

# Online Pay and Park System using ARM Cortex-M3

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**Abstract**–Parking vehicle is often considered as a challenge in urban areas. But with the advent of new technologies in the field of computer system, reliable solutions can be made possible. This paper mainly deals with developing a system that could give information of a vehicle in a parking lot, so that vehicle security is ensured in the parking lot. Here we have achieved the vehicle security with the help of Radio frequency identification (RFID) technology, which helps in identifying the vehicle. Also the web-access functionality enables user accessibility. The features supported by mbed NXP LPC1768 helps in establishing the ethernet connection and the data is uploaded on to a web page. Furthermore, this paper proposes an easily realizable and reliable parking solution.

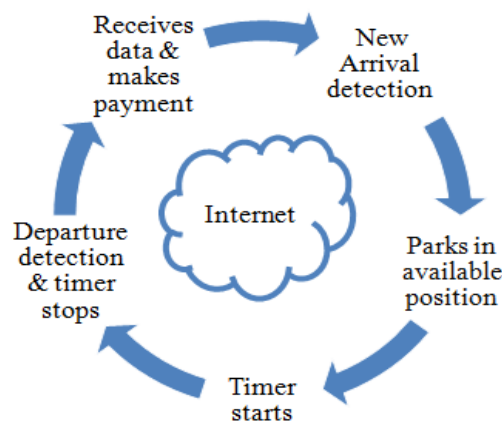
**Index Terms** – RFID, LPC1768, Ethernet.

## I. INTRODUCTION

The computer communication technologies are advancing daily and the internet is playing a major role in our day to day life. The internet could be a quick solution to many of the challenges in daily life. The profound positive impact of web based solution lead to the evolution of many smart systems [2]. This project addresses the vehicle security in a parking slot utilizing web based solutions.

In earlier times people used to follow manual cashing system, in which the presence of a human monitor is required. In addition to this there exists yet another system which is the subscription system, where a token is issued. Here the maintenance of the token collecting system is a difficult hurdle to cross. So a low-cost and reliable parking system should be met. A parking system should meet some basic requirements. Primarily, the presence of the vehicle should be accurately sensed and recorded in real time. In this project this is achieved with the help of radio frequency identification technology. Also necessary guidance should be provided to the residents and visitors about the available free slots in the parking lot. Such information can be easily updated in a web-page to ensure wide-accessibility.

Apart from these a parking lot should simplify the parking experience and should add value on to parking stakeholders. In this project the visitor in a parking slot gets information about the amount need to be payed for the vehicle parked. In addition to it for a perfect parking lot management system certain tools are required for optimizing the workforce management. By introducing internet into control, the restriction of the traditional parking system could be overcome [1] and effectively achieve parking management. The project basically has three important phases which includes interfacing the RFID, in order to verify the identity of the vehicle. Next phase is the ethernet interface which is provided to establish internet connection, and finally uploading the data obtained onto the web page. The ARM Cortex-M3 checks for ethernet connection and one the connection is established it sends data to the web page.

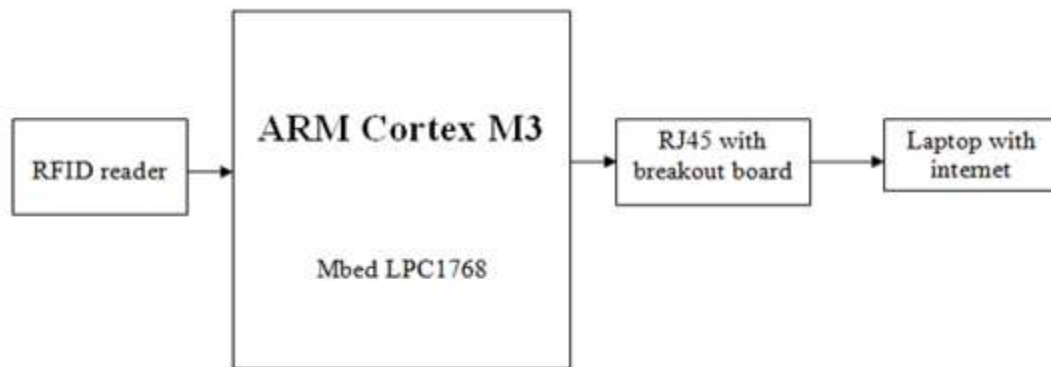


**Fig.1** Basic System View

## II. PAY AND PARK SYSTEM OVERVIEW

The pay and park system mainly includes RFID system and ethernet interface. The hardware part of the project consist of RFID tag which is usually fixed on to the vehicle, the RFID reader which reads the tag ID, and RJ45 socket along with ethernet cable for establishing ethernet connection. A cloud compiler is used as the software tool.

The ID from each vehicle is read and is saved for future reference, upon its entry into the parking slot. The timer is then made ON and until the vehicle leaves, it stays in that position. The processing of the information is done by the host device. The LPC1768 supports ethernet interface and is made possible with the help of RJ45 with a breakout board. The basic block diagram is shown in fig.2



**Fig.2** Block Diagram

### A. The RFID System

Radio frequency identification (RFID) is a wireless technology of non-contact type which uses EM fields to transfer data. The primary purpose is to automatically identify and track the attached tags. The RFID System consists of a reader, and RFID tags. Each RFID tag is associated with a unique ID [4] which is recorded in it and some finite information. The tag when approaches RFID reader it gets triggered. The recorded information in the tag is thus transmitted to the RFID reader.

The RFID reader thus passes the signal into the digital and computing system. In this project the RFID reader is deployed in the parking slot and the tags are placed in the vehicle. Whenever a vehicle with RFID system approaches, the communication between RFID tag attached to the vehicle and the antenna of the RFID system is established automatically. [6] The reader of RFID System then does the translation to the digital content from the signal information. This is repeated when the vehicle leaves the parking slot.

### B. Ethernet Interface System

Ethernet is a local area network, which generally covers only a single building or premises that are close to each other. With the advent of modern technologies it is made realizable for Ethernet networks to have a span of about tens of kilometers. It also allows computers to connect to one another into a network. This is done with the help of special Ethernet hardware and Ethernet protocols. Main part of this project is to transfer the Data which is sent by the host system after processing to the web browser using Ethernet and TCP/IP Protocol. Thus it displays the value by the virtue of internet. Two main protocols are used. One is CSMA/CD Protocol which is primarily for the Ethernet Wire Transfer and the other is TCP/IP Protocol for uploading these values to a Webpage and to display those in PC's. But it is the RFID system together with the LPC1768 which forms the host system that processes and sends the data.

The ethernet interface requires initialization which can be done in two ways; one is using static initialization and other using Dynamic host control protocol (DHCP). In Dynamic host control protocol one can either connect or disconnect the interface, but while connecting we need to start DHCP. The static initialization includes the gateway address, IP address and the MAC address. The default gateway, is just a router interface which is connected to the local network that sends packet out of network. The IP address indicates each and every computer and devices in the corresponding network. The MAC address is the unique identifier which is assigned to a network interface for communication with others. MAC address is used as a network address for most IEEE 802 network technologies, including the Ethernet. For a static initialization a Network-mask is used for dividing the IP addresses into subnets and to indicate the available hosts. In static initialization of Ethernet interface the Gateway address, the IP address and the MAC address are to be specified manually.

## III. METHODOLOGY

The pay and park system is achieved with the help of ethernet. This project requires ethernet connection to be established, which forms the primary task. The project method is explained in detail in the flowchart that is shown in Fig.3. Initially the ethernet connection is to be initialized which can be either static or DHCP. Here in this project Dynamic host control protocol is used so as to initialize the ethernet connection. Next is to initialize the web socket and provide the address. Now connection can be made possible to web socket. If connection is made true then the system can proceed to further stage. The RFID tag ID is read by the reader and is then send to the LPC1768. It stores the ID thus read as Current ID (CID). Initially the previous ID (PID) would be zero. If the CID is not equal to PID then it will start the timer. The timer is made to work and the amount to be payed is uploaded onto the webpage.

Here we need to send the data in real time, so we go for web-socket[5] which allows communication between the server and client in real time. The Web-Socket simplifies the complexity in communication and manages the connection. Once the vehicle moves out of the slot the previously read CID is stored into the PID. The newly read ID occupies the CID, which is again compared

against the PID. Now as since the ID's are same timer stops. This is again repeated and continued. The web-page requires refreshing which is done every minute.

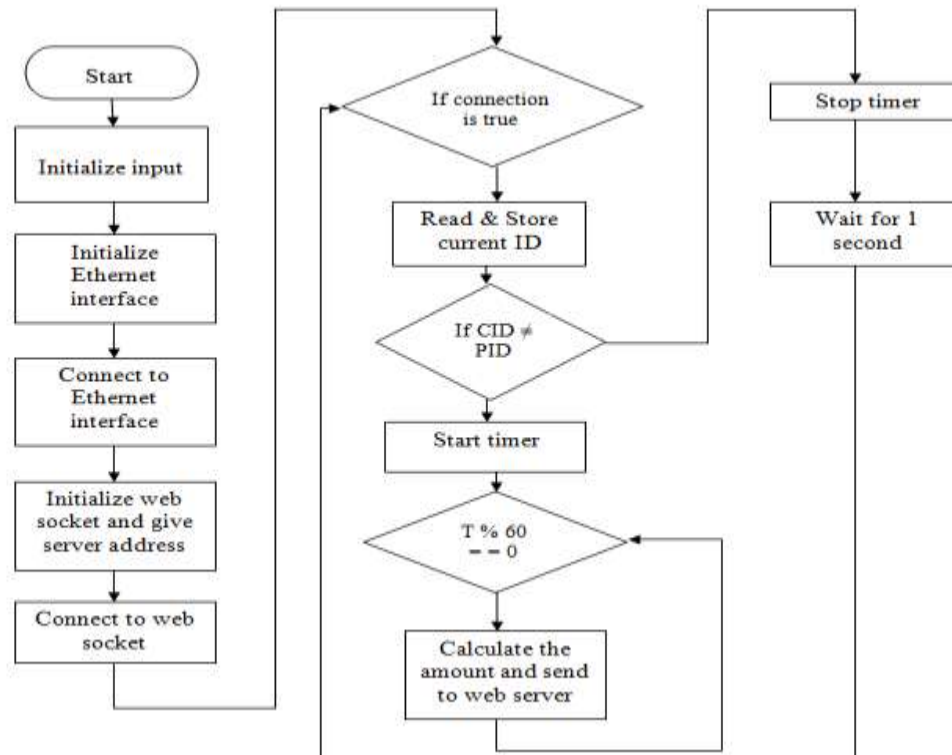


Fig.3 System Flowchart

#### IV. EXPERIMENTAL RESULTS

The system implemented updates information of vehicle in a parking slot. This includes the time for which the vehicle is parked in the slot and the amount to be paid. The processing of data is done in LPC1768 ARM Cortex-M3 [3] and transfers these values to the internet with the help of Ethernet data transfer concept. The project is accomplished with the help of the hardware features supported by the mbed LPC1768. Once the connections are made the RFID tag is swiped and the reading is indicated by a buzzer, followed by glowing of an LED. The Sparkfun's RJ45 with breakout board is used to connect the cable to the PC. For the transfer of data the TCP/IP protocol plays an important role. It helps the data to be stored in specified address. The webpage is refreshed every minute automatically, which helps in obtaining updated information. This is controlled while programming.

#### V. CONCLUSION

The parking system thus implemented using mbed LPC1768 ensures vehicle safety providing information about the vehicle. This mainly includes the time for which it is parked and the amount it needs to pay. This system requires less maintenance cost compared to the traditional token based on-street parking control system. It can be implemented in railways and airports where vehicle parking is difficult and often vehicle security is a threat. This can be extended by incorporating more number of slots and additional tools for optimizing workforce management.

#### VI. ACKNOWLEDGMENT

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