

## SMART PARKING FOR SMART CITIES

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### ABSTRACT

The system "SMART PARKING FOR SMART CITIES" provides a remote facility to a user to find a parking slot for a vehicle. Finding a parking lot in most of the metro cities is a tedious job which consumes lot of time and wastage of fuel. This system will help to book a parking slot within a certain distance with the help of a mobile device. Also this will help to save time, fuel & regulate traffic congestion. The system includes setup module which will describe the identification and registration as the sub modules, which checks slot status. A prototype of parking system is designed with interfacing of PIC with sensors and web server. The proposed system also come with offline facility for user without android cellphones. With the successful implementation time looking for an empty parking space that are caused by inefficient parking will be significantly reduced.

**Keywords – PIC microcontroller, Ultrasonic Sensors, Wireless Sensor Networks.**

### I. INTRODUCTION

This document specifies the requirements for the production and design of the Street parking for the Google Android operating system. The app include a efficient street parking search, empty slots. The user interface will be easy to use and allow the user to go in-between games with ease. It will use the cell phone operating system Android, which is on a lot of cell phones today. The android operating system uses a market place to sell applications for the phone.

Web application combines geographic data and parking space information with user location, social networks and other data sources in order to let its users conveniently find parking, and related value-add services, when coming to work or driving into town. Application has a particular focus on gathering space availability data about car parks through crowd sourcing from the inputs of its users. In the deliverable, we describe the envisioned functionality of the application, from which we extract the requirements on the mobile app, on the Web application, and on the back-end system. We also analyze the data sources that will fuel the first prototype of the application.

### II. SMART PARKING SYSTEM

#### 2.1 System Description

The proposed system comprises two different subsystems

- Online System
- Offline System

## 2.1.1 Online System

In this system we provide the facility to the user to park their vehicles within minimum time which will directly help to save the fuel cost and times. First of all user need to register itself on mobile application through the mobile number. Then application will shows the nearby parking areas within specific range by using GPS system. Then user choose the appropriate parking area for their vehicles, that time system will give some buffer time to the user for reaching to that particular parking area. The OTP is generated to verify the valid user and the OTP will remain valid for the specific time. When the user reach on the gate then the vendor will verify the user through OTP, if OTP is found valid then vendor allocate the parking slot to the user else for invalid user the parking slot will be not allocated.

The vendor will receive the continuous status about the parking slot which will be detected by using sensors through the sensor based detection system. Another system is designed for the user who do not have smart phones and active internet connection. In the offline system user need to send the specific formatted message to the particular number then he will receive parking areas near by the user according to their rating.

### Google Location Service

This will provide a GUI using GPS and google map display to user's mobile screen through which the user can find the nearby parking areas and proceed for reserving a parking slot.

### Application server

Through this server user interacts with the system through internet, this server provides the parking details and also their available parking slots.

### Server Database

This is the main central database server where all the information about parking areas, available parking slots, reserved slots etc is stored and also updated simultaneously. User will interact with this server through internet and the information will be automatically updated to the selected vendor server.

### Parking Owner

This is the owner(vendor) side where allocation and deallocation of the parking slot is done and updates are provided to central database. The continuous serial communication is done through sensors for continuous updates.

### Hardware communication

The ultrasonic sensors are connected to vendor server through PIC micro-controller which allows continuous monitoring of the parking slot and provide updates instantly to vendor.

## 2.1.2 Offline System

This system will also come up with offline facility which is irrespective of anyone registration required. The user needs only to type a specific formatted message into the message box and send it to a provided number. Then server gives the feedback to user about the parking space details with respective address provided by the user. The guaranteed slot booking is not available in the offline facility

## 2.2 Algorithm

The *k-nearest neighbours algorithm(k-NN)* is a non-parametric method used for classification and regression.

In both cases, the input consist of the k-closest training examples in the features space. k-NN is a type of

instance-based learning, or lazy learning, where the function is only approximated locally and all computation is deferred until classification. The k-NN algorithm is among the simplest of all machine learning algorithms.

There are various alternatives to k-NN algorithm such as Haversine Algorithm, Hamming Distance Algorithm etc. But these algorithms have difficulties while operating on large training data set. So to overcome this problem we have used k-NN algorithm which is quite effective on large data sets and also a simplest distance measuring algorithms.

**Require** : Nearest neighbours, Threshold Distance

**Procedure** STARTUP

Determine parameter k = number of nearest neighbours.

**end procedure**

**procedure** CALCULATE

Calculate the distance between the query-instance and all the training samples.

$$\text{distance} = \sum_{i=1}^N (a_i - b_i)^2 = (a - b) \cdot (a - b)$$

Sort the distance and determine nearest neighbours based on the kth minimum distance.

**end procedure**

**procedure** DISTANCE

Gather the category 'V' of the nearest neighbours.

Use simple majority of the category of nearest neighbors as the prediction value of the query instance.

**end procedure**

## 2.3 Hardware Specification

### 2.3.1 PICmicrocontroller

PIC is a family of microcontrollers made by Microchip Technology, derived from the PIC1650, originally developed by Instrument's Microelectronics Division. The name PIC initially referred to Peripheral Interface Controller.

- Small instruction set to learn
- RISC architecture
- Built-in oscillator with selectable speeds
- Easy entry level, in-circuit programming plus in-circuit debugging PIC kit units available for less than \$50
- Inexpensive microcontrollers
- Wide range of interfaces including I<sup>2</sup>C, SPI, USB, USART, A/D, Programmable comparators, PWM, LIN, CAN, PSP, and Ethernet<sup>[21]</sup>
- Availability of processors in DIL package make them easy to handle for hobby use.

### 2.3.2 Ultrasonic Sensors

Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The module includes ultrasonic transmitters, receiver and control circuit. The basic principle of work:

(1) Using IO trigger for at least 10us high level signal,

(2) The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.

(3) IF the signal back, through high level, time of high output IO duration is the time from sending ultrasonic to returning.

Test distance = (high level time × velocity of sound (340M/S) / 2,

### 2.3.3 LCD DISPLAY (16 x 16)

- 5 x 8 dots with cursor
- Built-in controller (KS 0066 or Equivalent)
- + 5V power supply (Also available for + 3V)
- 1/16 duty cycle
- B/L to be driven by pin 1, pin 2 or pin 15, pin 16 or A.K (LED)
- N.V. optional for + 3V power supply

## 2.4 System Features

Detect occupancy status of each individual space in a multilevel parking lot. This means that there will be continuous monitoring of the parking through a hardware device and the status will be automatically updated to the vendor as well as the user.

Parking monitoring and management software to coordinate and operate the various features. This will help in providing the accurate available slots for online users and also useful for vendor for calculating the total time taken by the user for parking his vehicle and display the amount to be paid.

The mobile user should be able to access parking information for any location. This information is provided in form of maps showing colored streets. The mobile user should be able to choose between three views namely area view, block view and street view. The mobile user will also be able to select one particular parking space and obtain the routing information for that selection.

The offline facility is also provided for the user in case if android phone or internet is not available at that moment. In this the user can only view the list of the available parking slots.

## 2.5 System Architecture

To develop the Smart Parking System architecture several pieces of equipment are required: ultrasonic sensors, LCD indicators, microcontrollers, and management software. The ultrasonic detector transmits its status message through a cable to the PIC micro controller, which collects and forwards the information to the central control unit (CCU) through cables. The CCU processes the data and sends commands to the vendors web application and LED panel. The CCU is the middle layer of SPS and is responsible for controlling the ultrasonic detectors. The CCU is responsible for the collection of parking space information and for processing data for the whole parking lot. The CCU transmits commands to the LED display board to update the parking space information. Simultaneously, collected data can be saved in the parking lot server's database which will allow a supervisor to monitor, manage and control parking lot information.

### III. LITERATURE SURVEY

- Smart Parking: Parking Occupancy Monitoring and Visualization System for Smart Cities. By Robin Grodi, Danda B. Rawat, Fernando Rios-Gutierrez (Georgia Southern University Sattesboro, GA 30460, USA)  
Using a Wireless Sensor Network (WSN), parking spot statuses (occupied or idle) are detected and transmitted to a database. This system should provide users with near instantaneous updates of available parking spots while the WSN allows for flexibility of sensor placement.
- iParker—A New Smart Car-Parking System Based on Dynamic Resource Allocation and Pricing ( Amir O. Kotb, Yao-Chun Shen, Xu Zhu, Senior Member, IEEE and Yi Huang, Senior Member, IEEE )  
Allocation and deallocation of parking and pricing .The new system is based on mathematical modeling using mixed-integer linear programming (MILP) with the objective of minimizing the total monetary cost for the drivers and maximizing the utilization of parking resources.
- IoT Smart Parking System for Reducing Green House Gas Emission ( PrabhuRamaswamy Enterprise Architect Cognizant Technology Solutions Limited Chennai, INDIA.)  
This paper describes solution to smart parking system using Internet of Things (IoT) to override parking hazards and explains how does it helps to minimize emitting greenhouse gases. IoT enables smart parking system using the system of interconnected Raspberry Pi, Distance Sensor, Pi Camera devices together. This hardware reacts to one another collects data and transmits to cloud storage. IOT technology is used to find various parking places (vendor &government ) location accurately.

### IV.RESULT

The prototype was successfully implemented using PIC 16F877X connected with Ultrasonic sensors. These sensors were able to establish connection with the micro controller that was connected to an application server. This server provided Internet connection and allowed the sensors to report their status to the remote MySQL database. The webserver was set up and able to provide live updates to end users with a refresh rate of 3 seconds. With this working prototype, we are able to see that this system is capable of working and is able to be scaled up to an amount equal to the limit of the local gateway. This web server is able to be accessed by any device capable of internet browsing.

**Benefit Analysis:** On average, a driver attending a high demand event or crowded parking lot spends an average of ten minutes looking for an empty space.

There are over 10 thousands cars on-campus and over 20 thousand cars during sports (football) or artistic events looking for parking. With these calculations, if each vehicle has to travel half-mile (let us say) extra distance while searching for a parking spot, 10k vehicles would spend over Rs. 32568 extra in fuel and emit 1842 kilograms of CO<sub>2</sub> (if car size is average) and 2567.50 kilograms of CO<sub>2</sub> (if truck size is light duty which are commonly used during sports event such as cricket game). For the same number of vehicles the manhour wasted looking for a space is about 1667 hours. These numbers would be even higher for higher number of vehicles and for extra miles or travel time. Thus, proposed smart parking systems results in a sustainable parking systems using wireless sensor technology and networking parking spot statuses

are reported in real-time and show the information to the people who are looking for the empty parking space. Thus, smart parking system helps to reduce fuel consumption, carbon dioxide emission, save parking search time for the commuters, and reduce traffic jams associated with parking search.

V. FIGURES AND TABLES

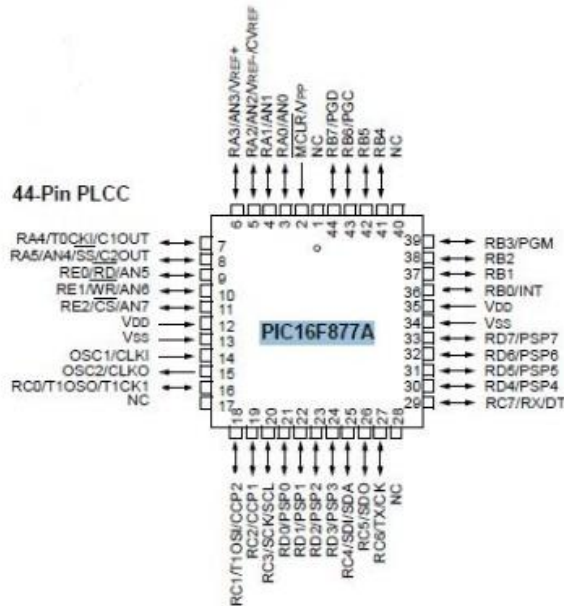


Fig. PIC micro-controller

Flash Program Memory (14-bits)	8K
Data Memory (bytes)	368
EEPROM Data Memory (bytes)	256
Interrupts	15
I/o Ports	Ports A,B,C,D,E
Serial Communications	MSSP, USART
Parallel Slave Port	Yes
10-bit Analog-to-Digital Module	8 input channels
Packages	40-pin PDIP 44-pin PLCC 44-pin TQFP 44-pin QFN

Fig. PIC Specification Table



Vcc Trig Echo Gnd

Fig. Ultrasonic Sensor

Working Voltage	DC 5V
Working Current	15mA
Working Frequency	40Hz
Max Range	10m
Min Range	2cm
Measuring Angle	15 degree
Trigger Input Signal	10us TTL pulse
Echo Output Signal	Input TTL lever signal and the range in Proportion
Dimensions	45*20*15mm

Fig. Ultrasonic Sensor Specification Table

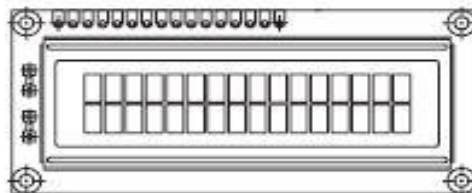


Fig. LCD Display(16x16)

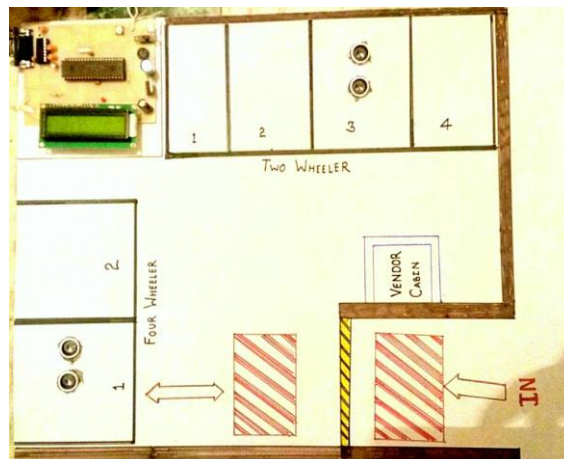


Fig.Parking SystemStructure

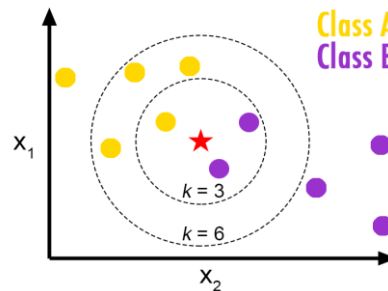
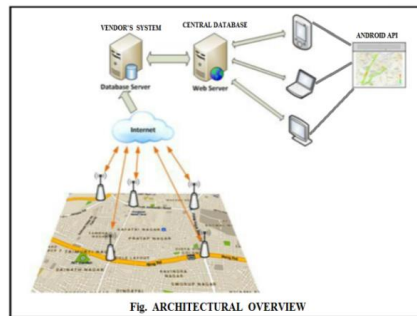


Fig: k-Nearest Neighbour

## VI. CONCLUSION

The main contribution of this study is to introduce the most significant parking problem i.e., finding an empty space — and propose a solution. Ultrasonic sensors can be used both for parking space detection and improper parking detection. 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. Future research might examine car park booking procedures and optimization of sensor usage. Cost effectiveness and marketing could be studied as well. This system can be expanded in future by increasing the distance limit for searching parking slot. Capability of system can also be increased by tracking that the correct vehicle is parked into the provided parking slot.

## VII. ACKNOWLEDGEMENT

We owe a great many thanks and take this valuable opportunity to profound gratitude towards RSCOE for providing a valuable platform and encouraged us during preparation of this paper.

## REFERENCES

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- [2] iParker—A New Smart Car-Parking System Based on Dynamic Resource Allocation and Pricing ( Amir O. Kotb, Yao-Chun Shen, Xu Zhu, Senior Member, IEEE and Yi Huang, Senior Member, IEEE )
- [3] IoT Smart Parking System for Reducing Green House Gas Emission ( Prabhu Ramaswamy Enterprise Architect Cognizant Technology Solutions Limited Chennai, INDIA.)