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Reservation Based Vehicle Parking System Using GSM and RFID Technology

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ABSTRACT
This paper is to develop a Reservation based vehicle parking reservation system to overcome the problem of unnecessary time consumption in finding parking spot in commercial parking areas. In this proposed system, we reserve the parking slot in shopping malls, theatres and offices by using short message service (SMS). User reserves the slot by sending a message to GSM modem placed at the parking end. GSM modem gives slot number and a password if the slots are available which is used to allow or deny access to the parking area at the entrance and exit. IR sensor is used for the indication of empty slot with a green LED. User can park the vehicle at the given zone, and this is valid up to a certain grace period only after that the priority will be given to next user. RFID technology is used for entering and exiting parking area and also used to debit the amount for parking charges through RFID tag. The main contribution is the system has more security .Thus users can just reserve the parking slots using the SMS.
KEYWORDS: GSM, RFID, IR sensor, SMS

I.   Introduction

In the existing parking system searching for parking space is always been a difficult process. In metropolitan cities it became a major issue due to space problem, no parking zones etc, hence comes the need of such a system which can automatically assists us to search the nearest available parking space in the surrounding area. Thus it will help us in saving time, petrol & money [1]**.** Most of them are manually managed and a little inefficient. All the work is done by staff of the parking slot. Drivers give the money to the staff directly. Many people are not satisfied with the current management of the parking system and the flexibility of finding empty space to park their vehicles. Parking demand is routinely high at theaters, shopping malls and offices. The problem that always occurs at the vehicle parking is time being wasted in searching for the available parking spaces. Users will keep on circling the parking area until they found an empty parking spot. That is, people often "circle around" looking for a good parking space then a traffic jam may occur [2]. Parking is an ever-growing challenge in cities and towns across the world. So the demand for Reservation based parking System is expected to grow rapidly in the near future to eliminate or reduce this problem with parking facility by just reserving their parking slot using the SMS without having to go online. The main objective is to design a parking system with ARM7 (LPC2148) microcontroller which can run on an embedded system. By using GSM and RFID technology the parking problem in big cities, especially the mega-cities, has become one of the key causes of the city traffic congestion. The Reservation based Parking System is considered to be an effective way to improve parking situation.

II.   Hardware Implementation

The proposed system is designed with ARM7 controller as show in the figure 1. The major components used in this system hardware are ARM7 (LPC2148) microcontroller, GSM module & RFID module. ARM7 microcontroller is interfaced with the GSM & RFID modules. Using GSM technology we can check for the parking slot using corresponding commands through SMS (Short Message Service). IR sensor which is placed at the slots sections checks for the availability of the slots, if there any availability a conformation message is received to the user mobile. Conformation message includes Parking slot number, Parking duration, charges for the parking depending upon the time duration & a security code. RFID technology consists of tracking tags attached to objects used for the security constrains and at the parking section and also to debit the amount for parking charges.

2.1 GSM Technology:

Global System for Mobile communication is a digital mobile communication network which has developed rapidly in recent years. It is a globally accepted standard for digital cellular communication and a common European mobile telephone standard for a mobile cellular radio system operating at 900 MHz. In the current work, SIM300 GSM module is used. The SIM300 module is a Triband GSM/GPRS solution in a compact plug in module featuring an industry-standard interface. It is used widely in mobile device standards. Because GSM network has almost covered the whole country, there is no need to set up another network when using wireless technology [3]. Consequently, it can reduce the cost of construction and service which heightens economic benefit. Compared to other wireless network technologies, subscribers access GSM network freely, without any limitation. As the most basic business of GSM network, Short Message Services (SMS) has become more attractive than ever before. With SMS we can realize the function of data bidirectional transmission, and its performance is stable. Therefore, SMS provides powerful platform for remote data transmission.
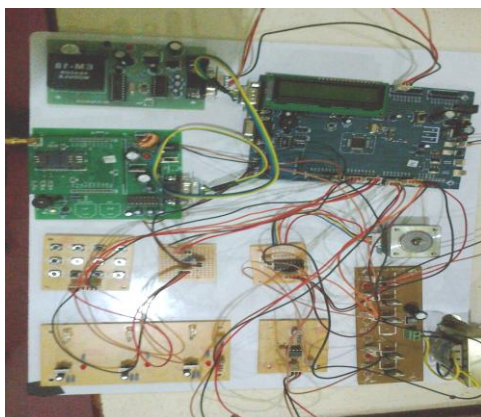

Fig 1: Shows the System hardware

GSM Module named SIMCOM_300 with RS232, power supply; buzzer and audio interface are used. This can be connected to PC by using a USB to Serial Adaptor. Terminal programs such as Real term are used to send & receive data. The interface between GSM Module and microcontroller can also be done directly with the help of wires.GSM modem is shown in figure 2. GSM Module works with AT COMMANDS where AT stands for Application Terminal.

Some useful AT Commands are:
1.   AT
2.   AT+CMGS
3.   AT+CMGR
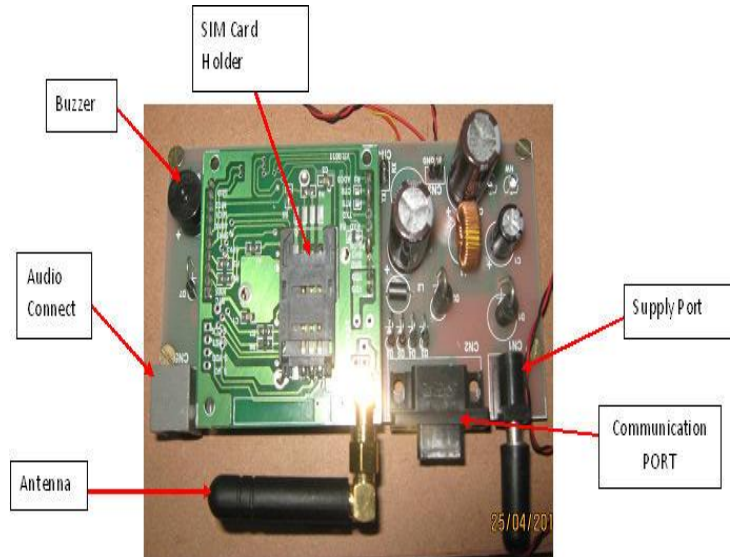4.   AT+CMGD
5.   AT+CSQ?

Fig 2: GSM Modem

For connection between ARM7 microcontroller and GSM, Receiver Pin (Rx) of ARM7 Microcontroller is connected to the Transmitter Pin (Tx) of GSM Module and Transmitter Pin (Tx) of ARM7Microcontroller is connected to the Receiver Pin (Rx) of GSM Module [6].

2.2 RFID Technology:
Radio-frequency identification (RFID) is an automatic identification method wherein the data stored on RFID tags or transponders is remotely retrieved. The RFID tag is a device that can be attached to or incorporated into a product, animal or person for identification and tracking using radio waves. Some tags can be read from several meters away, beyond the line of sight of the reader. It is the use of a wireless non-contact system that uses radio frequency electromagnetic fields to transfer data from a tag attached to an object. Some tags require no battery and are powered by the electromagnetic fields used to read them. Others use a local power source and emit radio waves (electromagnetic radiation at radio frequencies). The tag contains electronically stored information which can be read from up to several meters (yards) away. Unlike a bar code, the tag does not need to be within line of sight of the reader and may be embedded in the tracked object. While RFID's original uses were primarily for inventory tracking in retail environment, this technology has quickly created a presence in an extremely diverse number of fields including easy gas payment, credit card replacements [4] [8].

RFID system has three major Components:
    1. An RFID tag – transponder.
    2. An RFID reader – transceiver.
    3. A predefined protocol for the information transferred.

2.3 IR Sensor:

IR Sensors work by using a specific light sensor to detect a select light wavelength in the Infra-Red (IR) spectrum. By using an LED which produces light at the same wavelength as what the sensor is looking for, you can look at the intensity of the received light. When an object is close to the sensor, the light from the LED bounces off the object and into the light sensor. This results in a large jump in the intensity, which we already know can be detected using a threshold [3].

III. Functional Description

The block diagram of the proposed system is shown in the figure 3. First, the user sends a message to the GSM modem which is placed at the parking end. The GSM modem will send a confirmation message to the user if whether the slot is vacant or not. If it is vacant then the user has to message the exact time and duration he/she wants to park the vehicle in parking spot such as whether the user wants to park their vehicle for 30 min, 60 min, 90 min, 120 min. Then the GSM modem will send the password and the parking lot number to access the reserved parking lot. Once the confirmation message has been sent, the counter for the reservation time will automatically start for sending message.
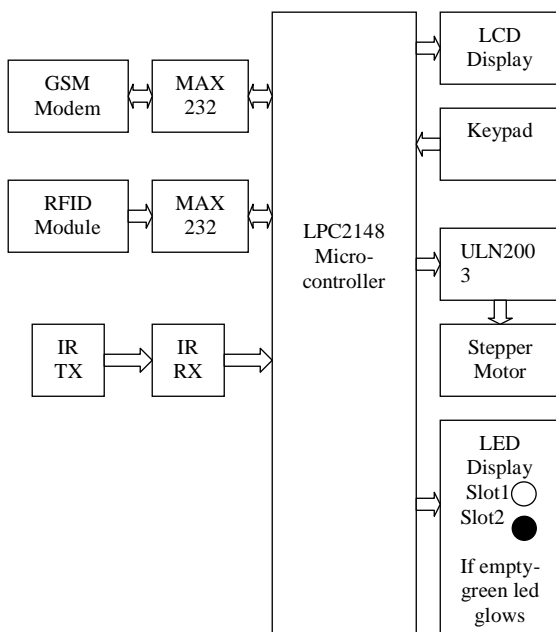
Fig 3: Block Diagram of the proposed System

The equipments used for the system are a 12V relays for barrier gate, matrix keypad to key in the passwords as well as alphanumeric LCD for display is used. The user has to arrive at the parking area within the time limit or else the reservation process will be expired. The user will park the vehicle according to slot number, with the help of the LED indicator. The green LED indicates that the slot is vacant. An IR sensor is positioned at the slot area to sense the presence of the vehicle. Just after the vehicle has parked in selected area, the green LED will be deactivated to indicate that the slot has been occupied. The user will need to use password provided upon confirmation of reservation to enter and exit through the barrier gate. The vehicle owner has to first register the vehicle with the parking owner and get the RFID tag. The tags contain electronically stored information like vehicle registration number, Name of the vehicle user & credit amount for example like petro card etc.., When the vehicle has to be parked, the RFID tag is placed near the RFID reader, which is installed near the entry and exit gate of the parking lot to authenticate only registered users.
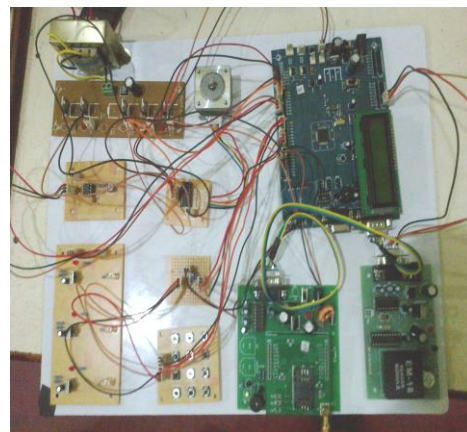
IV. Result Analysis:

Fig 4: Embedded Circuit at the parking Section

The user gives a missed call to authenticate the Phone number and a conformation message is sent to the user.
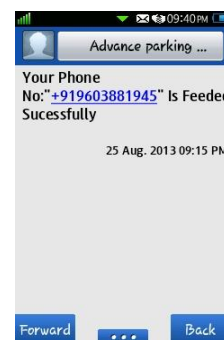
Fig 5: Initialization of GSM

Fig 6: Conformation message is received after giving a missed call to the GSM based Parking reservation

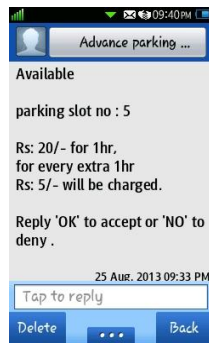Figure 7 (a) shows that checking for the availability using the command **Ck/Prk/avail**

Fig 7(a)

Figure 7 (b) shows the response that will be generated by checking for the availability of parking on a specified date & time using the command **Ck/Prk/avail/dd-mm-yyyy/00:00** & 7(c) shows the response if there is no availability of parking slot.
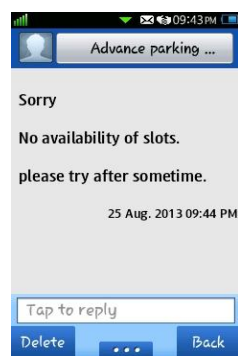
Fig 7(b)   **Fig 7(c)**
Fig 7: (b) A message is received if there is a availability of parking slots.

(c) A message is received if there is no availability of parking slots.

Once, if we accept the parking slot provided by the parking management a conformation message is received includes a security code as shown in the figure-8.
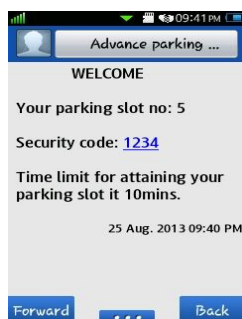
Fig 8: Conformation message is received with security code

The user should arrive at the parking area with in the specified time, or else the password will be expired
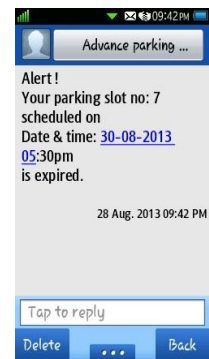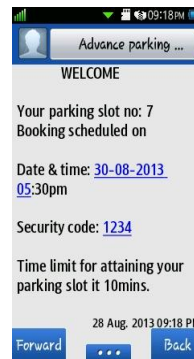
Fig 9: Shows the message on the expired session

V.   Conclusion

The objectives of this project have been achieved. The hassle in searching for available parking slots has been completely eliminated by reserving the slots beforehand via the SMS system and RFID System. These system helpes users reduce the wasting time of search parking slot and also improve the parking slot utilization.

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