www.ijecs.in
International Journal Of Engineering And Computer Science ISSN:2319-7242
Volume 3 Issue 5, May 2014, Page No. 5773-5775

AUTOMATED PARKING SYSTEM WITH BLUETOOTH ACCESS

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ABSTRACT

This paper aims at the prospect of developing a fully automated parking system for two wheelers and cars. This proposed system improvises upon the existing parking system by enhancing its security features and automating the parking process thus eliminating the need for manual intervention. For authentication and owner identification the parking system has an inbuilt Bluetooth reader. The user has to start his/her mobile's Bluetooth for identification and registration. The Bluetooth reader fetches the user's Bluetooth number and transfers it to database. The user has to re-start his/her Bluetooth at the time of exit. This eliminates the use of tokens or paper bills. The space management and automation is performed with the help of an ARM microcontroller which controls the mechanical motors to park the vehicle at an appropriate parking location [5].

Keywords: Bluetooth, LCD (Liquid Crystal Display), ARM Cortex M3, Rack and pinion.

1. INTRODUCTION

Two get an overview of the proposed system and to understand the advantages of using Bluetooth as a means of access, let us discuss the two things part by part so that we get a clear insight into the working of the system.

1.1 Bluetooth

Bluetooth is a wireless technology standard for exchanging data over short distances (using short-wavelength UHF radio waves in the ISM band from 2.4 to 2.485 GHz[2]) from fixed and mobile devices, and building personal area networks (PANs). Invented by telecom vendor Ericsson in 1994,it was originally conceived as a wireless alternative toRS-232 data cables. It can connect several devices, overcoming problems of synchronization.

Bluetooth is managed by the Bluetooth Special Interest Group (SIG), which has more than 19,000 member companies in the areas of telecommunication, computing, networking, and consumer electronics.[4] Bluetooth was standardized as IEEE 802.15.1, but the standard is no longer maintained. The SIG oversees the development of the specification, manages the qualification program, and protects the trademarks.[5] To be marketed as a Bluetooth device, it must be qualified to standards defined by the SIG.[6] A network of patents is required to implement the technology, which is licensed only for that qualifying device.

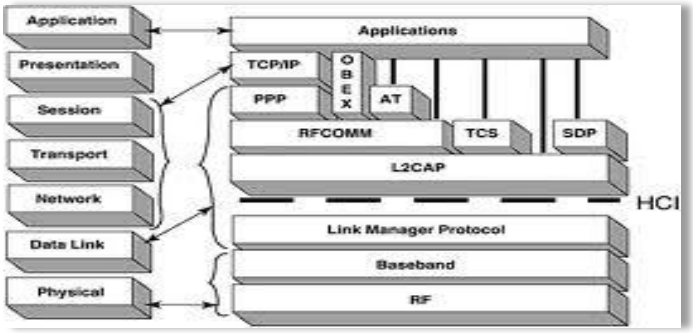

Fig 1: Bluetooth Protocol Stack

Fig 2:Bluetooth connecting

Depending upon the technology used the cards can be sub-divided into three categories which are contact cards, contactless cards and dual interface or hybrid cards. The contact cards consist of contact pads to interact with the smart card reader, the contactless cards have antennae and the dual interface cards have both the features [8].

India is taking a significant initiative for the implementation of smartcards in various fields. All the smartcards used in India must fulfil a set standards laid down by SCOSTA. The acronym 'SCOSTA' stands for Smart Card Operating System for Transport Applications and is the operating system specification for smartcards to be used as vehicle registration cards and drivers' license cards in India.

a) **Range**

Range is application specific and although a minimum range is mandated by the Core Specification, there is not a limit and manufacturers can tune their implementation to support the use case they are enabling.

Range may vary depending on class of radio used in an implementation:

- Class 3 radios – have a range of up to 1 meter or 3 feet
- Class 2 radios – most commonly found in mobile devices – have a range of 10 meters or 33 feet
- Class 1 radios – used primarily in industrial use cases – have a range of 100 meters or 300 feet

b) Power

- The most commonly used radio is Class 2 and uses 2.5 mW of power. Bluetooth technology is designed to have very low power consumption. This is reinforced in the specification by allowing radios to be powered down when inactive.
- The Generic Alternate MAC/PHY in Version 3.0 HS enables the discovery of remote AMPs for high speed devices and turns on the radio only when needed for data transfer giving a power optimization benefit as well as aiding in the security of the radios.
- Bluetooth low energy technology, optimized for devices requiring maximum battery life instead of a high data transfer rate, consumes between 1/2 and 1/100 the power of classic Bluetooth technology.

1.2 Automated Parking System

An Automated Parking System is a mechanism designed to minimize the area required for parking vehicles. It resembles a multi-story garage which provides parking facility for vehicles on multiple levels stacked one above the other to optimize the number of parking spaces while reducing land usage. Separate floors are assigned for two wheelers and four wheelers. This system makes use of a mechanical system that transports vehicles to and from parking lots rather than the vehicle owner; so as to eliminate the wastage of space. It is analogous to an automated storage and retrieval system for vehicles.

2. SYSTEM ARCHITECTURE

This parking system is fully automated and easy to access. The user drives the vehicle into a transfer area. The driver and all passengers de-board the vehicle. The driver starts his/her Bluetooth and initiates the parking process. The Bluetooth reader fetches the owner's unique number and then sends appropriate commands to the microcontroller which, thereafter, assigns an empty parking slot depending upon the type of the vehicle (two wheeler/four wheeler). When driver and passengers have left the entry area, the mechanical system lifts the car and transports it to a predetermined parking space in the parking garage. The vehicle is transported to the parking location with the help of a rack and pinion mechanism for linear motion. Since the build-up of the parking space is cylindrical in shape, linear motion along X-Y axes and rotational motion in X plane is used to place the vehicle in the specified position.

The driver retrieves the vehicle by re-starting his mobile's Bluetooth. The system calculates the parking charges to be collected according to the duration of parking and the type of vehicle. The driver makes the payment. The parking system then lifts the vehicle from its parking space and transfers it to an exit area using the same rack and pinion mechanism. Also, the retrieved vehicle is oriented in a direction similar to the exit route to do away with the need for the driver to back out.

Thus this fully automated parking system theoretically eliminates the need for parking attendants by using the vehicle owner's Bluetooth as a means of authentication and identification.\

Fig 3: The Proposed Parking System

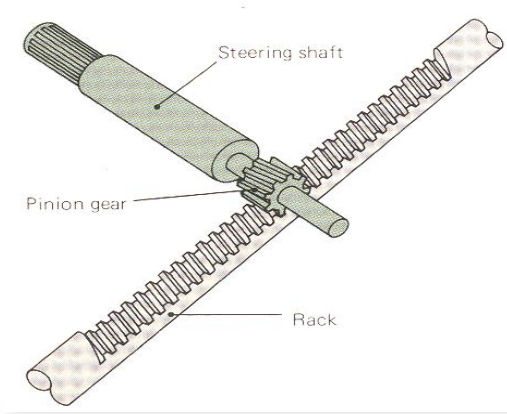

Fig 4: Rack and pinion arrangement

3. SYSTEM WORKING

During the parking process, the driver places his vehicle on a movable platform at the entrance of the parking lot. He/she then starts his/her mobile's Bluetooth. The Bluetooth reader terminal uses file access protocols to fetch the unique registration number stored in the Bluetooth chip in the mobile and forward it to ARM Cortex M3 microcontroller implementing the Serial Peripheral Interface (SPI) mode. The ARM microcontroller compares this with other registration numbers already stored in the memory. In case of mismatch the microcontroller decides that there is a new vehicle which needs to be parked and it initiates the parking process otherwise, it concludes that the vehicle which has already been parked needs to be retrieved and starts the retrieving process[1][3].

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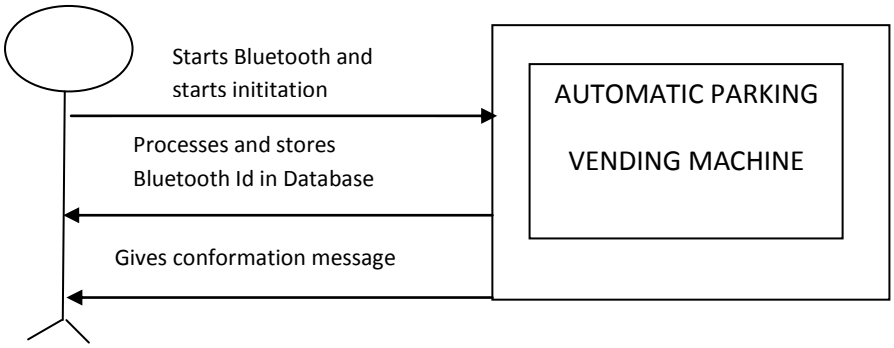

Fig 5: ENTRY PROCESS

During the parking process the microcontroller first stores the unique registration number in the memory, determines the nearest empty slot[6] and instructs the user to press

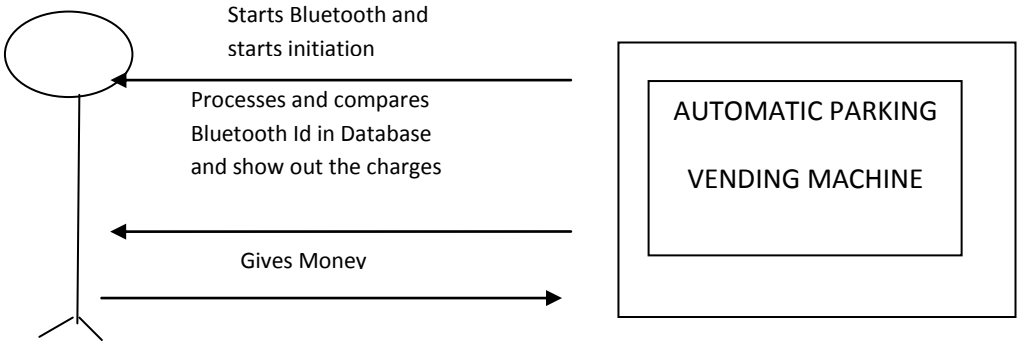

Fig 6: EXIT PROCESS

start button. After the start button is pressed, the microcontroller directs the motor driver circuit to act in accordance with the commands given. The LCD screen attached with the microcontroller displays "Parking in Progress". The motor driver circuit operates the motors according to the commands and the vehicle is parked at the nearest vacant location assigned by cortex M3.After the vehicle is parked the LCD displays the message "Parking Successful". The microcontroller stores the exact location of the parking slot corresponding to the specific registration number in the memory. During the retrieval procedure the microcontroller compares the registration number with those already existing in its memory. In case, the exact match is found the microcontroller fetches the location of the vehicle corresponding to the specific registration number from its memory. Accordingly it gives command to the motor driver circuit to retrieve the vehicle and the LCD displays "Retrieval in progress". The LCD will display "Successful retrieval" after the vehicle is retrieved from its parking location and brought back to the starting platform. The microcontroller then deletes that particular registration number from its database and waits for the next input from the reader terminal. The ARM Cortex M3 is programmed using Kiel uVision IDE[7].

4. ADVANTAGES

i. Eliminates the need for additional parking tokens.
ii. As every Bluetooth has a unique registration number so the system is free from redundancy.
iii. A significant advantage of this system is that Bluetooth reader and device is very cheap in comparison to NFC and other reader.
iv. Parking area is fully utilised since no extra space allowance need be made for driving the car into the parking space or for the opening of car doors.
v. No driving lanes or ramps are needed to drive the vehicle to/from the entrance/exit to a parking space.
vi. The parked vehicles and their contents are more secure since there is no manual access to parked vehicles.
vii. Minor damages such as scrapes and dents are eradicated.
viii. Driving around in search of a parking space is not required, hence, saving time and fuel.
ix. Bluetooth is available in every mobile phone.
x. Reduces cost of manual labour and paper tokens.
xi. Power consumption to operate Bluetooth is very low.

5. LIMITATIONS

i. The installation period and the initial cost of setup is high.
ii. Due to single entry and exit point there will be a deadlock situation if several vehicles arrive simultaneously.
iii. Bluetooth range in the device needs to be set low to avoid miss- communication

6. FUTURE SCOPE

Multiple routes for entry and exit points can be constructed to facilitate free flow of vehicles.

7. CONCLUSION

We, hereby, presented a detailed description of our Automated Parking System. It helps to alleviate the shortcomings of current parking systems. The biggest challenge that one faces in a system are specifically those manual processes which directly affect its revenue. In this system, we identified those processes to be issuance of parking slips to the customers and calculating the amount of time for which the vehicle has been parked because this is such a business where every minute is accountable and is being charged from the customers. Hence there has been a conscious attempt in the application to completely remove this hassle in the daily operations being done in this system. And even though the initial cost of setup is high, it is worth implementing as it provides an efficient way of optimizing space, performance and security.

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