Reservation based Smart Parking System

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Abstract—Due to the proliferation in the number of vehicles the number of vehicles on road, traffic is bound to exist. Finding a safe parking space is one of the challenges faced by the citizens of any metropolitan city or any populated city for that matter. Finding a decent parking spot becomes even more of a challenge during peak hours. Due to this unavailability the driver uses sides of working roads as its parking spot which leads to problems like severe traffic congestion. Smart parking is a solution to metropolitan cities to reduce congestion, cut vehicle emission totals and save persons' time by helping them in finding a spot to park. By periodically learning the parking status from the sensor networks deployed in parking lots, the reservation service is affected by the change of physical parking status. This paper proposes to create a prototype of a reservation based system that is equipped with sensors, 16x2 LCD (for display) and LEDs. It provides an option for pre-reservation using a mobile application based on android that can be accessed by the user. The application shows the number of available and unavailable slots. On pre-booking a vacant spot a notification is sent to the registered user.

Index Terms— Android, Arduino, database, elevator, multi-level, reservation, sensor, smart park

1 Introduction

In the development of traffic management systems, an intelligent parking system was created to reduce the cost of hiring people and for optimal use of resources for car-park owners. Currently, the common method of finding a parking space is manual where the driver usually finds a space in the street through luck and experience. This process takes time and effort and may lead to the worst case of failing to find any parking space if the driver is driving in a city with high vehicle density. The alternative is to find a predefined car park with high capacity.

Over the past two decades, traffic authorities in many cities have developed so-called parking guidance and information (PGI) systems for better parking management. PGI systems present drivers with dynamic information on parking within controlled areas and direct them to vacant parking spots. Parking information may be displayed on variable-message signs (VMS) at major roads, streets, and intersections, or it may be disseminated through the Internet [8], [9], [10]. PGI systems are based on the development of autonomous vehicle detection and parking space monitoring, typically through the use of sensors placed in the vicinity of parking spaces for vehicle detection and surveillance [11]. These sensors can be classified as either "in-roadway" or "over-roadway". In-roadway sensors are either embedded in the pavement or taped to the surface of the roadway; examples include loop detectors, pneumatic road tubes, piezoelectric cables, etc. Overroadway sensors are mounted above the surface of the roadway; examples include video, image, and acoustic signal processors [12]; microwave radar [13]; ultrasonic [14], magnetic, and passive infrared sensors; and radio-frequency identification (RFID) readers. Building upon the objectives of PGI systems, e-parking is an innovative platform that allows drivers to obtain parking information before or during a trip and to reserve a Parking spot [15]. Drivers access the central system via a cellular phone or the Internet

According to a report, Smart Parking could result in 2,20,000 gallons of fuels saving till 2030 and approx. 3,00,000 gallons of fuels saved by 2050 , if implemented successfully .

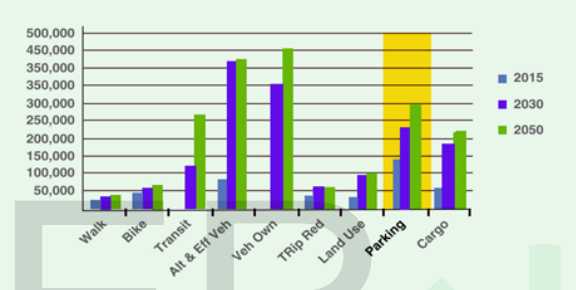

FIG. 1. AMOUNT OF FUEL TO BE SAVED BY IMPLEMENTATION OF VARIOUS ASPECTS

2 Review of Related Literature

Europe, the United Kingdom and Japan were among the first to implement smart parking systems. Today we can find several smart parking facilities in most major cities. Smart parking technology benefits the customer and the parking operator in the following ways:

- The customer can readily determine space availability prior to entering the garage and/or parking level.
- The customer can plan for their transit to public transportation with such smart parking systems employed at Park and Rides.
- The parking operator can use the system data to develop or improve pricing strategies.
- The parking operator can use this system data to predict future parking patterns and trends.
- The parking operator can reduce the staffing requirements for traffic control within the facility.
- The system significantly reduces traffic–and the resulting vehicle emissions– by decreasing the time required for customers to locate open spaces.

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3 PROCESS DESCRIPTION

3.1 Architecture

Smart Parking System as a domain has been divided into varied number of individual parts. Each part acts as a sub-block of the domain. It is clear to see that, the elements include, 'activites' , 'connectivity', 'application', 'platform' and 'sensor nodes'. Each sub-block has elements that constitute that block as a whole, for eg. The connectivity sub-block includes wifi as wifi module (esp 8266) was used to connect the android app with the arduino, after this connection the information that is retrieved by the application is stored in a database that is written in SQL, similarly the application sub-block includes java and xml because they were used to code the app.

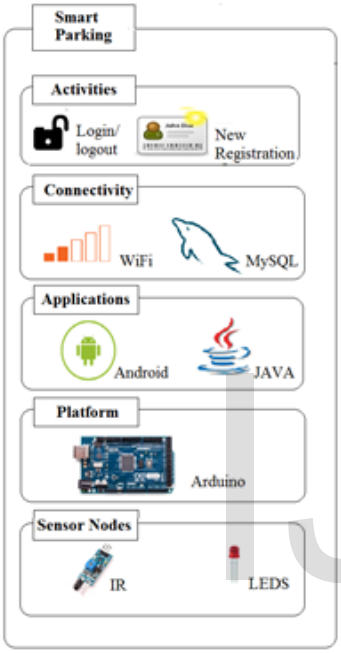

Fig. 2. The diagramtic representation of the architecture

3.2 Components Used

i. 16x2 LCD Display

A Liquid Crystal Display or LCD draws its definition from its name itself. It is combination of two states of matter, the solid and the liquid. LCD uses a liquid crystal to produce a visible image. Liquid crystal displays are super-thin technology display screen that are generally used in laptop computer screen, TVs, cell phones and portable video games. LCD's technologies allow displays to be much thinner when compared to cathode ray tube (CRT) technology. An LCD is either made up of an active matrix display grid or a passive display grid.

ii. IR Sensor Module

An Infrared (IR) sensor is used to detect obstacles in front of the robot or to differentiate between colors depending on the configuration of the sensor. An IR sensor consists of an emitter, detector and associated circuitry. The circuit required to make an IR sensor consists of two parts; the emitter circuit and the receiver circuit. . When IR light falls on the photodiode, its resistance and correspondingly, its output voltage, change in proportion to the magnitude of the IR light received.

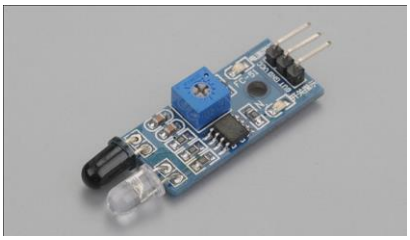

Fig.3. IR Sensor Module

iii. Arduino ATmega 2560

The Arduino Mega is a microcontroller board based on the ATmega1280. It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an adapter.

iv. DC Motor

DC motors have been used in industrial applications for years. Coupled with a DC drive, DC motors provide very precise control. DC motors can be used with conveyors, elevators, extruders, marine applications, material handling, paper, plastics, rubber, steel, and textile applications.

v. Limit Switch

A typical limit switch consists of a switch body and an operating head. The switch body includes electrical contacts to energize and de-energize a circuit. The operating head incorporates some type of lever arm or plunger, referred to as an actuator. The standard limit switch is a mechanical device that uses physical contact to detect the presence of an object (target). When the target comes in contact with the actuator, the actuator is rotated from its normal position to the operating position. This mechanical operation activates contacts within the switch body.

vi. IC 555

This simple **LED driver** circuit allows us to drive up to seven LEDs by using a single NiMH (Nickel Metal Hydride) AA cell. The circuit produces voltage pulses at a much higher level than the input supply voltage by pulsing the 220 uH inductor. The inductor must be a high Q (Q>90) power inductor. When the input is 1.25 V and the LEDs are connected, the voltage pulse level will be 23V

3.3 Block Diagram

The block diagram seen in fig.() clearly shows that arduino (Arduino Mega 2650 in this case) is the parent component. IR sesnor modules, LEDs , keyboard, LCD display and a WiFi

module are all interfaced with the arduino board. They all have their own special purposes. IR sesnor modules are used for indication purposes, LEDs are used for indication purposes, keyboard is interfaced to take slot number aas an input from the user, a 16x2 LCD is also used to diplay the unique numbers of all the available slots and the wifi module is used for connectivity purposes of the mobile application that is used for pre-hand reservation purposes. Detailed description of each and every component used is mentioned in the sub-parts mentioned above.

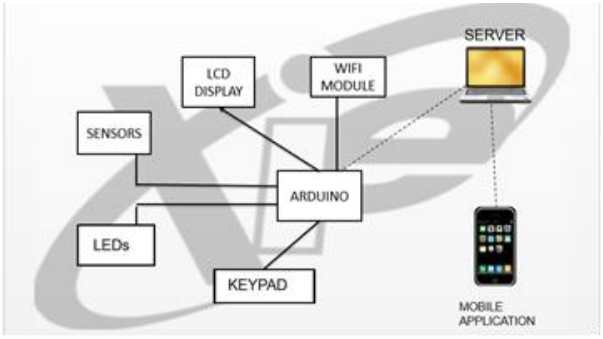

Fig. 4. Block Diagram

4 SYSTEM REALIZATION & WORKING

4.1 Parking Space Detection

The system in itself has both, a hardware and software part. They both work in sync for the perfect working of the prototype model of a Reservation Based Smart Parking system. The entire system is divided into individual slots. Each slot is equipped with Ir sensors and the LED for indication purpose. As the car enters the system, the information about the slot number that are available are provided by LCD display. A keyboard has also been interfaced with the arduino to take the 'slot number' as the input from the user. The presence of the car say at slot 2 ,will aid to its absence from the LCD display and accordingly this slot's LED will be OFF.The process followed after the reservation of slot through application is also pretty similar.

4.2 Working of the Elevator

The elevator is controlled by the DC motor and plastic gear module. As the user enters the slot number, the dc motor programmed through arduino will move towards the desired slot. The movement of the lift is in the rightward and leftward direction and a belt is used to lift the elevator in upward and downward direction. As the elevator reaches the desired slot the car is parked in the desired slot and the same process is carried while retrieving the car.

4.3 Software Prototype

The android application created in Android Studio will have its own database. The database of the application is connected to a local host network and the sensor's data is retrieved from the arduino. The database of the application will be updated on the entry and exit of the vehicle.The interface will get updated as soon as the mobile enters the proximity level of the wifi module esp8266.

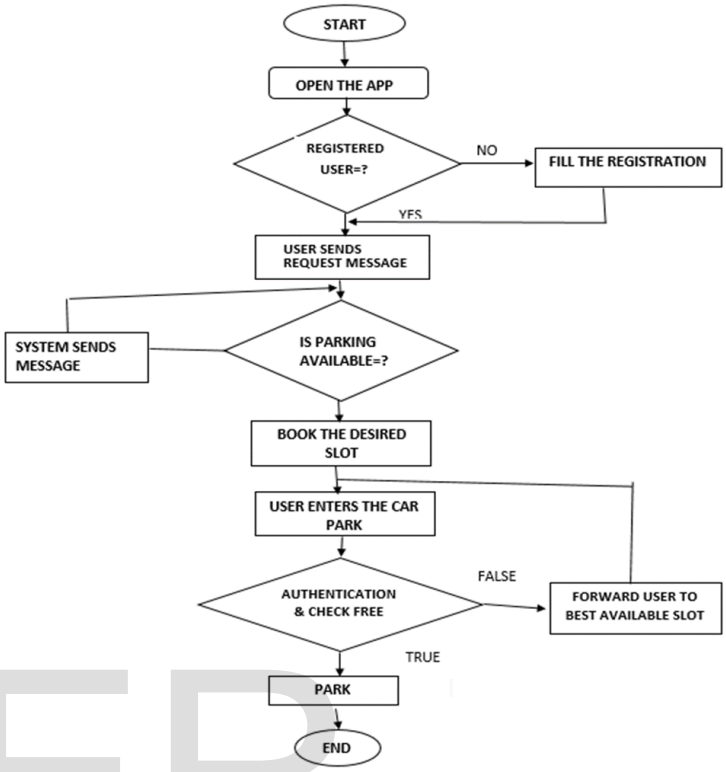

Fig. 5. Event Flow of Application

5 MERITS

- Less Pollution: Driving around in a traditional parking system to find an appropriate parking space leads to more burning of fuel and in turn an increased number of emissions which cause pollution
- Saves Time, Space and Money: As covered in point 1), more burning of fuel leads to the driver spending more money on fuel for the car. Secondly, smart parking systems are made extremely space efficient and hence make greater number of Cars Park in the same space.
- Reduced Traffic: Parking on streets leads to obvious increase in traffic and wastes more space too. A smart parking system will reduce traffic and save much more space than the traditional system.
- Enhanced User Experience: Most of the smart parking systems are semi/completely automated and user friendly. These make the users experience way better than the traditional parking systems.
- Decreased Management Cost: More automation and less manual activity saves on labour cost and resource exhaustion.

6 Conclusion

We have proposed a "smart parking" system that exploits technologies for parking space availability detection and for driver localization and that allocates parking spots to drivers instead of only supplying guidance to them. In this, we have developed a new Reservation-based Smart Parking (RSP) system to optimize parking management. The proposed architecture for a parking detection system would decrease searching time for vacant spaces and reduce instances of single cars improperly parking across two spaces. This system can overcome traffic congestion and it also offers time savings and reliability also fuel consumption is reduced which arises due to the unwanted travelling to search a parking space. Future research might examine car park booking procedures and optimization of sensor usage. Cost effectiveness and marketing could be studied as well.

Acknowledgment

This prototype is an opportunity where we came across developing and improving our knowledge in the field of electronics. We consider ourselves honoured to be lead throughout in the completion of this research work. We wish to express our indebted gratitude to honorable Dr.John Rose and special thanks to Mrs. Leena Patil for guiding us and helping us gather the resources to for the proposed project.This experience of work exposed us to self-development and exposure to the field knowledge.

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