VEHICLE PARKING SYSTEM USING IoT

Dr.G.M.Rajathi
Department of Electronics and Communication Engineering
Sri Ramakrishna Engineering College
Coimbatore, India
rajathi.gm@srec.ac.in

Mydilee.K.V. ,T.Revathi
Department of Electronics and Communication Engineering
Sri Ramakrishna Engineering College
Coimbatore, India
mydileevijay@gmail.com

***Abstract*—This paper proposes a smart parking system detecting, finding the parked location of a consumer's vehicle and also detecting any presence of obstacle in the parking lane. Using Ardiuno, infrared and ultrasonic sensor, the proposed system detects vehicles in indoor parking fields, accurately and also it detects any obstacle if present in the parking lane. WiFi module with local WiFi connectivity is used to update whether the lane is booked or empty through the obtained IP address.**

***Keywords*—Ardiuno; WiFi module; Embedded C;**

1. INTRODUCTION

1. Recently, IoT(Internet of Things) has studied in the various application fields of human living space. IoT is based on the smart sensors and the middleware for connecting between clients and terminal devices. It can provide the public with the interesting information about various things deployed in our surrounding environment. In particular, the smart parking system is one of the main projects for IoT.

In legacy parking management systems, only the administrator has information about the parking spaces occupied by vehicles. Since the existing parking system cannot use the active information exchanging, it did not provide useful parking information for drivers. To solve this problem, smart

Fig.1. Overall Block Diagram

sensors and the middleware for handing them are needed.

The vehicle parking location service has been proposed on the using of RFID devices. In this service, the drivers have to receive an RFID tag on the entrance of parking lot. The tag provides the vehicle location service for drivers through the RFID reader of parking space. However, this approach is inconvenient because the driver must receive the RFID tag inthe entrance. In addition, the cost for RFID tag is needed.

This paper proposes a new smart parking system to solve the problem of the exiting parking systems based on the local WiFi connectivity. The proposed system uses infrared sensors for indoor parking lots and a ultrasonic sensor for detecting the obstacle. For the location service of parking vehicles, the WiFi is exploited.

Fig.1 shows the overall block diagram of the implementation of parking system detection using IoT. The Infrared sensor senses whether if there is any vehicle parked in the lane or not. When the parking lane gets booked or empty, the WiFi module connected to Ardiuno board, directly updates the information to the user through local wifi connectivity generating an IP address. With the IP address generated, the user gets the information through PC monitoring or through his/her mobile phone.

A. 2. SOFTWARE USED

B. A. Embedded C

The open-source **Arduino** Software (**IDE**) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open-source software. This software can be used with any Arduino board.

A program for Arduino may be written in any programming language for a compiler that produces binary machine code for the target processor. Atmel provides a development environment for their microcontrollers, AVR Studio and the newer Atmel Studio. The Arduino project provides the Arduino integrated development environment (IDE), which is a cross-platform application written in the programming language Java. It originated from the IDE for the languages *Processing* and *Wiring*. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple *one-click* mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus.

The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub *main()* into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program to convert the executable code into a text file in

hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

3.HARDWARE USED

A. **Ardiuno**

Arduino is a computer hardware and software company, project, and user community that designs and manufactures microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. The project's products are distributed as open-source hardware and software, which are licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL), permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially in preassembled form, or as do-it-yourself kits.

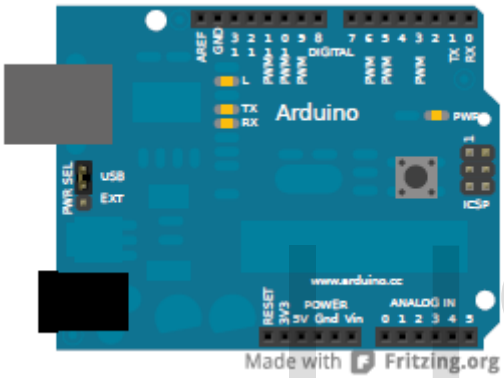

Fig.2. Ardiuno Board

An Arduino board consists of an Atmel 8-, 16- or 32-bit AVR microcontroller (ATmega8, ATmega168, ATmega328, ATmega1280, ATmega2560), but other makers' microcontrollers have been used since 2015. The boards use single-row pins or female headers that facilitate connections for programming and incorporation into other circuits. These may connect with add-on modules termed *shields*. Multiple, and possibly stacked shields may be individually addressable via an I²C serial bus. Most boards include a 5 V linear regulator and a 16 MHz crystal oscillator or ceramic resonator.

Arduino microcontrollers are pre-programmed with a boot loader that simplifies uploading of programs to the on-chip flash memory. The default bootloader of the AduinoUNO is the optiboot bootloader.Boards are loaded with program code via a serial connection to another computer. Some serial Arduino boards contain a level shifter circuit to convert between RS-232 logic levels and transistor–transistor logic (TTL) level signals. Current Arduino boards are programmed via Universal Serial Bus (USB), implemented using USB-to-serial adapter chips such as the FTDI FT232. Some boards, such as later-model Uno boards, substitute the FTDI chip with a separate AVR chip containing USB-to-serial firmware, which is reprogrammable via its own ICSP header. Other variants, such as the Arduino Mini and the unofficial Boarduino, use a detachable USB-to-serial adapter board or cable, Bluetooth or other methods, when used with traditional microcontroller tools instead of the Arduino IDE, standard AVR in-system programming (ISP) programming is used.

B. **Wi-Fi Module - ESP8266**

The ESP8266 Wi-Fi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your microcontroller. The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community.

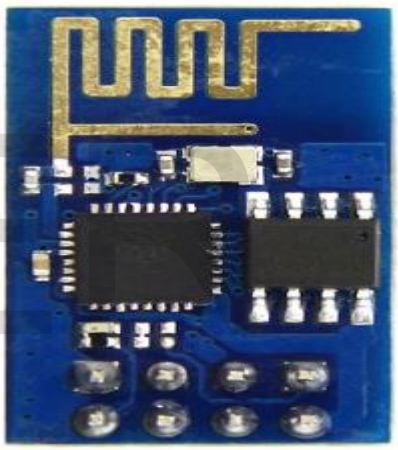

Fig.3. ESP8266 WiFi module

This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to occupy minimal PCB area. The ESP8266 supports APSD for VoIP applications and Bluetooth co-existence interfaces; it contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF parts.

C. **IR sensor**

An infrared sensor is an electronic instrument that is used to sense certain characteristics of its surroundings by either detecting and/or emitting infrared radiation. Infrared sensors are capable of measuring the heat emitted by an object and motion detection.The Infrared Reflectance Sensor Module carries a single infrared LED and photo transistor pair in an inexpensive, tiny module that can be mounted almost anywhere and is great for obstacle detection of robot and home alert system.

Fig.4. IR sensor

D. **Ultrasonic sensor**

Fig.5. Ultrasonic sensor

An Ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back. By recording the elapsed time between the sound wave being generated and the sound wave bouncing back, it is possible to calculate the distance between the sonar sensor and the object.

4. EXPERIMENTAL RESULTS

As a result, the parking area was implemented with the IRsensor and the slot was detected to be booked or empty. In addition, the obstacle was also detected using ultrasonic sensor along with the distance measured in centimetres.

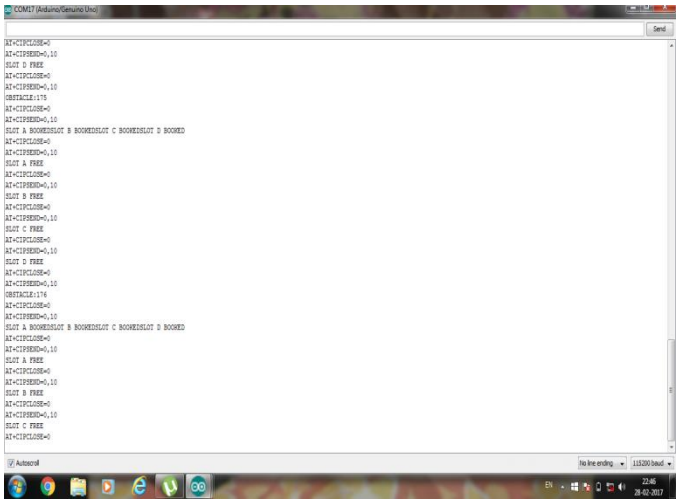

Fig.6.When all the slots are booked.

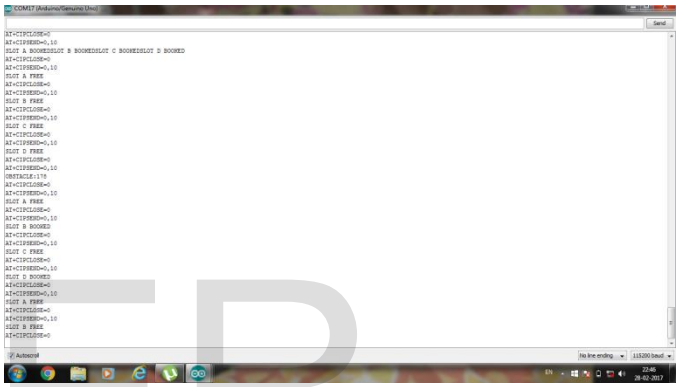

Fig.7. When some slots remain free.

5. CONCLUSION

In this paper, the smart parking system was proposed on the communication between the PC or mobile phone and WiFi module. It supported the identification of vehicles in parking slot. Since the mobile phone is used, the customer has the convenient service for vehicle parking location. In our experiments, the proposed system had shown the accurate parking location service in parking slots.Compared to the previous method, the proposed system supported the low implementation cost. For the future work, the additional applications for smart parking space can be developed, such as accident alarm, reservation for parking slot, and so on.

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