiding wasting time looking for one. In other words, personnel cost will cut off and the traffic jam problem will be solved.

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