

# Design of an Automated Vehicle Parking System Using Arduino Microcontroller

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**ABSTRACT:** This paper presents an automated car parking system for metropolitan traffic congestion due to increased economic activities. The search for parking space in most metropolitan areas, especially during the rush hours, is difficult for vehicle owners. The difficulty arises from lack of knowledge of the position of any available space for parking at any given time. The proposed system uses infrared transmitter-receiver pairs that remotely communicate the status of parking occupancy to the Arduino and displays the vacant slots on the display at the entrance of the parking lot so that the user gets to know the availability or unavailability of parking space prior to his/her entry into the parking lot. The microcontroller (Arduino), along with Infrared Resistor (IR) sensor are incorporated to monitor entry and exit of vehicles. The vehicles are allowed entry only when they swipe a valid RFID tag at the gate. Each parking slot will have an IR sensor to monitor when it is empty or filled and will update the details on the Liquid Crystal Display (LCD) unit.

**KEYWORDS:** RFID, Arduino, GSM Module, IR Sensor, LCD

## I. INTRODUCTION

Vehicle parking system is a system that is used to help manage cars in parking area in order to avoid congestion as well as the arrangement of cars in an allocated position. The industrial growth of the world is reflected by the increase in the number of automobiles on the streets throughout the world [2], which has caused a lot of parking related problems. The slow paced city planning has increased the problem even more [3]. The search for the parking space is a time consuming process which not only affects the economic activities' efficiency, but also the social interactions and cost [4]. In the 21st century, especially in large urban settlement like Lagos with approximately 13.4 million people of which 23% of the commuters use different public

transportation system, e.g. Lagos State Transport Management Authority (LASTMA), and Bus Rapid Transit (BRT). 77% commute to their work by private cars [8], finding a free vehicle parking slot becomes a mind-boggling process, as they find it highly difficult and challenging to get a parking slot for their vehicles. In trying to park these automobiles in parking space, they use the manual procedure of parking, which most cases are unplanned and lack discipline, because of this, people park their cars anywhere they want to, which creates disorderliness, and as a result of this, a huge traffic jam takes place while parking in and retrieving car. This also causes economical loss to individuals and commercial places like shopping malls, amusement parks as people are more likely not to visit these places due to this parking hazard. Survey has it that one million barrels of world's oil is being burnt everyday as a result of majority of traffic jam and congestion [5]. According to the recent survey, there will be continuous increase in the vehicle's population of over 1.6 billion around 2035, which poses more threat to parking system [8]. Human errors are the major source of traffic jam and accidents, therefore constructing vehicle technologies for checking the parking lot, avoiding accidents and guidance to the parking facility is turning out to be an integral area for research. The objective of such technologies is the reduction of the burden on driver, improvement of the traffic capacity, and provision of reliable and secure car functions [4], [12]. The manual vehicle parking is an inefficient system as it requires man power for management of the parking lot [1]. Parking control and enforcement systems provide efficient and effective monitoring of slots and it also keeps a check on any violations of the parking lot. This results in best possible use of the parking space for increasing the revenue. However, it requires man power which needs some capital [3]. Manually used parking system is not an efficient one; as the drivers are allowed to park without any restriction [6], and

the parking facility cannot be used to its full extent. This gave rise to the several researches on how to make the vehicle parking system better. Today, the automated parking systems are considered beneficial for the vehicle park operators, vehicle park patrons as well as in environment conservation [4]. This paper, the design of an automated vehicle parking system using Arduino Microcontroller focuses on the vehicle parking management system by which every processes are simplified and automated through the visual representation of the parking information showing the empty and occupied slots which help the user to decide where to park their car. The software and hardware system would not only save time but also manage the Check-in and check-outs of the cars under the control of RFID readers/ tags with additional features like the Servo motor controlling the entry and exit of the gate after user authentication at the RFID reader. The integration of GSM Module to send and receive SMS to alert the admin (Security Personnel) of an intrusion.

## II. DESIGN IMPLEMENTATION

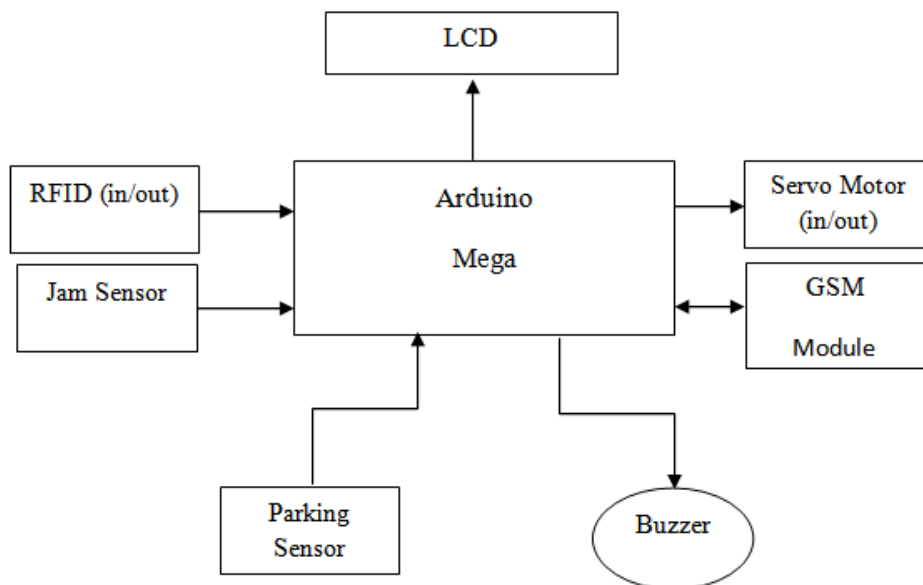
The RFID based automatic parking system is an independent system in itself and does not depend on any service from any external system. All the functions needed is performed by one or other component of the system itself and all the inputs and outputs concerned with our system is handled by various components of the system as detailed below.

### A Materials

The major components involved in this design include:

- i. RFID Reader (EM 18)
- ii. RFID Card
- iii. GSM Module (SIM 800)
- iv. LCD
- v. Buzzer
- vi. Lithium-ion Battery (2200 mAh)
- vii. Servo Motor
- viii. Microcontroller (Arduino Mega)
- ix. IR sensor (exit and entrance)

The proposed system is comprised of three stages to execute the lay-down objectives, namely; the input, processing and output stages respectively. The block diagram of the system is presented in figure 1.



**Figure 1:** Block Diagram of the Automated Vehicle Parking System

The diagram as shown in figure 1, consist mainly of three major components: Arduino Mega, RFID module, and GSM module.

The design and working principle of the system is detailed below:

The block diagram depicted in Figure 1 is made up of 3 major components: Arduino Mega, GSM Module and RFID Module. The core part of

this system is the microcontroller in Arduino Mega. The coding of this system has been done using Arduino IDE software. This software is used to compile the program into the microcontroller. It uses C-programming language for coding. The LCD display will display the number of available slots and it has an IR Receiver Module to get updates about the parkinglot. The vehicle owner has to first

register the vehicle with the parking owner and get the RFID tag. The RFID System consists of a reader, and RFID tags. Each RFID tag records a unique ID and finite information [9]. The tag is triggered when it approaches the RFID reader. The information recorded in the tag is transmitted to the RFID reader. An RFID reader will pass the signal into the digital and computing content. When the car has to be parked, the RFID tag is placed near the RFID reader, which is installed near the entry gate of the parking lot. As soon as the RFID tag placed on the vehicle is read by the reader and also swiped,

the system will send instruction through Arduino to open the gate using RFID Transmitter Module and update the LCD display. At the entrance, Servo motor helps the gate to open up when it gets the signal from Arduino, Arduino will only send the signal to Servo motor after getting necessary information using the RFID Receiver Module. The Arduino sends an error signal through the GSM module to a designated user when there is 3 trial of invalid RFID card and a beep sound through the buzzer as illustrated in figure 2.

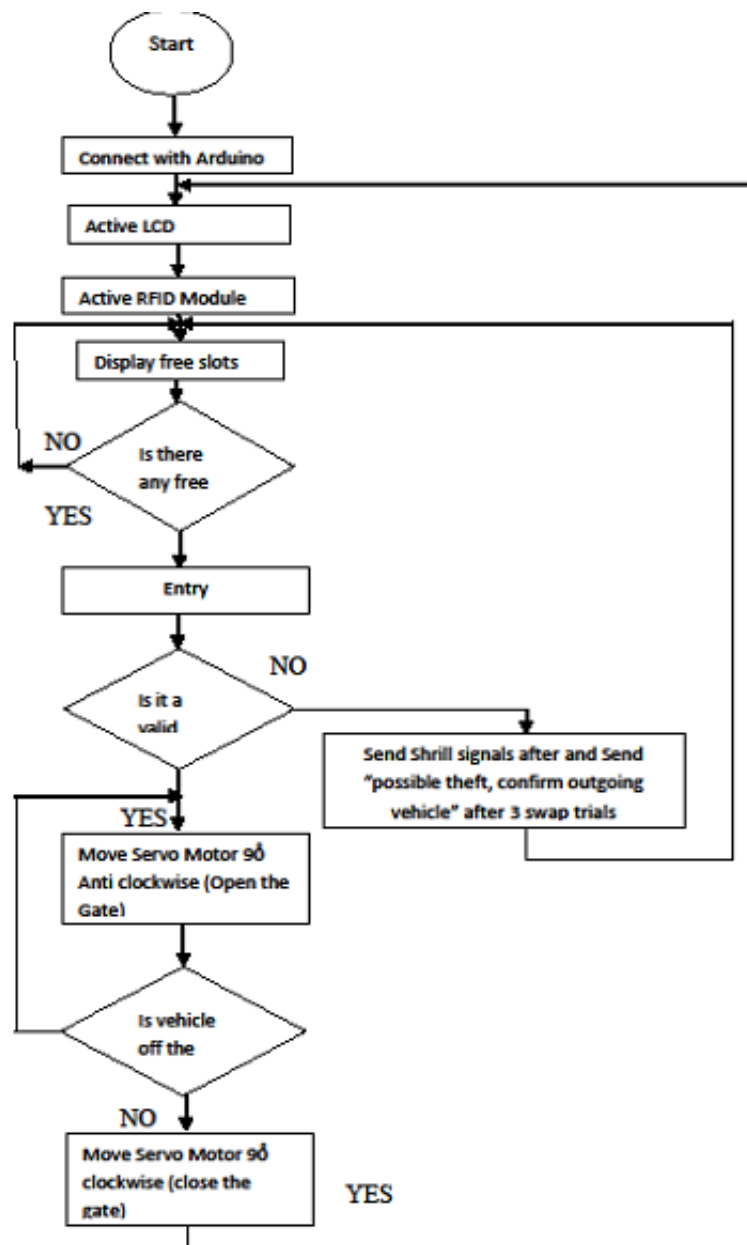


Figure 2: Flowchart Describing the Complete Processes

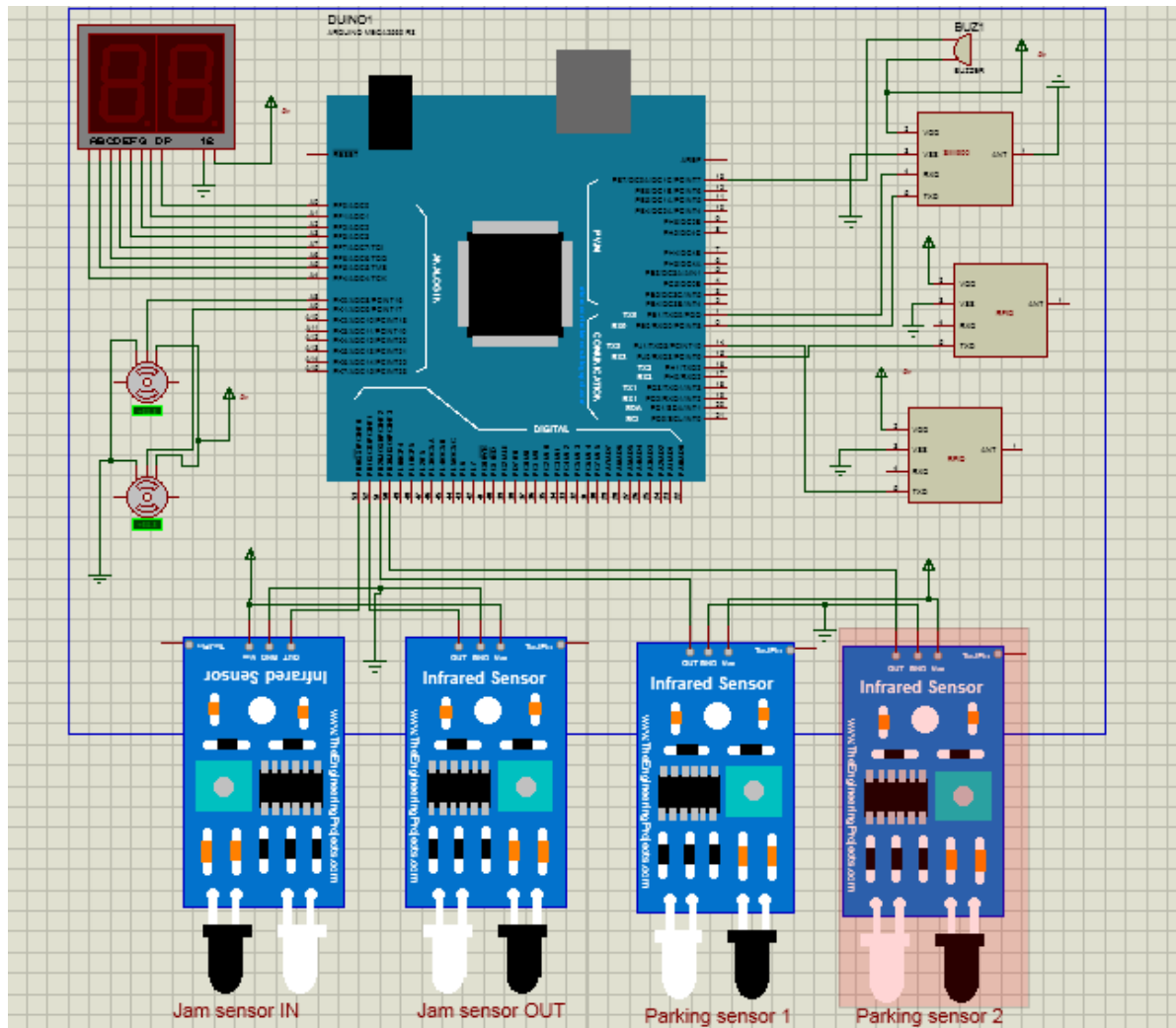


Figure 3. Complete Circuit Diagram of the Smart Parking Lot

### III. RESULT AND DISCUSSION

Due to the increasing demand for vehicle parking space which leads to users involve in real time access of the availability of the parking space leading to congestion, pollution, unorganized parking and theft of vehicles in the process. The existing system in today's world does not involve the facilities of parking reservation and parking slot availability. Therefore, a step-by-step approach in designing the RFID based automated vehicle parking system to tackle the menace. This system requires a number of hardware components, properly integrated in accordance with their specifications. The system requires a continuous and reliable power supply provided to them. Components like the GSM module incorporated for sending message to the designated user, the RFID module to handle the authentication of users before entry and exit, the IR sensors and LED to handle the proximity of objects/vehicle in order to aid in

organized parking. The results obtained as detailed below have shown that the system performance is quite reliable and accurate.

#### A Safety and Easy Location of Vehicle Parking Space

While making use of an Automated Vehicle Parking System, drivers don't have to spend time searching around for an available slot instead they can directly move to an available space which is shown on the LCD as detailed in Plate 1. Driving around searching for parking can be dangerous because drivers do not have a full concentration on the road because their focus is on seeing an available spot. Therefore reaching a parking slot definitely makes it easy for drivers and also removes tension and frustration which increases safety around the vehicle parking. The parking system also monitors the driver's vehicles which also increases safety [5].



**Plate 1:** Diagram Showing the Slot(s) Availability Update

### B Space efficiency and Economical space

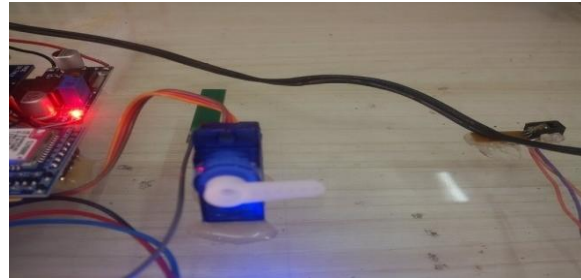
In this design of Automated Vehicle Parking System, client do not have to be worried about how to park or where to park as there will be directive on where to park using the parking sensor for guidance and the line marking for organization and space management as shown in Plate 2, All they have to do is to leave the vehicle at a space as directed. This system removes the need of vehicle owners to move around the parking looking for space to park their vehicle. This system just provides efficient space around.



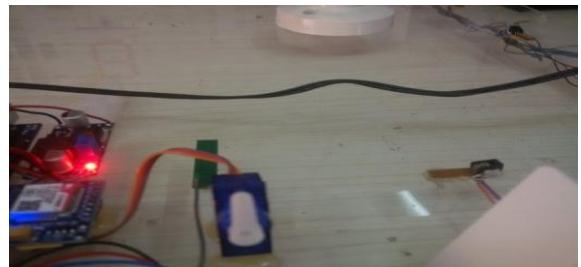
**Plate 2:** Diagram Showing Organized Parking Lot Space and Sensors in each

### A Security of the Automated Vehicle Parking System

The RFID Module was incorporated for vehicle authentication for entry and exit from the lot to offer security of vehicle. After which, the signals are sent to the microcontroller for onward transmission to the Servo Motor to either open/close the gate. Plate 3 shows before the command to open the gate is given to the Servo Motor. Plate 4 shows the gate opened after the command has been given to the servo Motor.



**Plate 3:** Diagram Showing the Closed Gate before Opening Command Was Sent



**Plate 4:** Diagram Showing Opened Gate after the Command was sent

## IV. CONCLUSION

An Automated Vehicle Parking System using an RFID Module was presented and the design proves to be fast and time saving, with the greatest flexibility, user-friendly, secured, cost effective and efficient as it requires little manpower to operate. It proves to be easy and cost effective to implement.

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