ISSN 2348 – 9928
IJAICT Volume 6, Issue 8, August 2019 Doi:01.0401/ijaict.2016.11.09 Published on 05 (8) 2019

SMART PARKING SYSTEM ARCHITECTURE USING INFRARED DETECTOR

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Abstract – *With the rapid growth in vehicle production and world population, vehicle availability and usage on the road in recent years, finding a space for parking the car is becoming more and more difficult which resulting in a number of conflicts such as traffic problems. In this paper a new parking system called Smart Parking System (SPS) is proposed to assist drivers to find vacant spaces in a car park in a shorter time. This system proposes a safe and efficient parking system which will work on sensor communication and secured wireless network. The new system uses infrared sensors to detect either car park occupancy or improper parking actions. The system includes two modules, parking lot vacancy monitoring module, and master module. Parking lot vacancy monitoring module consists of digital infrared sensor, liquid crystal display (LCD) and Zigbee module which are interfaced with microcontroller. Master modules include laptop GUI display and Zigbee modules. The user can get the status of parking lot vacancy through the LCD of monitoring parking vacancy module. The Zigbee transceiver on monitoring parking vacancy module which is interfaced with microcontroller is used to transmit the infrared sensor data. When the digital infrared sensor detects the presence of vehicle in the parking areas and thus provides the status of the parking lot to be displayed in master module with Graphical User interface (GUI). Using this system, we can easily find vacant space for parking and parking waiting time is reduced efficiently.*

Keywords— *Parking Monitoring, Zigbee, Graphical User Interface (GUI), IR Sensor.*

I. INTRODUCTION

As parking becomes a very essential requirement in our day to day life, we look forward to planning and acquiring a secured parking spot before heading out towards our destination in order to reduce the hassle of driving around looking for a parking spot during park hours. Recent years there has been a growing credit of the importance of parking issues in the urban area parking lots [1]. With the fast pace development of national economy and living standards, the automotive industry and population is becoming more and more demanding [2]. Finding a vacant space in a multilevel parking lot is difficult, especially on weekends or public holidays. A study showed that finding spaces during weekends or public holidays can take more than 10 minutes for about 66% of visitors. Stadiums or shopping malls are crowded at peak periods, and difficulties in finding vacant slots at these places are major problem for customers [4]. Therefore, insufficient car park spaces lead to traffic congestion and driver frustration [5].

Recently in Malaysia, there are various methods used in parking lot to detect the presence of car as in [6], the authors proposed a Secure Parking Reservation System where GSM technology is used to send the data-base password to those drivers enquiry for a reservation of parking lot. The password is needed in order for the drivers to enter and exit the parking lot. Other than that, image processing technique is applied in parking to detect the presence of vehicles rather than using sensor [7]. Moreover, infrared sensor is used in Smart Parking System (SPS) [9] to detect the presence of vehicles in parking lot and shows a green LED if there is no vehicles detected and red if there is occupancy of vehicles in that certain parking lot. The LED is installed at the top of every parking lot.

II. RELATED WORK

In this section, we briefly inspection the existing systems for parking guidance and information system and based on their main contributions, try to classify them into image processing oriented and infrared oriented [8]. The IR transceiver modules are placed in the parking slot to detect whether the car is placed or not. When the car is placed in between the IR transceiver then the output of the IR module is connected to microcontroller.

The microcontroller is also connected with a zigbee transceiver, which transmits the data to the other zigbee transceiver which is connected to the server [8]. In the server a Graphical User Interface (GUI) is created, the parking vacant situation is updated in the GUI through zigbee transceiver with

ISSN 2348 – 9928
Doi:01.0401/ijaict.2016.11.09 Published on 05 (8) 2019

serial communication. The user can take the parking slot through online.

2.1 Parking Lot Vacancy Monitoring Module

The parking lot is provided with digital infrared sensor and is permitted to sense the parking lot continuously. Whenever it detects the presence of vehicles in parking lot, it will generate event on presence of vehicles to the microcontroller to which it is interfaced [10]. Then, microcontroller will send the information get from digital infrared sensor to both LCD and Zigbee module. The Zigbee module transmits the status data to the Zigbee receiver at the master module at the entrance of parking lot. Then the status of parking lot is continuous updated in the master module. The LCD display is placed at the entrance of parking lot to display the number of available parking lot. Figure 1 below shows the flow chart of parking lot monitoring module [10].

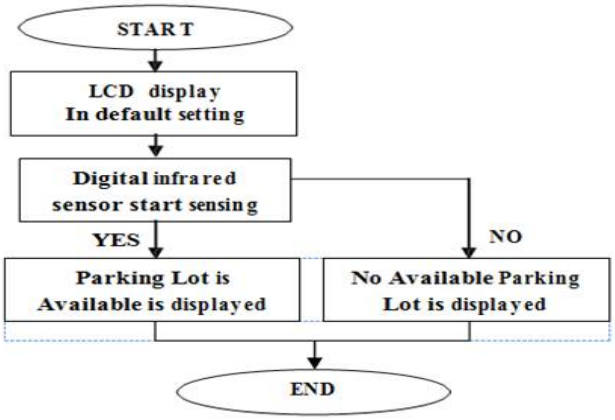

Fig 1: Flow Chart of Parking Lot Vacancy Monitoring Module

2.2 Master Module

The flow chart of master module [10] is as shown in Fig 2. Once the system is started, the Zigbee node will receive the status information from parking lot monitoring vacancy module and master module will start to check whether there is any vacancy in parking lot and then display on the GUI display.

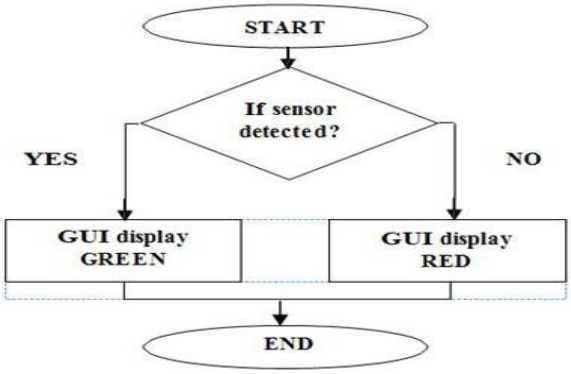

Fig 2: Flow Chart of Master Module

III. PROPOSED SYSTEM DESCRIPTION

3.1 SPS User Overview

In order to find vacant spaces, drivers look at an LED display board which shows how many and which type of vacant spaces are available at each level at that time. After navigating to the desired parking level, drivers look at internal signs hanging from the ceiling at the end of each aisle. Each internal sign shows two parts: the number of available spaces and the direction (left, right or forward) of the aisle which has a vacant space. Each individual parking space is equipped with LED lights which are located above the space and can show green, red, blue or yellow [9]. The color indicates the status of that space: green means the space is vacant, red means the space is occupied, blue means the space is assigned for handicapped drivers and yellow means it has been booked or is a VIP or reserved space for specific reasons. When the driver enters a vacant space, the green light changes to red. Figure 3 shows the four steps of utilizing a car park guidance system.

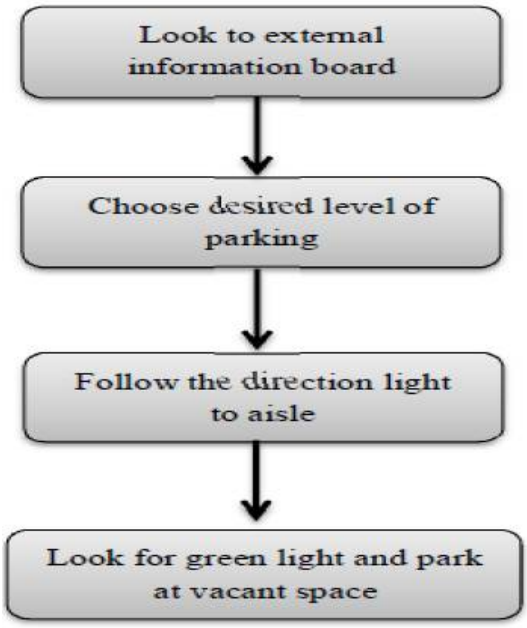

Fig 3: Overview of Smart Parking System

3.2 SPS Features

Smart Parking System (SPS) consists of main and secondary features for different purposes and situations. Some of the features mentioned in this paper will be part of future research. The main features of SPS [9] are:

- Detect occupancy status of each individual space in a multilevel parking lot.
- Display the number of available spaces at entrance of parking lot, at entrance to each level, and at end of each aisle.

- Display directional signage for each aisle, showing drivers which direction has vacant spaces.
- Parking monitoring and management software to coordinate and operate the various features.
- Display different colored LED lights to differentiate between spaces (reserved, occupied, vacant or handicapped)
- "Touch and Go" module to facilitate payment of parking fees.
- Assign space beside each directional sign for advertising purposes.
- Line detection system to avoid improper parking.

IV. HARDWARE DESIGN OVERVIEW

The Monitoring Parking Space Vacancy System consists of IR sensor module, microcontroller PIC 18F4550, Zigbee module, GUI display (PC or Laptop) and LCD module [10]. Every parking lot is installed with digital infrared sensor which is function to monitor the parking area. The digital infrared sensor and Zigbee module are interfaced with microcontroller PIC 18F4550. The parking lot status is updated and transmitted continuously to the master module. There is UART communication happened between Zigbee and microcontroller. Consequently, master module will have Zigbee module interfaced with it function is to receive the transmitted parking lot status from Parking Lot Vacancy Monitoring Module.

4.1 Microcontroller

Microcontroller is defined as a small computer with integrated circuit containing a core processor, memory and programmable input/output peripherals. Nowadays, microcontroller is widely used in automobile engine control systems, remote controls, office machine and toys [3]. The PIC 18F4550 family introduces design enhancements that make these microcontrollers a logical choice for many high-performance applications. PIC 18F4550 is a good choice for this system in term of cost effectiveness and efficiency.

4.2 Zigbee Module

ZigBee is an energy saving communication standard designed for low-power short-range communications between wireless devices. Zigbee is a low power radio frequency node which operates on a license free frequency band. It operates on 2.4 GHz frequency band. The UART interface can connect directly from microcontroller to pin of Zigbee module. Using UART interface, communication between wireless devices and microcontroller can be done. Zigbee module is used to transmit the parking lot status to master module for GUI display.

4.3 Infrared (IR) Sensor Module

In this proposed system we were used IR module as sensing node because of its simplicity, low cost, rugged operation. Infrared transmitter is one type of LED which emits infrared rays generally called as IR Transmitter [8]. Similarly IR Receiver is used to receive the IR rays transmitted by the IR transmitter. One important point is both IR transmitter and receiver should be placed straight line to each other. The transmitted signal is given to IR transmitter whenever the signal is high, the IR transmitter LED is conducting it passes the IR rays to the receiver. The IR receiver is connected with comparator. In the comparator circuit the reference voltage is given to inverting input terminal. The non inverting input terminal is connected IR receiver. When interrupt the IR rays between the IR transmitter and receiver, the IR receiver is not conducting. So the comparator non inverting input terminal voltage is higher than inverting input. Now the comparator output is in the range of +5V. This voltage is given to microcontroller or PC and LED so, LED will glow. When IR transmitter passes the rays to receiver, the IR receiver is conducting due to that non inverting input voltage is lower than inverting input. Now the comparator output is GND so the output is given to microcontroller [8].

4.4 LCD Module

LCD module is display unit interfaced with microcontroller which is placed at the entrance of parking area. The LCD module plays a role to display the status of parking lot where drivers can view the status before entering the parking lot [10].

V. RESULT AND DISCUSSION

The screenshot and the prototype of parking lot monitoring system are shown in the figure below. The Fig. 4 shows the circuitry board of the parking lot vacancy monitoring module.

Fig 4: Circuitry Board of the Parking Lot Vacancy Monitoring Module

Zigbee is used to implement on this project due to its low cost and low power consumption as well as its long range data integrity can sense up to 30 m in indoors and up to 100 m in outdoor. It is a new wireless data transmission technology that currently being use in many applications and various fields. The GUI display that design in this project is to display the availability of each parking lot that put under monitor whereas as can be seen in [3], the GUI display is to shows the reception of the user request for lot reservation.

VI. CONCLUSION

The proposed architecture of monitoring parking space availability system can effectively satisfied the basic requirement of a driver on parking system. The sensor technology is done by using digital infrared sensor play its role in sensing the presence of vehicles. The wireless technology as well successfully transmits the parking lot status data wirelessly from parking lot vacancy monitoring module to master module. Furthermore, the GUI display can monitor the parking space continuously and the status of parking lot is updated in real time. Therefore, this proposed system can overcome the traffic congestion in finding available parking vacancy. At the same time, it offers time savings and reliability which convince the users all time. The advantages consists of less time spend and fuel consumptions while finding for parking space.

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