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A Comparative Study of Different Smart Parking Assist Systems Using Wireless Sensor Networks

Vivekanand P. Thakare
G. H. Raisoni College of Engineering, Digdoh hills, Wanadongari, Nagpur, vivekanand.5977@gmail.com

Nekita Chavan
G. H. Raisoni College of Engineering, Digdoh hills, Wanadongari, Nagpur, niki.chavan@gmail.com

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Vivekanand P. Thakare & Nekita Chavan

G. H. Raisoni College of Engineering, Digdoh hills, Wanadongari, Nagpur
E-mail : vivekanand.5977@gmail.com & niki.chavan@gmail.com

Abstract - To deal with the parking guidance issue of the parking lots, this paper proposes a vision of improvements in parking guidance and information system based on wireless sensor system. This system consists of parking space monitoring nodes, routing nodes, parking guidance display and Central control center. The nodes transmit the information through wireless sensor network . After analyzing and processing the data, the central control center would distribute the parking information by LED screen and displays for the drivers..

Keywords - *Wireless Sensor Network (WSN), Parking Guidance and Information System (PGIS), Vehicle detection sub-system (VDS), Vehicle management system (VMS).*

I. INTRODUCTION

With the development of people's living standard, the development of national automobile industry and the declination of the price of the cars, the owners of the cars are increasing sharply. So the parking issue is becoming more and more serious for the owner of the cars in most major cities. The limited availability of parking results in traffic congestion, air pollution, as well as driver frustration. The price for parking expansion is usually prohibitive or extremely high. Smart parking is a parking garage that utilizes various technologies to efficiently manage the garage. Lot of research and development is being done all over the world to implement better and smarter parking management mechanisms. 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) technologies has attracted & increased attention and are rapidly emerging due to their enormous application potential in diverse fields. This field is expected to provide an efficient and cost-effective solution to the efficient car parking problems.

The rest of the paper is structured as follows. In Section II related work is discussed. In Section III propose3d work is discussed. In Section IV we will show comparisons of these systems. Section V includes conclusion.

II. RELATED WORK

Many approaches were proposed in the past to improve the parking guidance mechanism in order to save most of the time of the driver for seeing the parking space and also headache of drive the car inside the parking lot and see the parking space.

PGI is a parking technology [10] that guides and provides information about the availability of parking spaces located in major cities. Vehicle detectors are installed at entrances, exits and/or individual parking space to collect and calculate the number of occupied and available spaces. Common detectors include loop detectors, machine vision, ultrasonic, infrared, microwave and lasers. Information, ranged from ”empty” or ”full” lot, to the number of availability, or to the exact location of available spaces, are displayed at various spots so that drivers can make better decision.

Vehicle detection sub-system (VDS) and management sub-system (VMS) [5] is based on wireless sensor network (WSN). The VDS sub-system is used to detect the occupancy of a parking lot and report the result to the management sub-system. The management subsystem processes the gathered information and provides the information to the drivers. To evaluate the system, the WSN based VDS is implemented and experimented on the system with various kinds of cars.

A smart car parking management system [9] is proposed to compare sensor data gathered from different varieties of Acoustic, light and Magnetic sensors to

detect whether a car park bay is vacant or occupied in a given time. The main focus of the work is to utilize WSN to monitor a large area of wireless network. A WSN distributed over a large area is expected to gather information by different types of sensor nodes. This system is designed to gather parameters from all active sensors of different types. A central server then compares and analyzes these parameters recorded in different environment conditions to detect whether a car park bay is vacant or occupied in a given time.

A WSN based Visual Display Systems is implemented [11] to inform drivers about the available parking space. The authors have evaluated the performance of this Parking Guidance System (PGS) with several kinds of cars and demonstrated the feasibility of battery-powered T-Sensor node with simulation analysis using real measured current profile. This PGS architecture supports self-healing when a routing problem occurs.

The PGIS discussed in [1], there are three kinds of nodes, which are monitoring nodes, routing nodes and sink node. The monitoring nodes would detect the status of every parking space, and transmit the information through routing nodes hop by hop to the sink node. The sink node connects to the information and management center through RS-232 interface. After processing the data, the information and management center will send the message to all the nodes and update the information in LED screen at the entrance of the parking lot. So this PGIS can help the drivers to park their cars quickly and safely.

Based on the above classification of smart parking systems, a parking garage may employ one or a combination of above systems to best serve their customers. The system determines the occupancy of a given area and display space-availability information to customers via dynamic message signs located throughout the garage.

III. PROPOSED WORK

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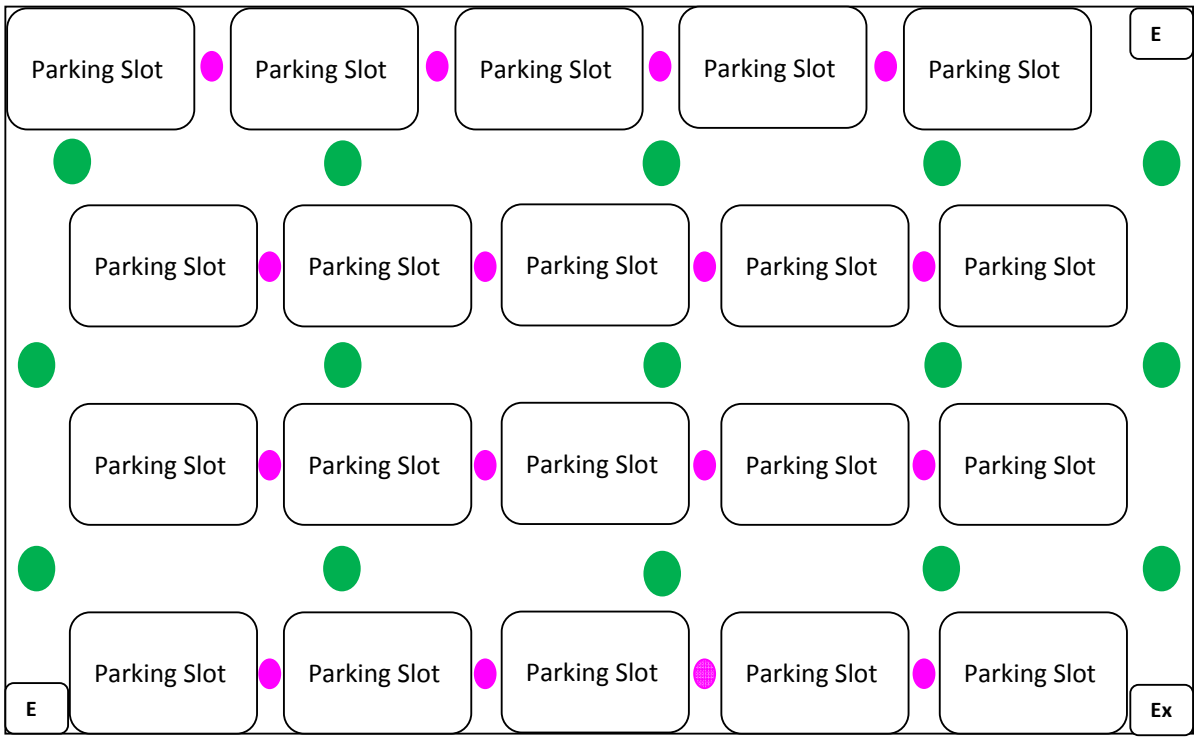

FIG. 1 PARKING SCENARIO WITH SENSOR NODES

. The purpose of this project is to compare different sensors parking guidance and management systems based on wireless sensor network. Being a wireless sensor network the system is expected to get information gathered by different wireless sensors distributed over a large area of wireless network coverage through nodes assigned to each sensor. This wireless sensor network is the heart of the system which detects the parking space available in the parking lot and guide the drivers for parking their vehicles.

In this work, A Parking scenario consists of Sensor Nodes and Central Control Center. Sensor nodes are monitoring nodes, routing nodes and LED display. The monitoring nodes are installed upon or aside of every parking space. The node detects the status of parking space with ultrasonic and transmits message by RF communication module. It also receives commands from information and management center to carry out some procedures.

The routing node receives data from monitoring nodes and transmits it to sink node hop by hop with tree-like topology. It also transmits the commands from information and management center to all the monitoring nodes. The LED display tells the new-coming car the available parking spaces in this parking lot and show the path to the available parking space according to the result by the optimal parking space choice model [2] from the PGIS. In addition, there are some LED displays at the main turnoffs which help the drivers to find the optimal parking space with less time.

The central control center takes the charge of managing and maintaining of the whole system. It processes the data from the monitoring nodes, calculates the optimal parking space for the new-coming car, counts the parking fee and controls the LED screen and displays. The center also sends commands to the nodes and controls the whole network. When there is a new-coming car, the PGIS will calculate an optimal parking space, and plan a path to the space for the car. All the information will show by the LED display. After the car parked in the parking space, the monitoring node will detect the status in a short time and transmit the data to the central control center. The center would re-calculate the guiding information and show it in LED screen.

IV. COMPARATIVE ANALYSIS

Parking Scheme	Advantages	Disadvantages
VDS & VMS	Vehicle Detection is possible.	Standard frequency allocation is required.
SPARK	Cost effective Real time Easy to use	Installation & maintenance problem which might disturbs the normal parking.
PGIS	Integrating embedded systems	Not convenient for current parking lots. Transmitting information is usually based on RS-485 bus.

Table. 1 comparison among different parking schemes

V. CONCLUSION

Smart parking assist systems employ advanced technologies to permit efficient use of parking lots. Smart parking ranges from simple systems that show the number of available spaces to complex ones that can guide customers to a free spot. We present PGS system architecture based on WSN. PGS is a parking technology that guides and provides information about the availability of parking spaces located in major cities.

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