Automated Multilevel Car Parking System using Raspberry Pi with Zigbee

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Abstract:- **Raspberry pi is the miniature of computer which has the adaptability with the sensors. Automated car parking system uses the Raspberry Pi. This paper proposes the automated car parking system that uses the ultrasonic and infrared sensors. The ultrasonic sensor reports the state of car parking slot periodically to the main control unit which mainly refers to the Raspberry Pi, through Zigbee protocol. Infrared Sensor senses the movement of the vehicle and transmits the signal to the pi. LED display is installed at the main entrance of the parking area and at each parking level, in order to provide enough information about the slot availability. The proposed work is implemented for four slots in each level. In real time scenario the proposed work can be enhanced further for multiple levels containing n number of slots with multiple Raspberry Pi.**

Keywords- Raspberry pi, Zigbee, ultrasonic sensor, IR sensor, pi camera, .LED display.

I.INTRODUCTION

In the present era where space has become a thing of utmost value as well as a matter of prime concern, it has become very crucial to avoid the wastage of space. In places where more than 500 cars need to be parked, this project proves to be a boon. The project enables the parking of vehicles, level after level. Hence space is utilized in the best efficient way i.e. maximum cars are accommodated in minimum space. The parking system built traditionally does not employ any intelligent monitoring system. Rather, human beings are employed to serve the purpose. All vehicles after entering the parking area are found wasting time to search for the parking slots. Sometimes, blockage is created. Things become worse when multiple parking lanes exist as a person in order to park needs to look for all the lanes. This project finds the nearest parking level and assigns the parking slots in that respective level. This way it minimizes the fuel consumption which in turn minimizes the traces of carbon footprints in atmosphere. The system captures the images of number-plates and stores the details in database for further actions like generation of bills and then allows the vehicles to pass. Since not even a single manpower is involved, maintenance and operation cost is low. This idea can be applied on the entrance of public places like malls, amusement parks, tech parks for visitors etc. The project follows "pay-as-you-go" model. During exit, the information stored in the database about car details, time of entrance etc. is extracted and is used to compute the time for which the car was parked. Based on the computed time, bill is generated.

At entrance, the ultrasonic sensor detects the presence of a car. The sensor transmits the signal to the camera. The camera upon receiving the signal captures the image of the number plate and sends it to the raspberry pi. The raspberry pi stores the details of the car in the database. Based upon the availability of the slots in any of the levels, appropriate message is displayed in the LED display. If slot is available, level number is displayed. Otherwise "no space available" message is displayed. After displaying the level number, automatic boom barrier allows the car to enter. The car goes to the allotted level and checks further for the allotted slot. The car is parked at the allotted slot and it is sensed by an ultrasonic sensor attached to Xbee (device to transmit wirelessly). This sensor checks the status of the slots and sends the availability details to the level control unit. Level control unit of each and every level is connected to the main control unit at the entrance which are connected to a single network. Meanwhile the IR sensor will detect the motion in particular level and it passes on the signal to the surveillance camera. Upon receiving the signal, the camera starts recording for fixed duration of time and waits for next signal by IR sensor. At the time of exit, the camera again captures the
Image of the car and sends it to the raspberry pi. The raspberry pi extracts the details of the car on the basis of the image and computes the number of hours for which the car was parked. Finally, the bill is generated.

II.RELATED WORK

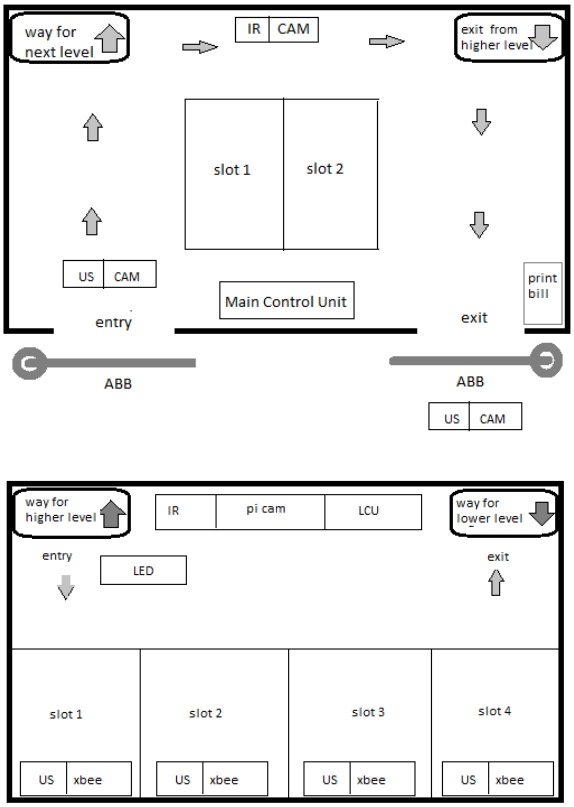
R Vishnubhotla, PS Rao and A Narmada [3] proposed a Zigbee based multilevel parking vacancy monitoring system. The stopping administration framework can distinguish the nearness or nonattendance of a vehicle in the particular parking spaces and automatically gives the location of the identified vacant spaces to planned clients progressively. It utilizes a ultrasonic based vehicle recognition framework, Zigbee systems and presents the preparatory results.

M. M. Rashid, A. Musa and M. Ataur Rahman [4] discussed on automatic parking system and electronic parking fee collection based on vehicle number plate recognition. The prime concern is to develop and implement an automated parking system which will increase security and convenience of the parking lot and collecting parking fee avoiding hassles of using magnetic

card. This will helps us to have less interaction of humans and magnetic card and its devices. The system uses image processing of recognizing number plates for operation of parking and also billing system. The frameworks keep running with customized controller to make less human inclusion in parking system and make sure the access control in restricted places. This paper presents algorithm technology based method for license plate extraction from car images followed by the segmentation of characters and reorganization and also develop electronics parking fee collection system based on information of number plate.

Aswin Sayeeraman and P.S Ramesh [6] developed Zigbee and GSM based secure vehicle parking management and reservation system in which they proposed a parking model provided with IR sensors which is used to sense the parking area continuously. If it sense any vehicle in the parking slot, it will indicate the presence of vehicle to the control unit to which it is connected. The main control unit will in turn send the state of availability to the Zigbee node.

III.BLOCK DIAGRAM OF PARKING SYSTEM



The above figures illustrate the block diagrams of the parking system. The whole area of parking slot is classified into different levels. Each level has fixed number of parking slot. Each parking slot is provided with sensor circuit. Sensor circuit consists of two main components – Ultrasonic sensor HC SR04 and Xbee PRO S2B.If a vehicle is detected in a particular parking slot, then the signal is sent by ultrasonic sensor to local control unit via Xbee. Local control unit is provided in every level of parking area which consist of raspberry pi and all these local control units are connected to main control unit which is also a raspberry pi. To establish a common network, Xbee is used. Interfacing of Xbee with control unit is done with the help of GPIO pins and interfacing tools<>. On detecting any motion, the PIR sensor HC SR501 sends the signal to the pi camera module Rev 1.3. On receiving the signal, camera starts recording. While exiting, ultrasonic sensor along with pi camera module does the processing and sends the details to the main control unit. The main control unit extracts the information from database and generates the bill. After payment is done, boom barrier lets the vehicle to checkout.

IV.HARDWARE COMPONETS

The main components used in project are

- Raspberry pi
- Xbee
- Ultrasonic sensors
- Pi camera
- IR sensor

A. Raspberry Pi

Raspberry Pi is a single-board computer. Raspberry Pi is a small scale computer in the size little bigger than a credit card, it has enough power to support games, word processor like open office, image editor like Gimp.

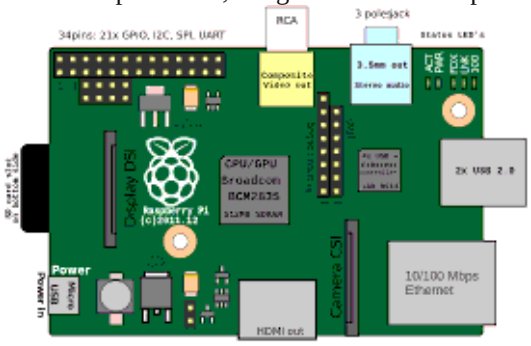


Fig.1: Raspberry Pi

Fig.1 shows Raspberry Pi. It showcases a Broadcom system on a chip (SOC). It consists of an ARM compatible CPU and a graphic processing unit (GPU). The speed of CPU ranges from 700MHz to 1.2GHz for pi3. The on board memory varies from 256MB to 1GB RAM. OS is stored in digital SD cards. Generally, the USB slots ranges from 1 to 4. Most boards contains HDMI and composite video output and 3.5mm phono jack for audio. GPIO pins provide lower level output and also support common protocols like I2C. There also exist models which have RJ45 Ethernet port. Pi3 has on board Wi-Fi 802.11n and Bluetooth.

B. Xbee

Xbee is a wireless RF device which uses the wireless communication standard 802.15.4.it can be used in
Such application where we need a range higher than Bluetooth and also if there is a need for ad-hoc network.

Fig.2: Xbee

Fig.2 shows Xbee. Even though the data rate of Xbee is lesser than Wi-Fi. It has wide application where data transmitted is less and power consumption is a matter of concern. It is enabled with a 250 kbps RF data rate. It runs at 2.4 GHz. The Xbee modules have sleep modes for extended battery life

C. Ultrasonic sensor

The HC-SR04 Ultrasonic sensor interfaced with Raspberry Pi consists four pins: ground (GND), Echo Pulse Output (ECHO), Trigger Pulse Input (TRIG), and 5V VCC.

Fig.3: Ultrasonic sensor

Fig.3 shows Ultrasonic sensor. We utilize our Raspberry Pi to send an information sign to TRIG, which triggers the sensor to send a ultrasonic signal. The beat waves ricochet off from any adjacent objects and few are reflected back to the sensor. The sensor detects these arrival waves and it's utilized to figure the time between the trigger signal and returned signal, and after that transmits a 5V signal through the ECHO pin. ECHO will be "low" until the sensor is activated. Once an arrival signal has been found ECHO is set "high" for the term of that signal. Signal duration is the full time between the sensor outputting a ultrasonic signal, and the arrival signal being identified by the sensor collector. Our Python code will quantify the signal duration and after that then computes distance from the nearest object.

D. Pi Camera

The Pi camera board has a 5 MPixel sensor, and can be interfaced via a ribbon cable to the CSI connector on the Raspberry Pi.

Fig.4: Pi camera

Fig 4 shows pi camera. The video and image quality is good when compared with a USB webcam of similar cost. It comprises of indistinguishable sensor with the IR channel evacuated, and a dark PCB. It can see close IR wavelengths (700 - 1000 nm) like a security camera, with the tradeoff of poor shading version. It is generally the comparable and utilizations the same programming to act as the ordinary camera.

E. PIR sensor

This model uses a PIR motion sensor. PIR stands for Passive Infrared.

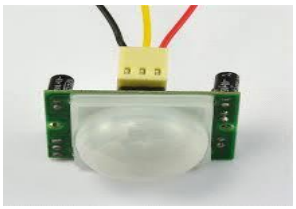
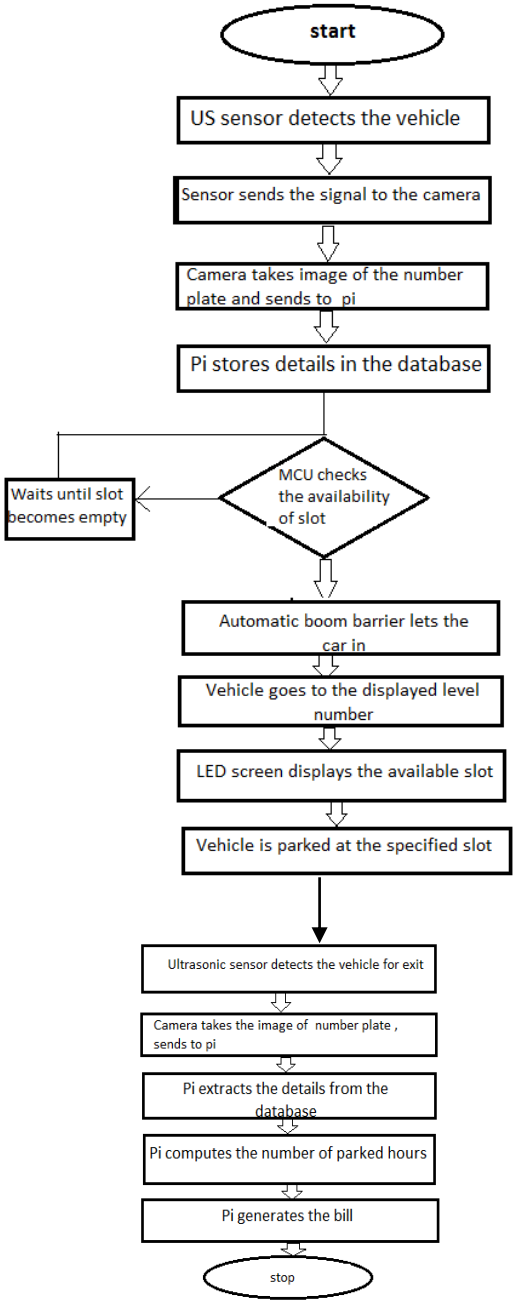


Fig.5: PIR sensor

Fig.5 shows PIR sensor. This motion sensor comprises of Fresnel lens, an infrared detector and supporting detection circuit. The lens present on the sensor detects infrared radiation present around it. The sensor produces a 5V signal for a period of one minute as soon as it detects the presence of a vehicle. It offers a tentative range of detection of about 6-7 m and is highly sensitive. When the PIR motion sensor detects a vehicle, it transmits a 5V signal to the raspberry pi via its GPIO.

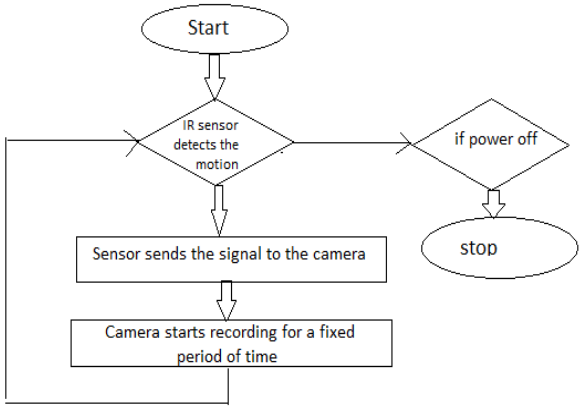
V.SOFTWARE DESIGN

The programming of raspberry pi and Xbee is done in python programming. We have used XCTU which is a tool for configuring Xbee ,and HTML was made use to create web page to display the live video recording and also make UI which is used to display information of vehicle and time of entry and time of exit .the system flowcharts provided in next section the software flow are distributed as



A) Flowchart to know status of parking space

To understand the working, the above flowchart needs to be referred. When a vehicle comes to the entrance gate for parking, its presence is detected by the ultrasonic sensor. The sensor sends the signal to the camera. Upon receiving the signal, the camera captures the image of the number plate. The image is sent to the raspberry pi. The pi based on the image stores the details like car number, time of entry, number of persons etc. Now, the main control unit At the time of exit, the ultrasonic sensor again detects the presence of the vehicle and sends the signal to the camera.



B) Flowchart to detect the motion and record

To understand how the things work when the vehicle is parked, flowchart (II) is referred. At the parking slots, whenever the IR sensor detects the motion, its sends the signal to the camera. The camera on receiving the signal, starts recording for a fixed interval of time. This process continues until the sensor keeps on sensing the motion in specified range

VI.RESULTS

Fig.6

Fig.6 shows Xbee interfaced with raspberry .The raspberry pi is supplied power by an external source, which in turn drives the Xbee.

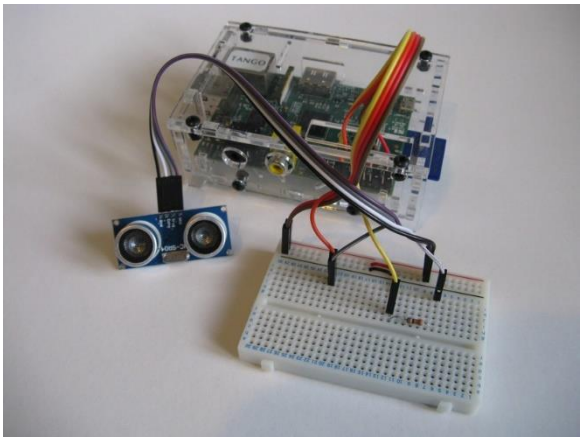


Fig.7

The fig.7 demonstrates interfacing of Xbee with ultrasonic sensor to enable wireless transmission.

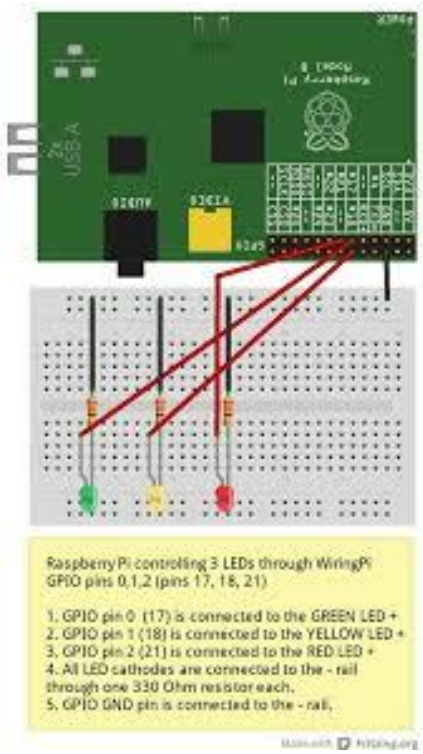


Fig.8

Fig.8 also demonstrates the configuration of GPIO pins.

VII. CONCLUSION

This paper deals with automated car parking system which makes utilization of Raspberry pi with Zigbee innovation. Which comprises of a model that grants vehicle drivers to effectively find the unfilled stopping openings. The proposed model comprises of a ultrasonic sensor which senses the nearness of vehicle and further transmits signals by means of Xbee to raspberry pi, and an PIR sensor for sensing The course of action in parking area,, and a pi camera for recording exercises that happens in stopping territory Xbee gadget is interfaced with all sensors furthermore control units to have every one of them in a typical system.

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