VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM

KARNATAKA, INDIA – 590014

A Project Report On

"Design and Implementation of a Prototype Smart parking (SPARK) System Using Sensor Networks and Android App"

In partial fulfillment of requirement for the award of the degree of Bachelor of Engineering in Computer Science & Engineering of the Visvesvaraya Technological University, Belgaum.

Submitted by

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Under the Guidance of

Prof. Padiyappa K.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

MARATHA MANDAL'S ENGINEERING COLLEGE

R.S.NO.104, Halbhavi, Opp, Siddhaganga Oil Mills,

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CERTIFICATE

Certified that the project work entitled

"Design and Implementation of a Prototype Smart parking (SPARK) System Using Sensor Networks and Android App"

Carried out by

Mr. Pandurang D. Prabhu.	**2mm10cs022**
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in partial fulfillment of requirement for the award of the degree of Bachelor of Engineering in Computer Science & Engineering of the Visvesvaraya Technological University, Belgaum, during academic year 2013-14. It is certified that all corrections/suggestions indicated for the internal assessment have been incorporated in the report. The project report has been approved as it satisfies the academic requirement in the respect of the project work prescribed for the Bachelor of Engineering Degree.

22/05/13

GUIDE	**HOD**	**PRINCIPAL**
Prof. Padiyappa koogati	Dr. Ameet Patil	Dr. V.B.Sondur

Principal
M. M. Engineering College,
Belgaum.

DEDICATED TO OUR BELOVED TEACHERS AND PARENTS

ACKNOWLEDGEMENT

The sense of contentment and elation that accompanies the successful completion of this project would be incomplete without mentioning the names of those people who helped me in accomplishing this project. There are many people whose constant guidance, support and encouragement resulted in its realization.

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We would like to express our cordial regards to our parents for their encouragement and moral support.

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-Project Associates

ABSTRACT

With the rapid proliferation of vehicle availability and usage in recent years, finding a vacant parking space even in multi floored parking space is becoming more and more difficult, resulting in a number of practical conflicts. Parking problems are becoming ubiquitous and ever growing at an alarming rate in every major city. Widespread use of wireless technologies paired with the recent advances in wireless applications for parking, manifests that digital data dissemination could be the key to solve emerging parking problems. Wireless Sensor Network (WSN) technology has attracted increased attention and is rapidly emerging due to their enormous application potential in diverse fields. This buoyant field is expected to provide an efficient and cost-effective solution to the effluent car parking problems.

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SYNOPSIS

"Design and Implementation of a Prototype Smart parking (SPARK) System Using Sensor Networks and Android App"

Aim

Our aim is to find a vacant parking space in multi floored parking system and providing available information to the user.

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Present Theory

With the rapid proliferation of vehicle availability and usage in recent years, finding a vacant parking space even in multi floored parking space is becoming more and more difficult, resulting in a number of practical conflicts. Parking problems are becoming ubiquitous and ever growing at an alarming rate in every major city.

Widespread use of wireless technologies paired with the recent advances in wireless applications for parking, manifests that digital data dissemination could be the key to solve emerging parking problems. Wirėless Sensor Network (WSN) technology has attracted increased attention and is rapidly emerging due to their enormous application potential in diverse fields. This buoyant field is expected to provide an efficient and cost-effective solution to the effluent car parking problems.

Proposed Work

This proposes a Smart Parking (SPARK) Management System based on sensor network technology which provides advanced features like remote parking monitoring, automated guidance based on Android App. Here each sensor is placed in between parking slot of a multi floored parking building. So whenever a car gets parked in parking slot. The sensor detects it and sends the signal to the microcontroller which in turn stores it in the server regarding the current place occupied by the car. This is same in the case when the car leaves the parking space.

The Android app which is installed in the driver's smartphone gives the clear updates to the Driver about the current free & also occupied positions of the parking spaces in their smartphones. So that he/she can park their car easily check current available space for their car to be parked in the current vacant space available.

Fig i. Sensor attached free space available for parking.

Expected Outcome of the project

The driver gets detailed information about occupied and free spaces available in the parking area through android apps. It reduces the amount of traffic while searching each free space for parking of the car.

Applications

1. This system can be implemented in the metropolitan cities where areas like Shopping Malls, Restaurants, and Multiplexes face a lot of problems on parking system.
2. It reduces the amount of traffic while searching each free space for parking of the car.
3. The driver gets detailed information about occupied and free spaces available in the parking area through android apps.
4. Lower investment than the other Parking Techniques which are presently available.

System Requirements

Hardware specification

- Microcontroller
- Sensors
- Android cell
- LCD screen

Software specification

- Sensor Networks
- Android Application
- PHP
- HTML
- Javascript
- CSS

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Guidesignature

Prof: Padiyappa Koogati.

CHAPTER 1

INTRODUCTION

Recent increase in the growth of automotive industry coupled with the perpetual demand of commuters urged the need for better and smarter parking mechanisms. Though lot of researches were conducted in this area, most of the existing parking management systems rarely address the issues of parking space management, vehicle guidance, parking lot reservation etc. Majority of these systems have control at the entrance & exit and use vehicle detectors as an essential element to provide smart parking. Though inductive loop is one of the most widely used detectors today, it includes various problems in installation and maintenance which might disturb the normal operations of parking.The widespread use of wireless technologies paired withthe advancement in wireless applications for parking implies that digital data dissemination could be the key for resolving the growing parking challenges. WSN have a great potential towards providing an easy and cost effective solution to this credible application for various reasons. Ease of deployment in existing parking lots without excavation and expensive cable installations has increased our attention towards wireless sensor network technology. Flexibility to couple with sophisticated but cheap sensors that can accurately detect vehicles makes WSN a natural candidate to solve the emerging car parking problems. Wireless sensor network usually consists of a large number of nodes that are deployed in the sensing area and are equipped with different kinds of sensing, computation and communication units. These functional units enable WSN nodes to cooperatively collect, process, and transmit information to the sink. Compared with the existing parking management systems. Smart PARKing (SPARK) solution based on wireless sensor network technology. The proposed system is capable of monitoring & managing individual parking spaces, providing automated guidance and advanced reservation services as well.Unmanned vehicle driving systems have been developed by famous auto mobile companies for years. Regardless of the issues of laws and regulations, there still have many technical issues, such as navigation, combination with Geographical Information System (GIS), and real-time monitoring of surrounding environment. One of the key technical issues is how to acquire the current position of the vehicle accurately. Making good decisions can often mean the difference between life and death. In order to make critical decisions, people must be able to assess their current situations and have access to pertinent information that addresses variables upon which these decisions are based. By increasing situational awareness, individuals are able to make decisions faster and more effectively. This is especially important in emergency response and military operations, where time and quality information are of the essence. Car-park management systems operate by monitoring the availability of car parking spaces and making that information available to customers and facility administrators. Customers use it for guiding them in their choice of parking space; administrators use it to aid in overall management and planning. Sensor networks are a natural candidate for car-park management systems, because they allow status to be monitored very accurately - for each parking space, if desired. Wireless sensor networks have the advantage that they can be deployed in existing car-parks without having to install new cabling for network and electricity to reach each sensing device. For this reason, wireless sensor networks also have use for road-side car-parking. a smart parking service based on wireless sensor networks and mobile phone application for vehicle drivers. We have designed and implemented a prototype system of smart parking services that allows vehicle drivers to effectively find the vacant parking spaces, both in outdoors and indoors environments. The proposed smart parking system consists of wireless sensor networks, embedded web-server, central web-server and mobile phone application as Android and iPhone. In this system, low-cost wireless sensors network modules are deployed into each parking slot equipped with one sensor node. The state of the parking slot is detected by sensor node and is reported periodically to the embedded web-server via the deployed wireless sensor network. And this information is sent to central web-server using WiFi networks in real-time, and the vehicle driver can also find vacant parking lots using a mobile phone or a tablet. A few existing solutions focus on parking lot applications using sensor technologies, such as magnetometers and video cameras. However, magnetometers are very sensitive on environmental factors, as a result of which their detections are not always accurate. Moreover, since magnetometers measure the change in magnitude and direction of Earth's magnetic field caused by the presence of a vehicle, they need to be placed at close proximity to the vehicle. Although this might be possible near the entrance of a parking lot, it is very difficult to place them in close proximity to vehicles on upper floors simply because there are typically no entrance marked for upper floors and vehicles move at relatively higher speeds than near the entrance. On the other hand, video camera based solutions are energetically expensive and they can generate large amount of data which could be very difficult to transmit over multiple hops in a wireless environment. These disadvantages coupled with the fact that there are other objects moving in a parking lot, such as humans, greatly reduce the applicability of only one type of sensor technology, i.e., only magnetometers or only video cameras for cheap and accurate parking lot management solution.

CHAPTER 2

LITERATURE SURVEY

2.1 System Evaluation

The SPARK prototype system is developed as a proof of concept to meet the real time requirements of parking management systems. We have carried out preliminary experiments to evaluate the functionalities and features provided by our prototype system. In our initial experiment we have modelled this prototype for 20 parking lots.

1) Parking Monitoring:

a) Scenario 1: Total parking lots are vacant: When all the parking lots are vacant, the sensor nodes placed in the parking lots detect that there is no event generated. The entrance display shows total vacant lots as 20 and parking lot GUI depicts.

b) Scenario 2: Three cars are parked: In this scenario we experimented by parking three cars in the parking lots. The sensor nodes detected the events and transmitted the report message to the sink. The sink in turn forwarded these messages to the management server. The management server processes this information and sends the status report to the respective guiding nodes and entrance display. The entrance display and parking lot GUI then, displayed the total no of vacant lots as Device Specification1) Sensor Node: This is the lowest level of the system andis provided by autonomous sensor nodes as shown in figure. These small, battery-powered devices are placed in the areas of interest. Each sensor node collects environmental data primarily about its immediate surroundings. In the prototype system we placed these nodes at every parking lot. These nodes will sense the presence of car in the parking lot using the light sensors attached and sends the event to the sink node through RF communication. The LEDs attached with the nodes also provide status information about the parking lots. Sink Node: Individual sensor nodes communicate and coordinate with one another. The sensor nodes will typically form a multi hop network by forwarding each other's messages, which vastly extends connectivity options. Ultimately, the data from each sensor node are propagated to the gateway/sink node Status LED Display: These LED displays as are placed at each and every parking lot. They indicate the status of parking lot. Red LED indicates that the parking lot is occupied, while the green LED indicates that the parking lot is vacant. Any reservation of the car parking lot is indicated using the blue LED. It is inefficient for artificial guide for parking inside the garage in the traditional parking management. Parking spaces positioning and display system helps the user to find the location of their own parking spaces quickly, whose hardware includes: control computer, reader, RFID tags, antennas, etc. The actual parking lot with the situation of parking spaces is drawn in the flat electronic map in real time. Users can easily get how many spaces and how to get there with the help of electronic map. One user getting the parking spaces positioning and display terminal installed at the road side punch their parking card which is taken from the automatic issuing machine in the entry. The terminal will highlight the parking space which has been distributed. The user can find their parking space quickly according to the reminding of the terminal. The schematic diagram of the parking spaces positioning and display system. Each special user will get one RFID tag, which is bounded with its personal information and parking information stored into the database. One car, of which electronic tag is installed in the proper position, will be checked through the RFID, when it enters into the coverage of electromagnetic waves emitted by antenna. If the tag is valid, entry's railing is lifted, and then the car enters into the garage without stopping; if the tag is invalid, special user has to enter into the garage as a temporary user. Graphic electronic map of the system is simple relatively, which is just used for an illustration here. In actual using, drawing the corresponding two-dimensional map based on the distribution of parking spaces in different parking lots is needed. The location of the parking positioning and display terminal is installed at the entry of the parking lot, which is convenient for users to park and query. As shown in the deployment scheme the platform is distributed in a metropolitan space. And different parts of the platform have different software/hardware platforms, terminal mobility and other characteristics. Communications and collaboration between the various parts are the key issue must be resolved. We can see there are three kinds of connections in the system including connections between mobile terminals and the server, connections between parking subsystem and the server and connections between traffic monitors and the server. For the first one, mobile communication network is the only choice because smart phone acts as mobile terminal, its capability of 2.5G/3G data communication providing a natural connection between mobile terminals and 2.5G/3G modems attached to the server. For the second, there are several available communication schemes include wired broad-band, Wi-Fi, wireless Mesh network and mobile communication to access the metropolitan area networks. To consider the relatively less data transmitting and flexible deployment requirement and lacking wired accessing method in most parking lots, mobile communication based on a GPRS/3G modem is more competent for this job. For the last one, if we transmit real-time traffic monitoring video to the central server which will does the analysis work to get real-time traffic state the cost of mobile communication traffic is unacceptable. And wired metropolitan-area network access point is absent often where the traffic monitor is placed. Therefore video image recognizing work is completed in traffic monitor terminal and the recognizing result is passed to the server. Then the required bandwidth is less and long-time-run cost is lower despite increase of performance requirement of monitoring terminals. To provide real-time parking information, parking lots are required to execute sense, collect, transmit and distribute information about vehicle passing event and information about available parking room. Think over facts of cost and deployment flexibility, we implement this requirement based on WSN technology. The work plan includes several key points. Firstly deploy vehicle sensors at entrances and exits to detect vehicle passing event. Secondly gather all the signals in sink node and the embedded parking machine witch stores parking lot's initial information. Then calculate the current number of available parking spaces. Last report data to remote server. To sense vehicle passing event, there are infrared sensor, magnetic sensor and video identification method. Magnetic sensor is adopted finally for it is simple, easy to implement, low-cost and with good anti-jamming performance to achieve vehicle detection. There are many ready-made magnetic sensors on sale. Most of them include induction coils and a relay controlling box and output a square-wave pulse when vehicle passes. a set of smart parking services based on Wireless Sensor Networks. We design and implement a prototype system that allows vehicle drivers to effectively find can effectively satisfy the requirements of WSN-based parking slots monitoring service. In this system, low-cost wireless sensors networks module are deployed into each parking slot equipped with one sensor node. The state of the parking slot is detected by sensor node and is reported periodically to the embedded web-server via the deployed wireless sensor networks. And this information is sent to central web-server using Wi-Fi networks in real-time. Besides, the vehicle driver can find vacant parking lots using their mobile devices. Though this prototype system we demonstrate that the proposed architecture can effectively satisfy the requirements of smart parking service and we believe that wireless sensor networks and mobile device application can be an encouraging technology to solve future parking management.

CHAPTER 3

REQUIREMENT SPECIFICATION

3.1 Hardware specification

- Microcontroller
- Sensors
- Android cell
- LCD screen

3.2 Software specification

- Sensor Networks
- Android Application
- PHP
- HTML
- Java script
- CSS

CHAPTER 4

SYSTEM DESIGN

4.1 System Architecture

We describe the design of Smart Parking (SPARK) management system which consists of WSN, Sink, Parking Management, Automated Guidance, Entrance Display and Client Reservation subsystems. At a glance, the systemshall be able to graphically display real time information related to the availability of parking lots to the users and would also enable users to reserve parking lot from remote locations.The system will also be capable of guiding users to efficiently locate vacant parking spaces so as to park their cars quickly and safely. The overall architecture is divided into six major subsystems as mentioned. The functions of each subsystem are as follows.WSN subsystem mainly deals with monitoring of parking status. This subsystem detects the status of parking space with hybrid sensing techniques and transmits status information through RF. It also receives commands from parking management subsystem to carry out various procedures. The subsystem internally consists of four major modules which include sensing, routing, dissemination and status modules. System Architecture of SPARKB. Sink Subsystem. The sink subsystem collects the parking status report from WSN subsystem and delivers them to the parking management subsystem. It acts as a gateway between wireless sensornetwork and external networks. This subsystem also forwardsthe information regarding the change in parking status receivedfrom management subsystem to the guidance subsystem through WiFi interfaces. Parking Management Subsystem This sub system acts as the heart of entire SPARK system. Whenever sink subsystem sends data to the parking management subsystem, the gateway transceiver module associated with the subsystem receives the data, processes it and forwards to the database module and vice versa. The database module stores the event based sensor data and the health information of the sensor nodes. The sensor & guiding node information from the database will be collected by the parking guidance module and displays the corresponding information on the parking lot GUI. It also takes the health information from sensor health monitoring module & displays on GUI. Parking entrance display module existing on this subsystem gets consolidated status information from the database and then processes the information to besent to the parking entrance display.Whenever the client reserves a parking lot, the reservation message will be forwarded to parking reservation module running on the management subsystem. It will further retrieve data from the sensor database and based on the availability of parking lots will forward an acknowledgment to the client. Automated Guidance Subsystem Guiding nodes divide their managing areas into several sections according to the turn offs of the parking layout. This subsystem helps vehicles to find idle parking spaces within less time. It consists of 2 modules which are as follows:

1) Guiding Application: If there is a change in the status, the management subsystem processes the information and forwards it to the sink subsystem. The processed data is then forwarded by sink subsystem to the guiding application running on the guidance subsystem, which is later depicted on parking guidance display.

4.1.1 ARCHITECTURE

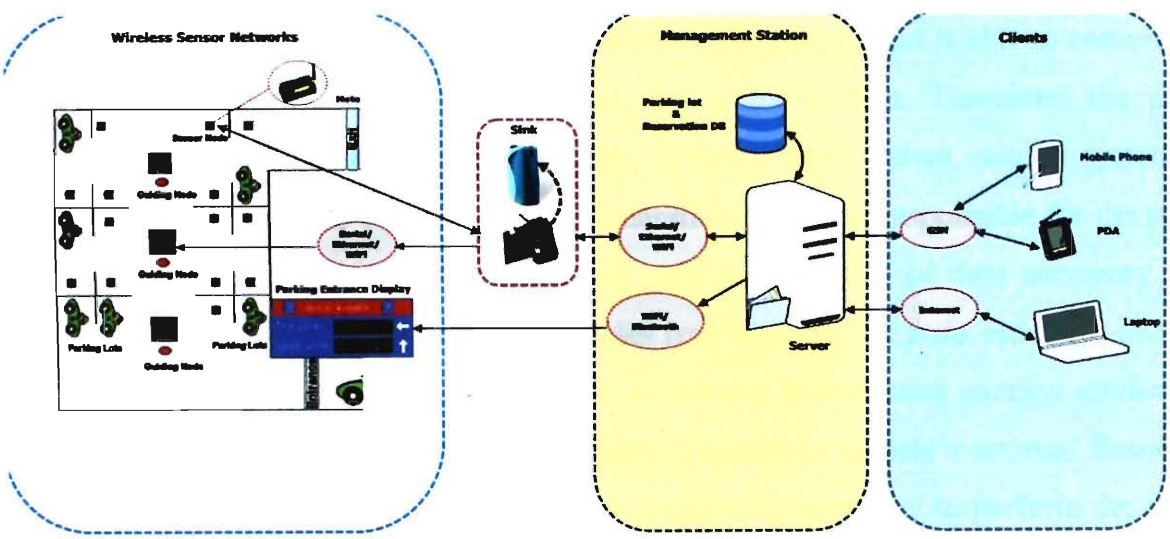


Fig 1. Architecture of Parking System

We describe the design of Smart Parking (SPARK) management system which consists of WSN, Sink, Parking Management, Automated Guidance, Entrance Displayand Client Reservation subsystems. At a glance, the system shall be able to graphically display real time information related to the availability of parking lots to the users and would also enable users to reserve parking lot from remote locations. The system will also be capable of guiding users to efficiently locate vacant parking spaces so as to park their cars quickly and safely .details the system architecture of SPARK. The overall architecture is divided into six major subsystems as mentioned.

4.1.2 DETAILED DESIGN

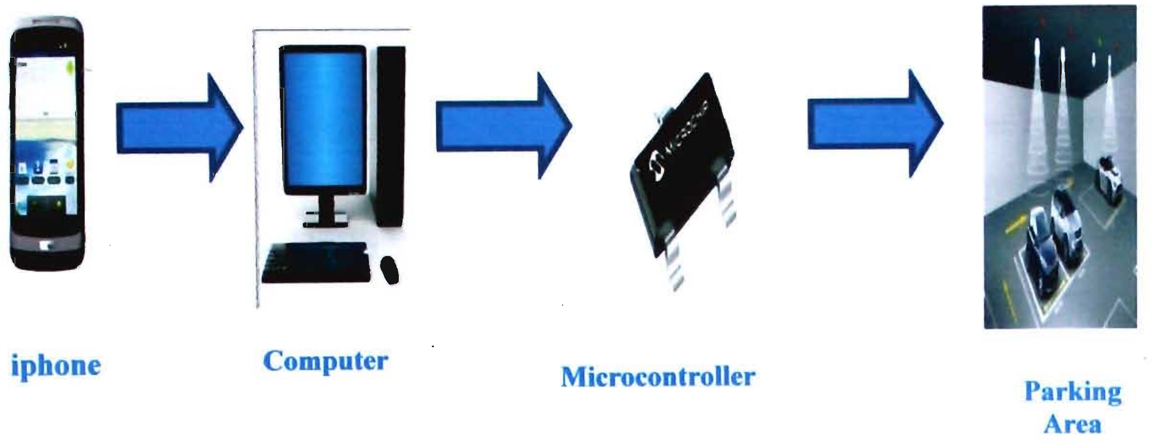


Fig 2. Detailed Design

It is assumed in this work that a parking administration system that is able to communicate with a vehicle entering the parking lot is part of the system. Therefore, the parking assistance systemis composed of a parking administration system, sensor system, and driver assistance system. The parking administration system is responsible for the parking lot management, assignment of parking bay, and transmission of data necessary in the assistance system. The sensor system provides real-time vehicle state estimates necessary in the driver assistance system. The driver assistance system uses parking environment static data (providedby the parking administration system),a vehicle's external dimensions, and the estimated vehicle state to derive the commands necessary to perform the parking task. The information flow between these systems is shown in Fig. In contrast to similar autonomous systems, the parking assistance system maintains the driver in the vehicle control loop. It means that factors such as driver delay, driver errors, and driver in security should be considered in the system's design. Driver delay is the time interval between the task command display and the start of the commanded task. Driver errors emerge while the driver is following the system commands using the steering wheel, brake pedal, and accelerate or pedal. A system that leads to an excessive dependence onan audio–visual interface to perform the driving task may cause driver insecurity. The necessity of addressing that problem makes necessary a completely different design approach from that employed for similar autonomous systems.

A. Parking Administration System

The parking administration system is responsible for providing the entering vehicle with static environment data needed Information flow between the systems of the parking assistance system for parking. Thus each entering vehicle receives the location of the assigned bay, guidance data to reach this bay, correspond traffic lane geometry data, the surrounding bays condition (occupancy) from the parking administration system.The administration system also interchanges data with each leaving vehicle. So, the parking administration system manages the empty parking bays, and is able to assign each entering vehicle a proper parking bay.

B. Sensing System

It is well known that one of the most important requirements for vehicle automation is its localization (real-time position andattitude estimation). Preview information about road geometry and, adjacent vehicles state information are also necessary for satisfactory control performance. The requirements of future I CAN systems are expected to include the same information needs. An accurate and robust vehicle state sensing system (with state including absolute position, absolute attitude, and velocities) may be used to generate this necessary information. Therefore, the vehicle state sensing system was chosen as the first parking assistance system approach because of its generality and promised high accuracy .If the sensor system was designed specially for the parking assistance system a different sensor suite should have been selected. However, working with general sensors (sensors that will probably be present in the next generation vehicles) were desirable from the point of view of I CAN research.Vehicle state sensing system was also employed because it was selected as one of the key research topics in the I CAN framework due to its importance in many ITS applications.

1) Sensor Suite Selection: The sensors most commonly suggested for being used in ITS and their main characteristics were studied for composing the sensing system. Special attention was paid to Global Positioning System (GPS) technology-based sensors. This was so because of GPS's excellent sensing capabilities (all weather, all time), and also because of the possibility of extending these capabilities to indoor environments. None of the investigated sensors used by itself could sufficiently constitute a vehicle state sensing system. Wireless sensor network modules detect a parking slot state to read the measured result of the light sensor in real-time, and then to send this information to embedded web-server. The hardware architecture of wireless sensor networks nodes on the right and an actual photograph on the left. This wireless sensor networks node is a micro device equipped with the hardware architecture of Wireless Sensor Networks. The communication network provides data transmission among parking lot information collection terminals, information collection servers, information distribution servers and information in terminals. The communication between information collection terminals and information collection servers is determined by factors such as the communication modes currently in use and parking management system types; the communication between information distribution servers and information in terminals uses the Internet and wireless communication. Tree network topology and hybrid static and dynamic routing protocol are adopted in our experiment. When an end device is turned on for the first time, it is connected to the routers automatically according to the quality of the transmission channel based on AODV route algorithm. When the signal of the end device is blocked, it will change its static route mode to dynamic route mode which allows the device broadcasting its data without reply. A parking algorithm based on state machine is proposed for street parking. It works in six steps. First, raw magnetic signal is detected by an end device. In our experiments, we find the magnetic sensor is mostly sensitive to two axis data. Therefore, we put the end device in the direction so that the car goes across the sensor from south to north, given the x-axis of the sensor pointing to south, y-axis to east and z-axis to vertical direction.

CHAPTER 5

IMPLEMENTATION DETAILS

5.1 Driver Assistance system

The driver assistance system generates and displays commands to guide the driver from the parking lot entrance until parking is completed. Parking lot data, vehicle external dimension data, and estimated vehicle state are used to compute the commands. The design of the parking assistance system is described in this section. The assistance system's general architecture, composed of a path generation module and an HMI module, is proposed, developed, and investigated.

A. Driver Assistance Architecture

The assistance steps from the parking lot entrance until parking is completed are as follows

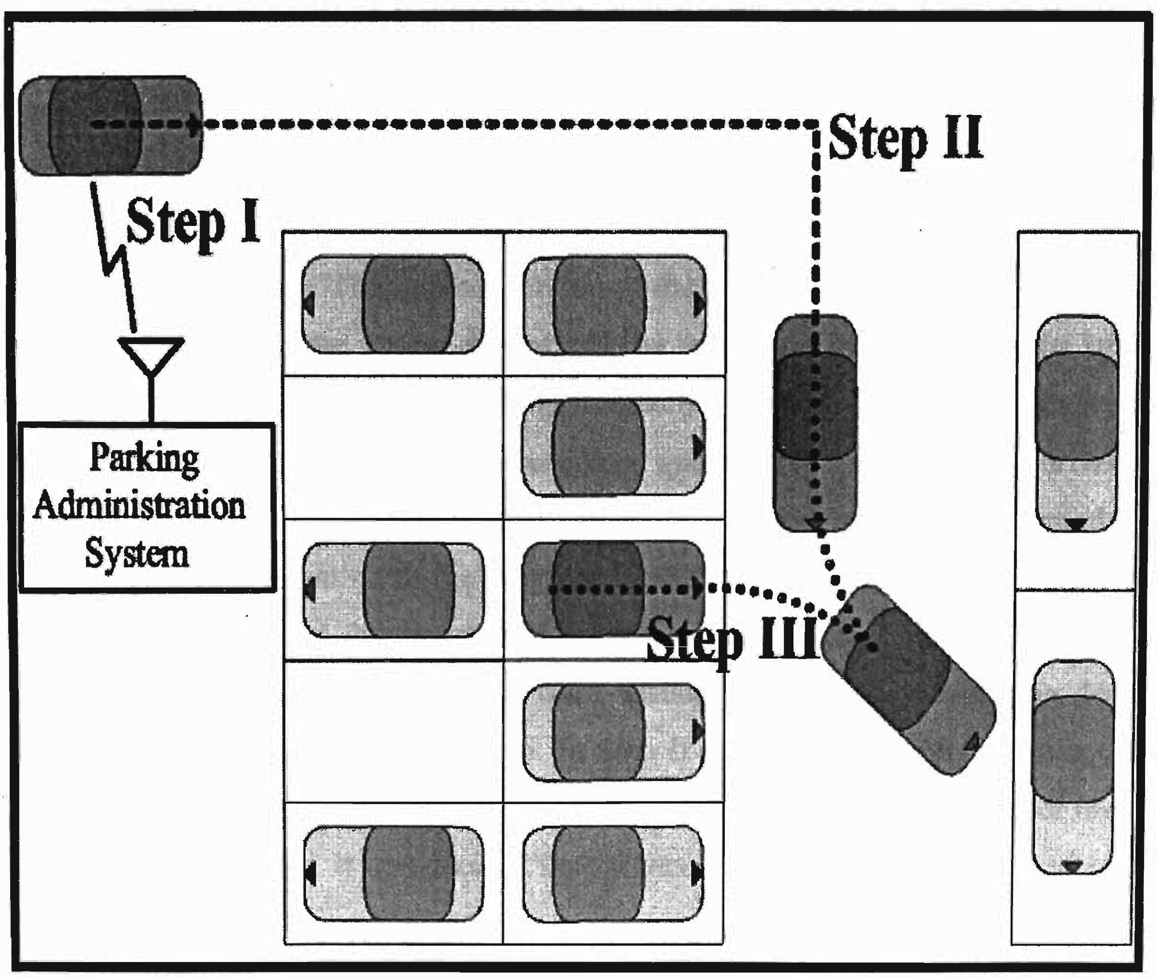


Fig 3. Assistance steps.

These are the following steps:

Step I)

Data transmission performed by the parking assistance system.

1) Parking bay assignment.

2) Parking data (parking bay dimensions, parking bay front lane dimension) transmission.

Step II)

Guidance from the parking lot entrance to the entrance of the parking bay.

Step III) Guidance until parking is completed.

We claim that the proposed assistance system's general architecture based on path planning and HMI comprises a sufficient assistance system for all the steps of this parking scenario. In an assistance system, a task is accomplished through the synergy of machine intelligence, human intelligence, and human skill. Depending on how the system uses the human intelligence, three approaches are possible.

Approach 1: Minimally use human intelligence and generate all the necessary commands.

Approach 2: Provide/display only the environmental information and rely on human intelligence to perform path planning and to generate the driving commands.

Approach 3: Use human intelligence in an intermediary level between the before-mentioned approaches. The implementation of the proposed architecture should begin with the determination of the approach that will be employed in each guidance step. Proper HMI and path-planning algorithm design for each step should follow. Assistance for skill- and rule-based tasks demands the derivation of quantitative commands and driver attention given to the HMI. Consequently, when assistance for these tasks are performed the driver tends to focus his attention in the interface, and attention/recognition capability in regard to any event than that displayed in the interface is expected. So, the necessity and/or feasibility of skill- and/or rule-based tasks assistance is one key factors in deciding the approach to be employed in each step. In Step II assistance there is no demand for skill- and rule- based task assistance, and it is not desirable that the driver focuses his attention to the HMI. Therefore, it was decided that in this step, assistance will be performed using Approach 2.

5.2 Intelligent car park management system

The architecture of our system, as shown in Figure 3, illustrates the relationship between the sensor network, MOTE-VIEW, Posgre SQL database, Tiny OS, Car Record database, and the car park application. The sensor nodes can be deployed to a car parking field and collect the real-time occupation information and vehicle information. The collected information can be transmitted to a gateway via wireless communication among the sensor nodes. The gateway is connected to a database server via Internet. The collected information will be acquired and installed into a database by a database server. The car park management application operates on top of the database. This architecture can effectively decouple the upper layer application from the underlying wireless sensor networks. The variation of the underlying wireless sensor networks will not lead to the change of the upper layer application system.

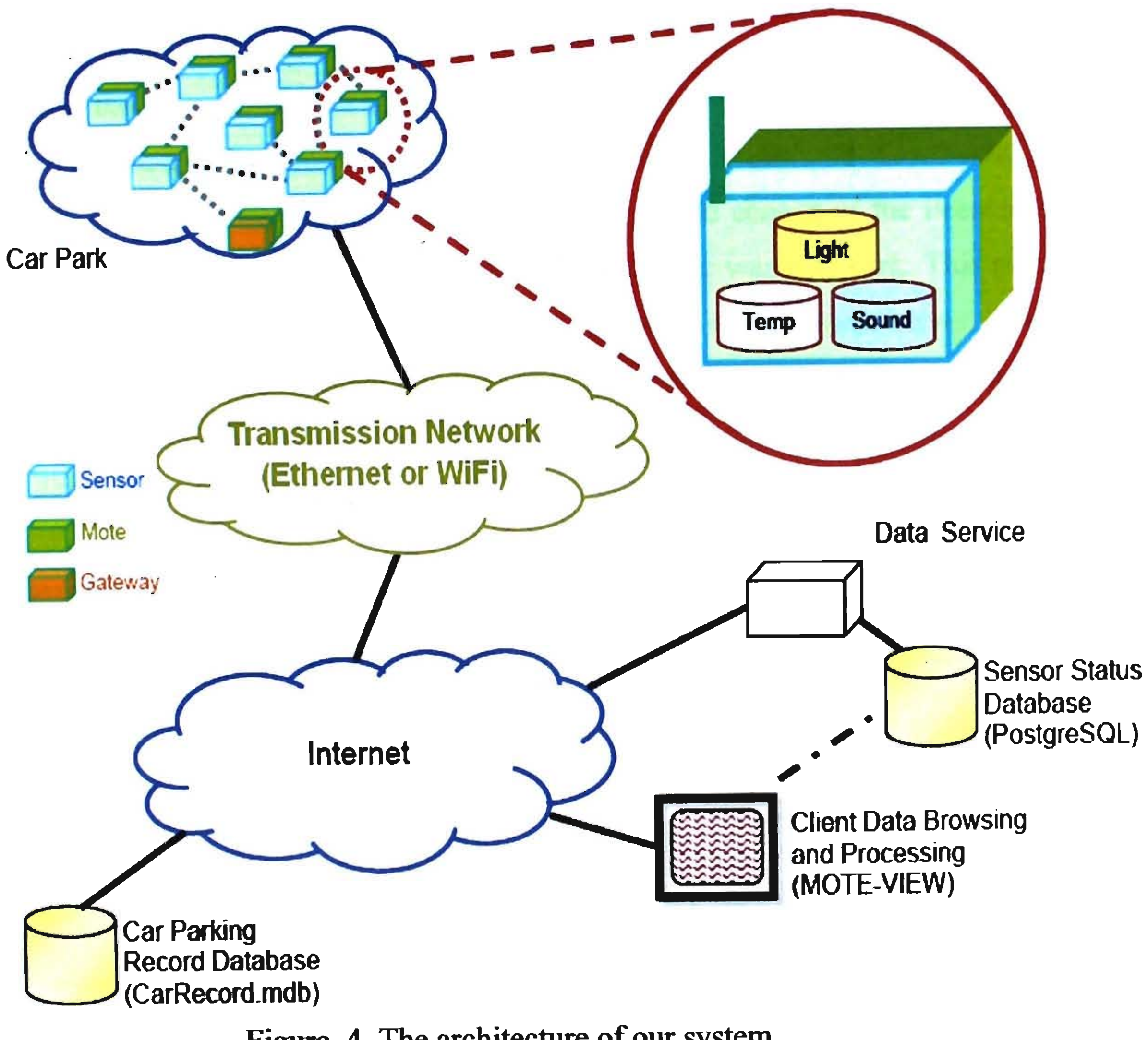


Figure 4. The architecture of our system

5.3 Prototype System: Experimental Setup

The initial SPARK prototype system was deployed at our Ubiquitous Computing Research Centre (UCRC) which includes 20 sensor nodes, 3 guiding nodes, entrance display, sink and a management server with GSM module as shown in the figure 4. Initially, when the system starts functioning, all sensor nodes form a network autonomously. The sensor nodes check the availability of each parking space and transmit the status report messages to the sink node. The sink node collects the status messages and delivers them to the management server. This information is stored in the database and will later be used by the management server to compute the vacant & occupied spaces. It further transmits the status information to the guiding and parking entrance display. When a car parks in a parking lot, the sensor node detects that the parking space is occupied and sends a report message to the sink node. It also turns on the red LED to indicate the parking lot status as occupied. After receiving the report, the sink node would notify the management server regarding the change in the status. Consequently, the management server would re-calculate the information and sends it to the proper guiding and entrance display to change the display status. Customers interested in reserving the parking lot could send a message through the client reservation GUI. The message would consist of the license number of the car, time of parking and duration for which the user wants to park. This message will be processed by the reservation module running on the management server. The user will then receive an acknowledgment with the confirmation and the expiry time of their parking depending on the vacant lots in the parking area. If parking area is completely occupied, the customer will receive a message which shows Parking lots are full.

Fig 5. Parking Layout (SPARK Prototype Model)

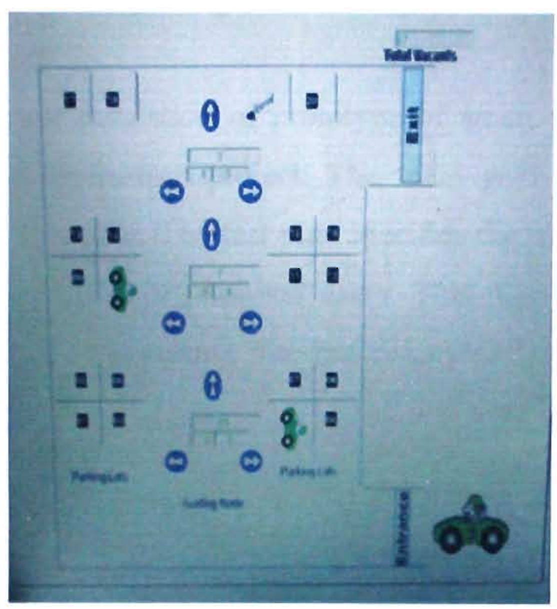
The parking assistance prototype , used a Toyota- modified as a test vehicle in experiments regarding the development of the Intelligent Car Navigation Systems. The experimental vehicle has the following dimensions: length (4695 mm) and width (1695 mm). A normal driver is expected to have difficulties in parking this vehicle since its wheel base (2985 mm) and minimum rotation radius (42 000 mm) are bigger than those of usual vehicles. The system components and the main software modules are mainly because of differences in requirements; distinct modules were coded in different programming languages. The path planning and state estimation modules algorithms were implemented in C language. The human machine interface and parking administration modules algorithms were implemented in JAVA language. The parking administration system is based on a standard Pentium II PC system. The on-board computers and parking administration PC are connected via a wireless LAN and uses Hirano Object Request Broker (HORB) [35] for data communication. A vehicle entering/leaving the parking lot is detected by the phototube-sensor in the parking lot entrance. The parking assistance system starts the data communication process after detecting an entering vehicle. The implemented parking administration system screen also allows the visualization of a bay reservation/occupancy situation and in-parking vehicle data (including its state).

The on-board processing system is based on two standard Pentium II PC systems connected via LAN. One is responsible for path planning and estimation algorithms, while the other PC is responsible for the HMI. Simulation and experimental results indicated that position and pose error less than 10 cm and 1 , respectively, are necessary.

For achieving the desired precision The three-axes INS unit was mounted on the vehicle above the center of the rear axis. The D-GPS receiver antenna was mounted on the vehicle roof above the INS unit.

Entrance Display

Fig 6. Entrance Display



Reserved Lot

Parking Lot GUI

Fig 7. Reserved and Parking Lot GUI

CHAPTER 6

SYSTEM TESTING

6.1 Overview

As mentioned above our project consists of three modules. In module1 searching free parking slots for parking the vehicle. In that we are using wireless sensors through that we are going to find free parking space. Module2 consists of sending information from sensors to microcontroller. In that we are using 8051 microcontroller.In module3 sending information about parking slot is whether empty or full through android application on users mobile phone.

In testing phase, we are performing unit test in this we are testing whether sensors sending correct information to the microcontroller or not. And even we testing working of microcontroller by checking whether it sending information to customer through android application. We tested all three modules by integration testing method and verified its proper working by android application.

This is Test Plan for design and implementation of prototype of smart parking system using wireless sensors and android application project. The main goal of this plan is finding the free space for parking the vehicle. The test plan specifies the essential features to be tested for the system to be acceptable by the end users. This plan also elucidates several other parameters associated with the testing like test risks etc. The features to be tested are listed further in the document.

6.2 Test Plan

This test plan corresponds to the level of Acceptance test and test will be performed by the actual end-users. The primary focus will be end-to-end testing of application through android app interface. The programs will enter into acceptance test level after all crucial defects associated with them have been corrected.

The significant constraints for testing are availability of enough resources to be allocated to the project and the improving of deadline constraints. The list below indicates some of the risks occurring during the test process.

- Changing to the original requirements or designs.
- Late delivery of the software, hardware or tools.
- Lack of personnel resources when testing is to design.
- Lack of availability of required hardware, software, data or tools.

- Delays in training on the application and/or tools.

Following is the list of items to be tested:

- Customize the software for a particular type of project.
- Creation of project.
- Creation of work-break down structure.
- Design of tasks.
- Scheduling of tasks.
- Appending the modules to the existing system.
- Progress of the project.
- Achievements of milestones.
- Creation and execution of modules.
- Compatibility with the system.

Features to be tested

Following are the features to be tested:

- Process of project creation.
- Process of tasks creation.
- Process of creation work-breakdown structure.
- Definition of resources and assignment of the resources to tasks, and workers to the tasks.
- Creation of standard templates and link them with the project.
- Definition of the base-line of the project.
- Monitoring the progress of the project with respect to task completion time.
- Performance metrics, simulations are carried out under both non-interfering and interfering flow cases.

Features not be tested

The following features are not to be tested from user's view:

- Percentage of completion of tasks.
- Definition of milestones.
- Upload of various reports.
- The type of network between two nodes.

6.2.1Test cases

Case-1: Searching vacant space for parking vehicle

Here we using sensors for searching free space. And with those sensors we are going to recognize vacant space. We are using IR sensors for recognize free space, and sending information to the microcontroller.

Case-2: Sending information about parking space on android phone

The performance metrics that we have considered in our proposed work is about finding vacant space for park the vehicle. Here first IR sensor sends the information about the free space to the 8051 microcontroller then it sends that information on the users android phone through android application.

• The proposed driver assistance system general architecture sufficed for the present system but it should be further developed for employment in future systems. The proposed scheme should be generalized in order to provide assistance for drivers with different abilities and skill levels and when complex "assistance mode" transitions and thresholds are necessary. The scheme should apply approaches similar to that proposed in [36] for complex automated driver-in-the-loop systems.

• Present sensing system technologies are able to provide the precision necessary for driver assistance systems (including these with skill level tasks assistance). Typical advanced driver assistance systems will require multiple vehicle state estimates. Considering this issue as well as the safety issues, multi sensor systems should be preferred for use in driver assistance systems.

• In driver assistance systems, the human interface and path-planning algorithm are tightly coupled systems. Therefore, the path planning for driver assistance systems should consider factors other than the physical constraints such as drivability and ease of the driver's understanding of the commands via the machine interface. The proposed approach should be further developed for use in future assistance systems. Issues that remain to be resolved include the problem of performing the techniques involved in regard to experienced drivers and/or complex driving scenarios, and the problem of assisting when dynamic physical constraints exist.

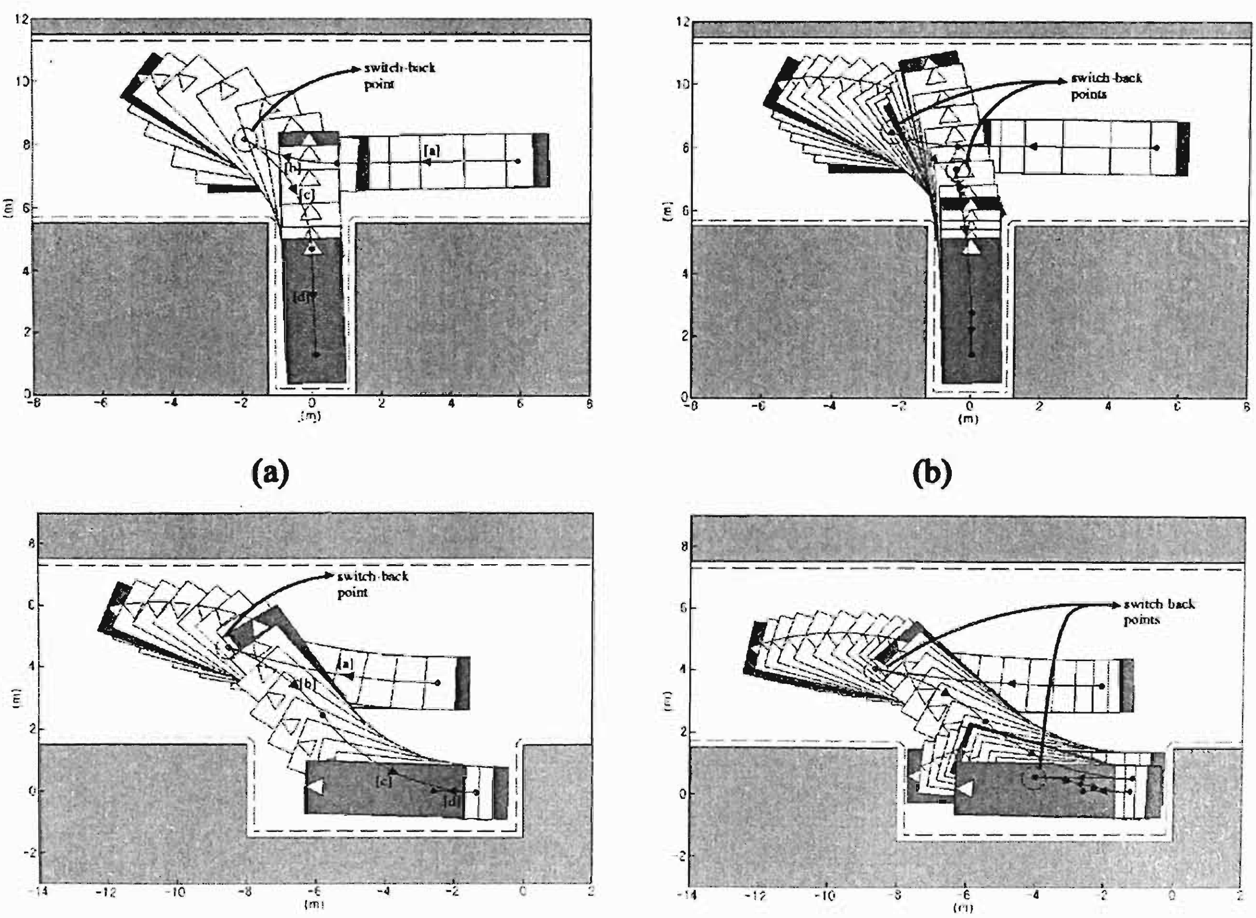
• The influence of HMI design on general system performance is very significant. We were not able to develop any systematic design methodology for the human interface have opted to evolutionarily develop the HMI based on basic design guidelines.

CHAPTER 7

RESULTS AND SNAPSHOTS

7.1 Experimental Results

Extensive tests were performed in parallel with system development. The test results were fed back and used to derivesystem design improvements. These improvements had mainly to do with the HMI system. Row parking experiments were conducted in a pre-existent parking bay with the dimensions of of 5500 mm by 2500 mm, and front traffic lane with a width of 6000 mm. The lane parking experiments were conducted in a parking bay whose dimensions were 8000 mm by 3000 mm and a front traffic lane whose widthwas 6000 mm.shows examples of results of row parking experiments shows examples regarding lane parking experiments. The figures show the vehicle state estimates recorded while the driver was performing the parking task assisted by the parking assistance system. Thes had owed rectangles represent the vehicle stopping positionswhere steering wheel and gear commands were affected.



(a) (b)

(c) (d)

Fig 8. Parking guidance experimental results.

7.1.1 Front screen of the application

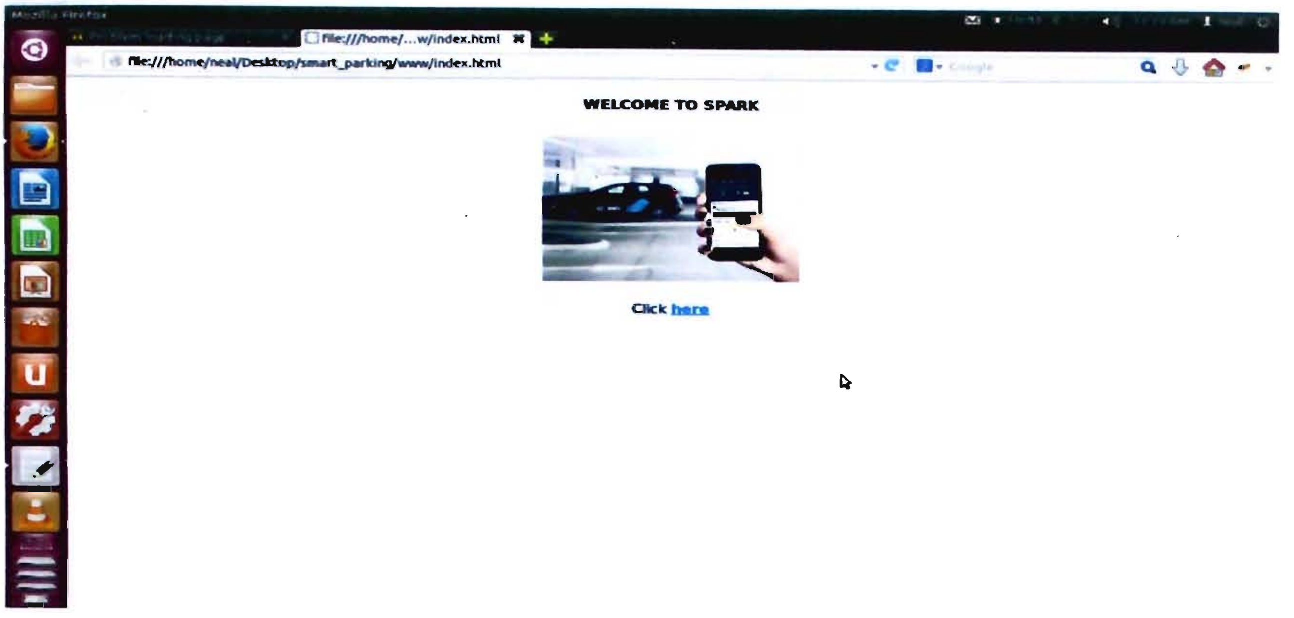


Fig 9. Front screen

7.1.2Selection of the location

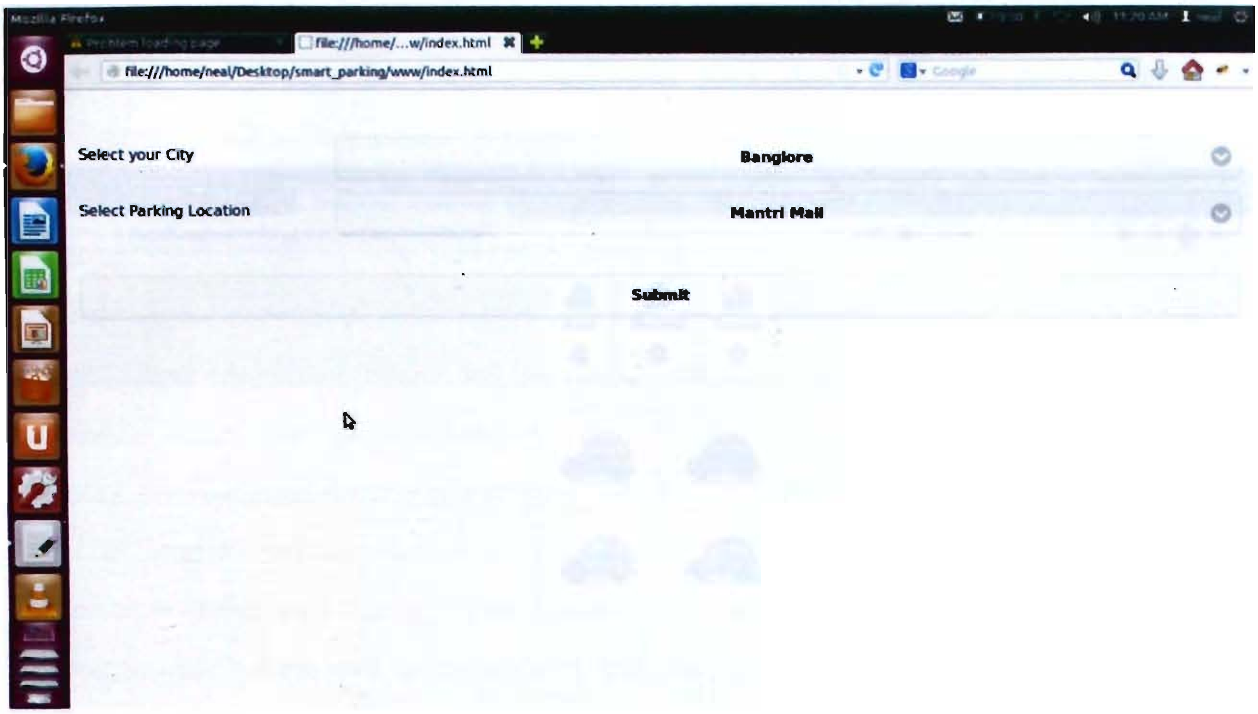


Fig 10. Selection of location screen

7.1.3 Checking of free, booked or parked vehicle

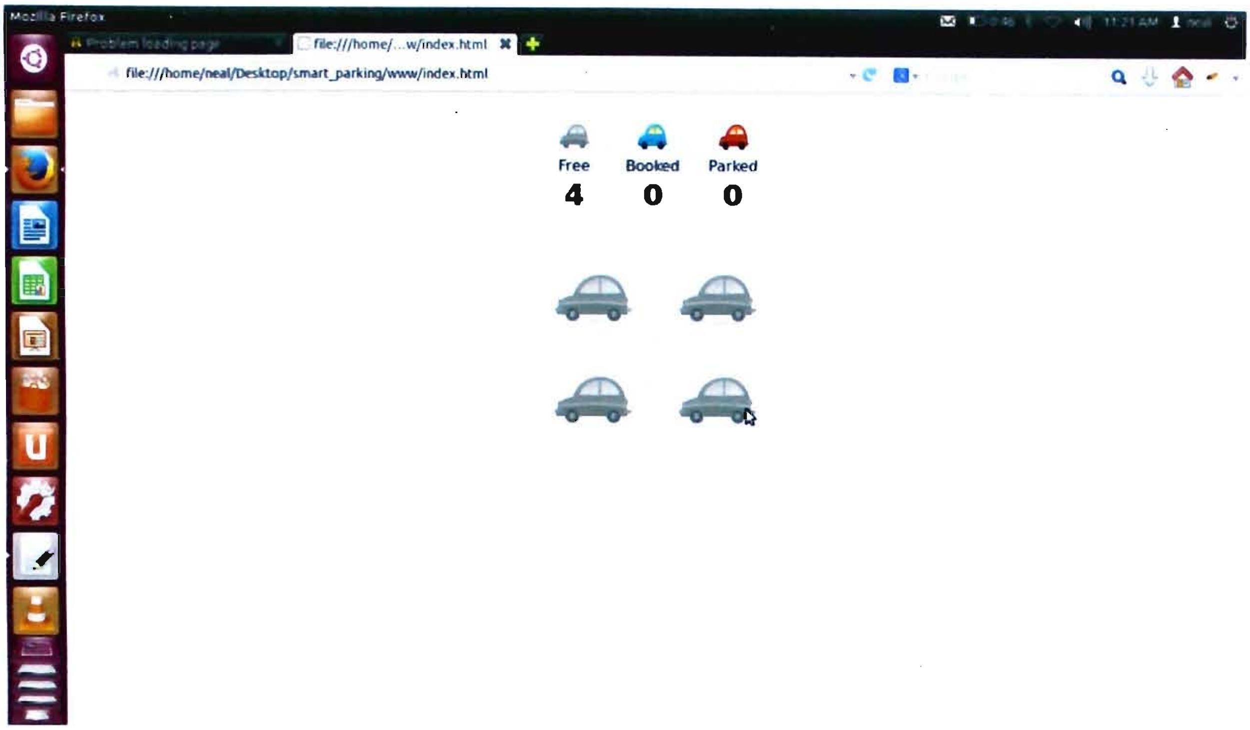


Fig 11. Checking of free, booked, and parked screen

CHAPTER 8

CONCLUSION AND FUTURE WORK

In almost every major city in India and other countries, parking problems are ubiquitous. The present day metropolitan areas have seen a sprouting growth in human population as well as vehicles.

Through this prototype system we demonstrated that the proposed architecture can effectively satisfy the requirements of a car park management system and we believe that wireless sensor networks can be a promising technology to solve future parking hassles.

we described the Smart PARKing (SPARK) management system using wireless sensor networks. Based on the requirement analysis for existing car parking management systems, we designed the system architecture and its subsystem level components as part of UCRC project. We implemented a full fledged prototype model as a proof of concept to realize and understand the real time scenarios in parking management systems. Through our prototype system we demonstrated that the proposed architecture can effectively satisfy the requirements of a car park management system and we believe that wireless sensor networks can be a promising technology to solve future parking hassles.

This proposes a Smart Parking (SPARK) Management System based on sensor network technology.

- Here each sensor is placed in between parking slot of a multi floored parking building. So whenever a car gets parked in parking slot.
- The sensor detects it and sends the signal to the microcontroller.
- which in turn stores it in the server regarding the current place occupied by the car. This is same in the case when the car leaves the parking space.

The Android app which is installed in the driver's smart phone gives

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