

RFID Based Automatic Multi-Storied Car Parking System

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Abstract: This paper presents a design and implementation of automated car parking system by using RFID and passcode technologies. In this system, a parking tower with three floors and two slots per floor on either sides of the central lift was implemented. The control of entry-point and exit-point from the parking-lots is one of the applications of Radio Frequency Identification (RFID) technology which leads to the high reliability and security issues. RFID is a wireless technology to identify and track tags attached to objects via radio waves. The parking lots have an elevator to carry vehicles to different floors according to the vacancies that are collected by using an RFID system and are updated periodically into the database. This project is designed with RFID system, stepper motor for elevator, servo motor for turning the pallet to desired position, and DC motor for moving and placing the vehicles toward the specified slot of parking. This project will help to minimize the car parking area companies and apartments. And also it will help to reduce the manual work and save time.

Keywords: Automatic Car Parking, Radio Frequency Identification (RFID), Arduino

1. INTRODUCTION

In the modern world, technological advancement penetrating in every aspect has been undeniable. So, the variety of vehicles is increasing and vehicle parking is becoming a major problem. Automatic car parking system will play an important role to reduce the manual work and save time. That is the most effective solution for big city that are facing problem in placing the vehicles at available parking space. The mechanized lift will transport the vehicles to the different levels at a certain position.

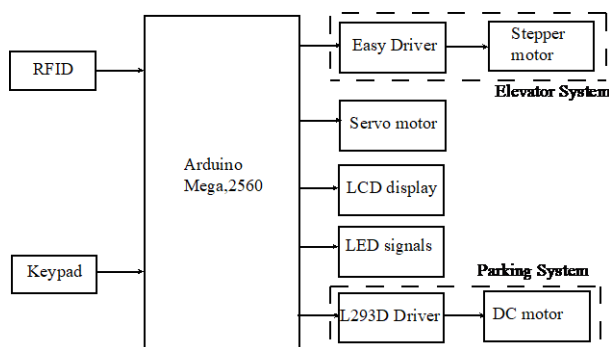


Figure 1. Overall Block Diagram of the Proposed System

Multi-storied car parking system will help in parking large number of vehicles in a smaller area. For this purpose, parking slots are assigned inside the multi storied structure depending on the size of the car.

2. RELATED WORK

In the literature, many methods, for example, Crane Parking system, have been proposed for automatic car parking system. It consists of a central lifting and positioning mechanism that is built into the center isle of a parking structure. However, to increase the redundancy of the system, another crane can be added to the rails and the two are coordinated by software [2].

In some paper, some researchers have been proposed this system by using PLC (Programmable Logic Controller). A kit has been designed for automation of a car parking system. The PLC has been pre-programmed and it reads the inputs from the various sensors and makes logical decisions. In case of occurrence of a failure, the protective measure is also taken [4].

Some other researchers have been discussed this system by using GSM technology. The system is integrated with GSM module so that when a user requests for the details related to the available slots, the system will send a SMS text message to the user with the details related to the parking slots and the same will send the message stating “No Slots Available for Parking”. Thus, with the mentioned information the user can take a wise decision whether to park vehicle or not. Then the GSM modem will send a password and the parking lot number to access the reserved parking lot [3].

After doing the study on various system that used various technologies, the proposed title has been tried to describe as a proper system by using RFID and Arduino Mega with AT-mega 2560 microcontroller for car parking system.

3. PROPOSED METHODOLOGY

This section consists of overall description of hardware for automated car parking system and details of the circuit components that used in the project. This project is constructed by stepper motor, servo motor, DC motor , RFID module, 4x4 keypad and 16x2 LCD display Arduino Mega,. Arduino Mega is used as a main controller for this system. Stepper motor is used for elevator control system. Servo motor is used to control the pallet to get the desired position. DC motor will work for moving and placing the vehicle towards the specified slot of parking.

Keypad system is often needed as a backup plan to provide the security for RFID based parking system when the user loses the RFID card. When a password is entered from the keypad, it will be matched with the data stored in the controller. If the password is correct, the parking or retrieving of the vehicle can be taken. If not, LCD will show an error message and any action cannot be taken.

Radio Frequency Identification (RFID) technology is widely used in various applications such as attendance system, tracking systems, monitoring system or parking system, inventory control, identification (ID) badges and access control, equipment or personnel tracking in hospitals and others [1]. RFID use the electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. In RFID module, there are two main components: the interrogator (RFID Reader) which transmits and receives the signal and the transponder (Tag) which is attached to the object [2].

There are two portions in the automated multi-storied car parking system. They are RFID system and car lift control system. For authorization process, the system starts the matching with the user information already stored in database system .SD card adaptor is used as database and data storage device. For identification and classification, radio frequency produced by RFID reader and RFID tag are used to identify whether register person or not. Once the system finds out the corresponding parking slot, the lift will move to the parking slot and then activates the conveyor belt at that location and thus the car is moved to the lift. The 16x2 line LCD display is used to alert notification message depend on the process.

The car is placed on the rotating platform, after that, the program sends the signals to the controller to move the lift to the designated space. This will be accomplished by sending continuous movement instructions to make smooth movement [1]. The movement of the pallet will be achieved by using DC motors.

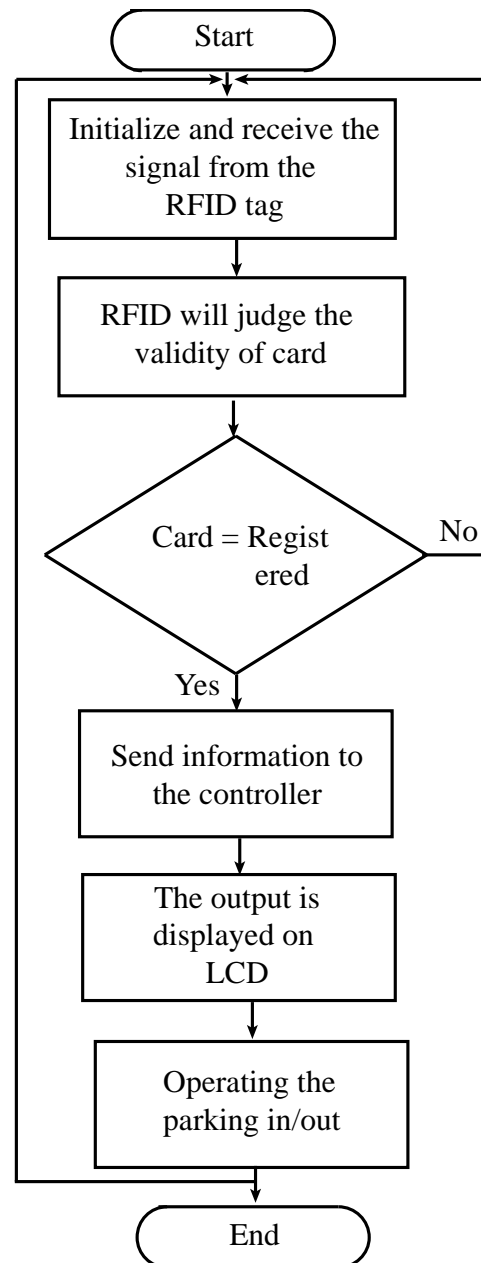


Figure 2: System Flow Chart.

The System flow chart is shown in figure 2. RFID card reader reads the ID number from the RFID tag. Then, the reader sends the ID number to the controller for checking with the database. If the ID number is valid, the user can select the room number. LCD displays the information about the number of cars that can be parked and the vacant place for parking. If the ID number is invalid, an error message will be displayed on the LCD screen and any parking or retrieving of the vehicle cannot be taken.

3.1 SETUP DIAGRAMS OF CAR PARKING SYSTEM

The following pin layout is shown as recommended by the documentation of the MFRC522 library that is used in the programming section [7]. Figure 3 shows the pin connection of RFID, keypad and LCD Display with Arduino Mega. The best thing about servo motor is that it can be connected directly to Arduino. Figure 4 shows the pin connection of motors with Arduino Mega.

The easy driver is used for stepper motor and this driver is able to drive the stepper motor up to 30V. And it has an on board voltage regulator to get precision motor control

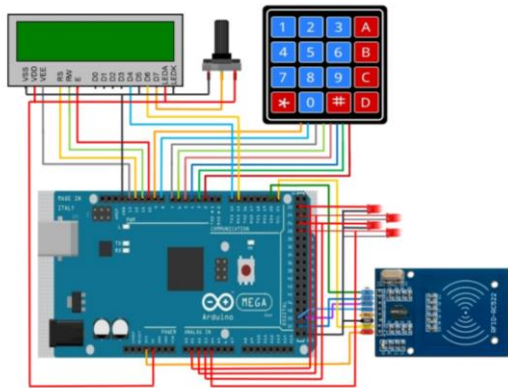


Figure 3: Pin Connection Diagram of RFID, Keypad and LCD Display.

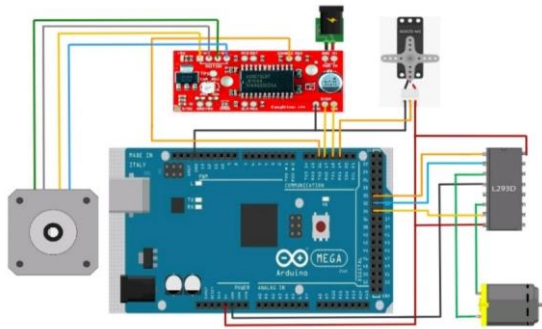


Figure 4: Pin Connection Diagram with Motors

3.2 IMPLEMENTATION AND RESULT

The testing results are presented in this section. Arduino IDE (Integrated Development Environment) software was used to simulate and implement the car parking system. The testing results show that the proposed architecture can achieve an effectively performance.

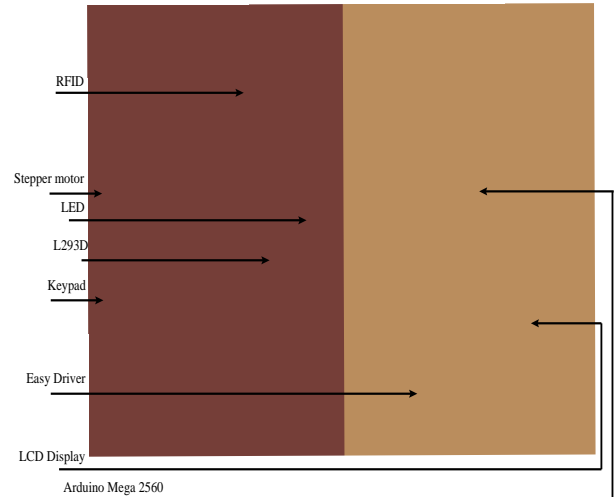


Figure 5: Experimental Setup

Figure 5 describes the experimental setup diagram with Arduino Mega, RFID module, easy driver, stepper motor, L293D motor driver, DC motor, servo motor, 4x4 matrix keypad and LCD display... Figure 6 shows the experimental testing result of DC gear motor with the pallet for position control. Complete model of proposed system is described in figure 7 and that shows a parking tower with three floors and two slots per floor on either sides of the central lift. The operation of vehicle retrievable system is shown in figure 8.

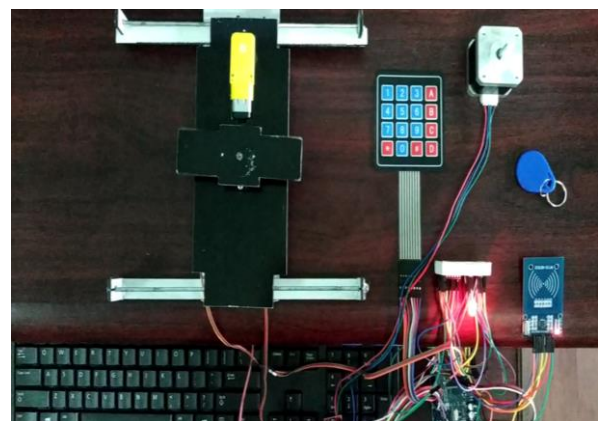


Figure 6: DC Gear Motor Testing

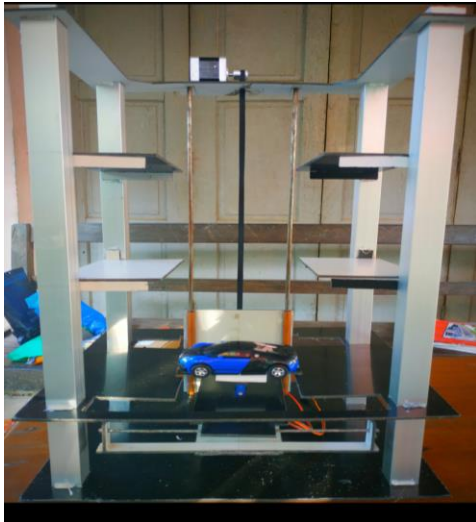


Figure 7: Complete Model of Multi-Storied Car Parking System

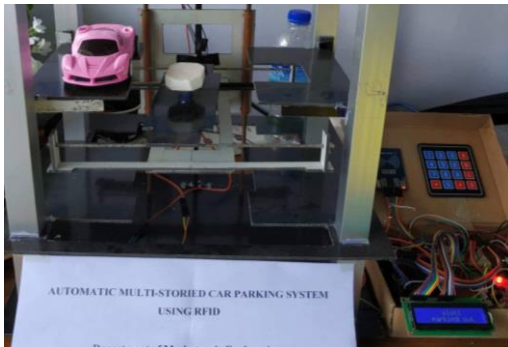


Figure 8: Experimental Result of Multi-Storied Car Parking System

3.3 CONCLUSION

In this paper, RFID based automatic multi-storied car parking system has been implemented for desired objectives. This system is implemented by using RFID technology and AT-mega 2560 microcontroller of Arduino Mega. This result is expected as a very useful solution for the users and developed countries. In further works, this system can be enhanced with additional features and security elements.

4. ACKNOWLEDGMENTS

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