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An Iot-Based Intelligent System for Real-Time Parking Monitoring and Automatic Billing

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Abstract
This paper describes an internet of things (IOT)-based parking sensing system that deploys a robust outdoor vehicle localization and recognition methodologies. Although, parking occupancy monitoring systems have made a considerable progress, smart parking payment is rarely studied in smart parking research. This paper proposes a new low-cost sensor system allowing real-time parking occupancy monitoring along with parking payment without requiring any user/driver interaction. The proposed on-board vehicle transceiver device (VTD) sensor, will be deployed without having to install new components on each parking lot. It has benefits in terms of detection and payment reliability, and reduced expense by reducing the system complexity, infrastructure investment, and battery replacement expense. A robust vehicle recognition and parking occupancy monitoring is achieved using two-fold sensing approach. It is a sequence of motion detector and global navigation satellite system (GNSS) sensing techniques. The sensor is triggered when the vehicle is within a parking area thanks to a proposed radio frequency (RF) wake-up technique's consequence, the energy consumption is optimized and the VTD has a power saving scheme with a power consumption slow as 20 μW at 3 V supply. The VTD can be seamlessly integrated into the intelligent vehicular ad-hoc networks (in VANETs).

Introduction

Today, the parking industry is being transformed by new technologies that are allowing cities to reduce rates of congestion significantly. Sensor networks that sense vehicle occupancy are providing the basic intelligence behind smart parking systems. Thanks to the Smart Parking technology, it is now possible to know in real-time the location of free parking spaces and to help drivers to get to their ultimate destination. A variety type of vehicle detectors has been used in parking information acquisition. These vehicle detectors mainly include the inductive loop, acoustic sensor, infrared sensor, or ultrasonic sensor. System using video camera sensor technologies have been proposed to collect the information in vehicle parking field. However, a video camera sensor is vulnerable to bad weather and night time operation. Furthermore, it is expensive, and can generate a large amount of data that can be difficult to transmit in a wireless network. The magneto-resistive based detection systems combined with a wireless area network are the most popular technique due to their high accuracy. Yet, this type of sensor is facing different issues, i.e., it can be delivered by electromagnetic interference, which affects the accuracy, the reading from sensor needs to be collected constantly which will result in wearing out the battery. To extend the battery lifetime and increase the vehicle detection accuracy, a parking sensor system has been proposed. When a user occupies a parking space designated with an individual ID, he enters this ID into a parking meter or via a smart phone mobile app., and pays the parking fees. The database processes the received data and changes the status of the parking space with its ID from unpaid to paid. These data are used as information on the occupation of a parking space. In this paper, we propose a smart sensor system allowing outdoor parking monitoring and payment without requiring any user/driver interaction. It will be deployed without having to install new components on each parking lot. The proposed sensor has benefits in terms of detection and payment reliability, and reduced expense by reducing the system complexity and installation, and extending batteries lifetime through the reduction of the system power consumption.

Background:

A variety type of vehicle detectors has been used in parking information acquisition. These vehicle detectors mainly include the inductive loop, acoustic sensor, infrared sensor, or ultrasonic sensor. System using video camera sensor technologies have been proposed to collect the information in vehicle parking field. However, a video camera sensor is vulnerable to bad weather and night time operation. Furthermore, it is expensive, and can generate a large amount of data that can be difficult to transmit in a wireless network. The magneto-resistive based detection systems combined with a wireless area network are the most popular technique due to their high accuracy. Yet, this type of sensor is facing different issues, i.e., it can be delivered by electromagnetic interference, which affects the accuracy, the reading from sensor needs to be collected constantly which will result in wearing out the battery. Existing sensors, such as ground based parking sensors costs up to $200 per

parking lot. As consequence, smart-parking technology using wireless sensors for outdoor parking is costly due to the large number of sensors units required to cover the entire parking lot. Although, parking occupancy monitoring systems have made a significant progress, smart parking payment is rarely studied in smart parking research. Yet, there are companies working on the patents of parking systems for payments. A first approach consists in using a camera or an RFID transceiver for vehicle detection and identification. A limitation of this solution lies in that the system is complex and its implementation is expensive when a detection device is installed on each parking lot. Furthermore, when only RFID transceiver is used for vehicle detection and identification, the system can be delivered by electromagnetic interference, which affects the accuracy. Moreover, this system is designed to detect a vehicle when entering a parking and seek payment, whereas information on vacant parking lots is not provided. A technique for monitoring vehicle parking using one camera to record the entrance of a vehicle and a second camera to record the vehicle leaving the parking has been proposed.

Objectives:

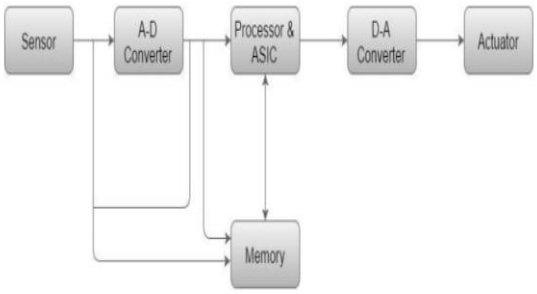
• The main objective of this project is to provide easy parking system to minimize the traffic congestion in the parking areas.

Detection and giving information of slots where the parking can be done using IOT.

To provide smart and easy parking payment at the exit without using human intelligence. So, in the end, parking the vehicle and generation of bill can be done in a very short period.

Embedded System:

As its name suggests, Embedded means



something that is attached to another thing. An embedded system can be thought of as a computer hardware system having software embedded in it. An embedded system can be an independent system or it can be a part of a large system. An embedded system is a microcontroller or microprocessor-based system which is designed to perform a specific task. For example, a fire alarm is an embedded smoke.

An embedded system has three components:

• It has hardware.

• It has application software.

Basic structure of Embedded System:

Proposed System

• The ticket machine prints a ticket that the driver displays in the vehicle. When the time is about to expire, the driver can extend his stay by inserting coins or a personal card at the parking meter. • In addition, pay-by-mobile phone and real time parking reservation systems and smart phone applications are used for parking lot reservation and payment.

Block Diagram

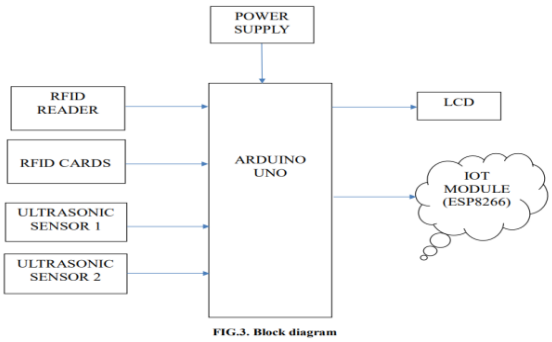
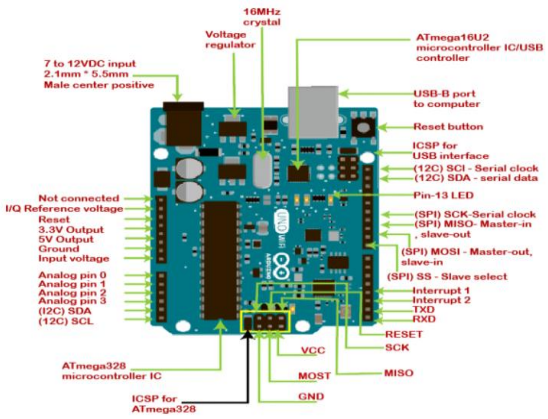


FIG.3. Block diagram

Working:

In this system we are using ARDUNIO controller and different like sensors. Here we are using components like RFID reader, RFID cards, ultrasonic sensor, IOT module and LCD. In the active RFID system, the reader sends signal to the tag using an antenna. The tag receives this information and resends this information along with the information in its memory. The reader receives this signal and transmits to the processor for further processing. RFID methods utilize radio waves to accomplish this. ... RFID tags contain an integrated circuit and antennas, which are used to transmit data to the RFID reader (also called an interrogator). The reader then converts the radio waves to a more usable form of data. Ultrasonic sensors emit short, high-frequency sound pulses at regular intervals. If they strike an object, then they are reflected back as echo signals to the sensor, which itself computes the distance to the target based on the time-span between emitting the signal and receiving the echo. IOT module give the live update on the parking slots of the cars. LCD will showcase all the details about parking slots.

Arduino UNO pinout



Parameters:

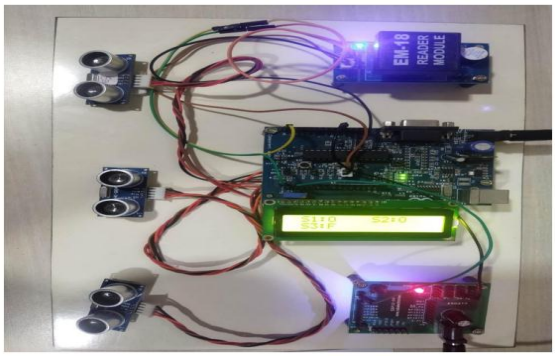
Categories	Items	Values
WiFi Paramters	WiFi Protocles	802.11 b/g/n
	Frequency Range	2.4GHz-2.5GHz (2400M-2483.5M)
Hardware Paramaters	Peripheral Bus	UART/HSPI/I2C/I2S/Ir Remote Contorl
		GPIO/PWM
	Operating Voltage	3.0~3.6V
	Operating Current	Average value: 80mA
	Operating Temperature Range	-40°~125°
	Ambient Temperature Range	Normal temperature
	Package Size	16mm*24mm*3mm
	External Interface	N/A
Software Parameters	Wi-Fi mode	station/softAP/SoftAP+station
	Security	WPA/WPA2
	Encryption	WEP/TKIP/AES
	Firmware Upgrade	UART Download / OTA (via network) / download and write firmware via host
	Ssoftware Development	Supports Cloud Server Development / SDK for custom firmware development
	Network Protocols	IPv4, TCP/UDP/HTTP/FTP
	User Configuration	AT Instruction Set, Cloud Server, Android/iOS App

APP Using:

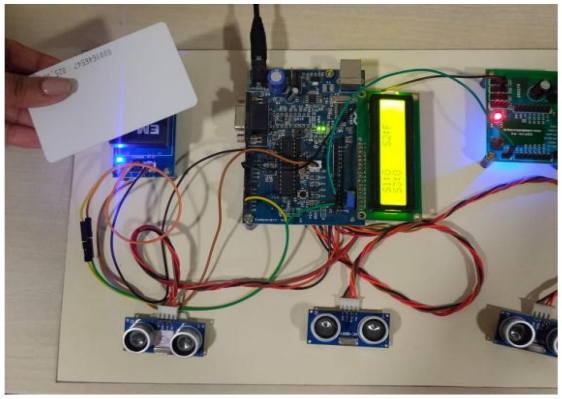
IOT is an open-source app for connecting an Android device to cloud such as Arduino and other devices. It has been tested extensively to work with some modules and should work for wide range of device. We are using in this project to connect our mobile given user's name and password and then login to the app then it will be shown like below.

Testing Result

The below figure shows the hardware setup of IOT based Real time parking monitoring and automatic billing. In addition to this, we are using an Arduino UNO controller and a few ultrasonic sensors in this system. Also, the others used here are RFID reader, RFID cards, and an IO T module and LCD.



The internal process is, in the active RFID system, the reader sends a signal when an RFID card is tapped on it using an antenna. Now, this reader receives this information and stores it, then reutilizes it. when the card is tapped again by the driver when leaving the parking slot. When the Arduino receives signals from the RFID reader, ultrasonic sensors come into the picture, which are placed in each slot. These ultrasonic sensors sense the information about the slots, whether they are free or occupied, and then send this information to the Arduino Uno. Now to display this information to the driver, the Arduino UNO again sends the information to the LCD connected to it. As we can observe, the Arduino Uno plays a vital role in this system.



If the slots are free (F) then it will show like above figure. Now the driver can choose a free slot and park his vehicle in that place. So, when the next car comes, the driver taps the RFID card, and the reader reads the card, then the whole process repeats. However, everyone cannot wait in the lot and check for the empty slot by tapping an RFID card, so we introduced an app for such cases. So, this app stores the data of the vacant and occupied slots, which are then pushed into the cloud by the Arduino. In the end, the driver can tap his RFID card to the reader

again at the exit. And this reader shows the time his car has been parked and then generates a bill accordingly on the LCD

Advantages:

- Optimized parking.
- Reduced traffic in parking lot.
- Increased safety.
- Real-Time data and trend insight.
- Decreased management costs.

Applications:

- Passports
- Toll booth passes
- Hospitals
- Libraries

Conclusion

In this work, IOT based smart parking system has been proposed which integrates several physical devices to check the parking slot availability. It permits actual time parking tracking together with parking price without requiring any user/motive force interaction. Mobile app allows the user to locate and reserve a parking slot in online, navigation from entrance gate to available parking slot is also the proposed system reduces the driver's effort and time to search parking space. Prototype is built for single storage parking slot, but this model can be extended for multi storage parking space.

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