A Preference Based Smart Parking System: KFUPM Case Study

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Abstract — This paper describes a proof of concept implementation of a smart parking system. At KFUPM there are several parking buildings available for student dorms and some of which can be completely full. A lot of time is wasted by students looking for the most suitable parking space. The developed parking system informs each user the closest vacant parking space to his preference through a display board and an SMS to his mobile phone. Every student will have his preference stored in the campus smartcard database that includes his mobile phone number. If the preferred parking space is occupied, the system finds the closest vacant parking space.

Index Terms – Preference based parking, RFID, smart parking.

I. INTRODUCTION

Several intelligent surveillance systems have been developed around the world to assist drivers in finding vacant parking spaces. There are mainly four categories of car parking management systems. These include counter-based, wired-sensor-based, wireless-sensor-based [1-2], and image-based systems [3-4]. When using wireless sensor technology, cost of sensor node, power management, and communication protocols, need to be considered.

II. SYSTEM IMPLEMENTATION

In our implementation, ultrasonic sensors are deployed to detect the status of parking spaces. The project comprises of two main circuits: Vacant Parking Space Detection Circuit and Parking Management Circuit.

A. Vacant parking space detection circuit

The vacant parking space detection circuit basically detects if a parking is available or not and transmits the data wirelessly to the parking management circuit. A block diagram with main parts of the detection circuit is given in Fig. 1.

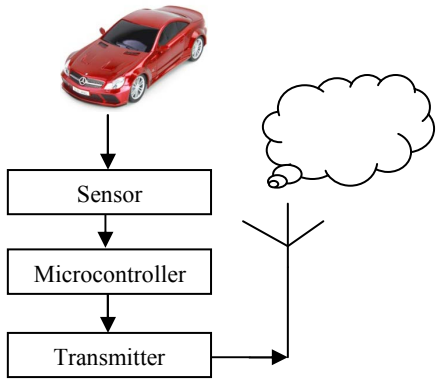

Fig. 1. Block diagram of sensor unit

There will be as many detection circuits as the number of parking spaces in the building. The circuit at each parking space consists of a sensor, a microcontroller and a transmitter. The different components of the circuit used at each car space are:

- Ultrasonic sensor (HC-SR04)
- RF transmitter (WRL-10534) – 434MHz
- Microcontroller (ATMega328)

Ultrasonic sensor works by continuously sending an ultrasonic pulse and microcontroller calculates the distance from the reflected pulse. Then, the microcontroller transmits the location ID and status of the parking lot to the control unit. Communication between this unit and the sensor unit was achieved using RF transmitter (WRL-10534) and receiver (WRL-10532).

B. Parking Management Circuit

The block diagram of the implemented management system is shown in Fig. 2, and the circuit is shown in Fig. 3. The parking management circuit basically communicates with all the vacant parking space detection circuits

using a microcontroller (Atmel ATmega328) and receives the parking status wirelessly. It then updates the status for vacant and filled parking spaces accordingly. The parking management circuit also contains the database for users with their mobile numbers. When a user presents his smartcard close to the RFID reader, if the user is unauthorized to park, the message "You are not authorized" is displayed. Otherwise the display shows a welcome message and displays the closest available parking space to the user's preference list from the database. It also sends the information via SMS. The different components of the central control unit are:

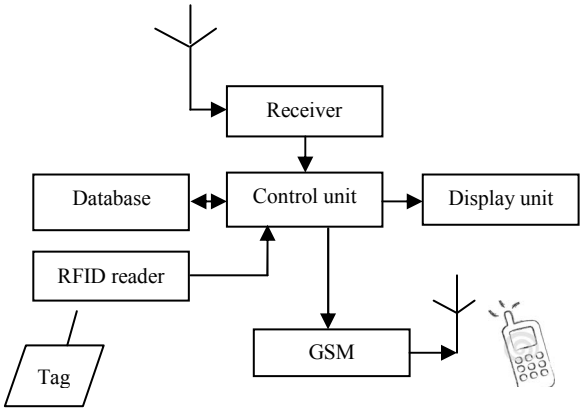

Fig. 2. Block diagram of central control unit

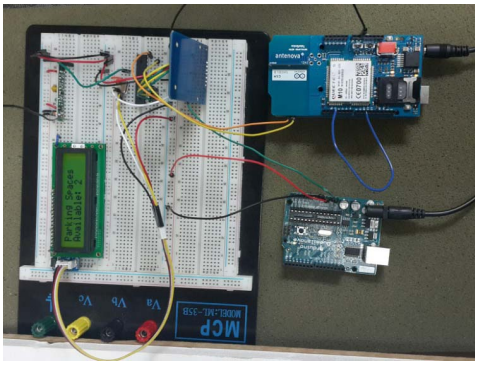

Fig. 3. Central control unit circuit

- RF receiver (WRL-10532) – 434MHz
- LCD display (Grove Serial LCD)
- RFID reader (Parallax)
- Database of parking users
- GSM shield (Arduino)
- control unit (ATmega328)

III. EXPERIMENTAL RESULTS

The communication between parking detection circuit and the control unit is via simplex transmission. It gives the advantage of saving in number of components and power. But in order to identify the faulty parking detection circuits, it increases the workload on the control unit side. The parking detection circuits need to continuously transmit the parking status and the control unit needs to keep a check on them. If a parking status circuit transmission is not received for 30 minutes, the system will report a faulty detection circuit.

The continuous transmission of the parking detection circuit from all parking spaces at the same time can create corruption of data. For this reason one detection circuit transmits the data at a given time and when it is done, it interrupts the next detection circuit to transmit the data and so on. The disadvantage is the delay in the update of parking status due to serial detection of interrupts. However, in the real implementation this can be solved by using duplex communication.

VI. CONCLUSION

The paper described a proof-of-concept implementation of a preference based parking system. Experimental results showed that system is able to direct users to the closest vacant parking space to their preferred one, thus saving time, reducing pollution, and discourage parking violations.

ACKNOWLEDGMENT

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