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Ti RTOS Based Parking Lot Guidance System

Swathikaa S. V. and J. Selvakumar

ABSTRACT

This idea is proposed with the problem statement in mind that due to the lavish lifestyle and enhanced living methods, the count of automobiles in India is increasing exponentially with a minimum of one car per household used for travelling. Because of this, finding a proper parking space in a parking lot turns out to be a major problem. The proposed parking lot guidance system checks for the parking lot's availability and is capable of guiding the vehicle to the allotted space in a simple, secure and efficient way. With sensors in every parking spot to indicate the presence of vehicle, RF modules to ensure the security of the vehicles, LCD to direct the vehicles to the allotted spot, MSP430 controller for low power and RTOS implementation for updating the data immediately makes this prototype a hard real time, standalone, automated one with very less human intervention.

Keywords: MSP430, TI RTOS, hard real time system

I. INTRODUCTION

Time and cost are the two important factors of this rapidly evolving lifestyle be it for an individual or business. It increases the quality of living leading to urbanization resulting in increased vehicle production and usage. With the escalation of vehicles, comes requirement of sophisticated parking facilities which is not met by the public parking lots. Entering a parking lot and finding out that it is full is an annoying experience. Statistics show that around 30% vehicles have difficulty and spend in average of 7.8 minutes searching a parking space. In a developing country like India with its traffic congestion, various tactics should be used to bring out the best with limited time consumption in every way possible.

Parking Guidance and Information System which displays the number of free parking spaces in the nearby locality in each direction are yet to be implemented in our country. Along with the information about free spaces, there arises a need to know about the exact parking space thus reducing the search time. This forms the initiative of fully automated Intelligent transportation system.

In this paper, design and implementation of a parking lot guidance system with the main objective to reduce the search time leading to less traffic congestion is done. It is based on MSP430 thus making it as a low power application that is simple yet robust. Moreover, with the implementation of TI RTOS, it is a hard real time system thus making it a one that is required in our day-to-day life.

II. EXISTING SYSTEM

Today we can find several smart parking facilities in most of the major cities. Customer and the parking operator are benefited by the smart parking service in different ways:

i) Space availability can be determined before entering the parking level.

ii) This type of system significantly reduces traffic and air pollution – by minimizing the time required to locate open spaces.

* Dept of Electronics and Communication Engineering, SRM University, Kattankulathur, Chennai, India, *E-mail: swathikaasvs@gmail.com*

** AP(S.G), ECE Department, SRM University, Kattankulathur, Chennai, India, *E-mail: selva2802@gmail.com*

iii) Future parking patterns and trends can be predicted from the system data and this data can be used to minimize the vehicle thefts.

iv) Staff requirements are also reduced to control the traffic.

v) The parking operator can use the system data to develop or improve pricing strategies.

2.1. Parking Guidance Information Systems (PGI)

PGI guides, provides information about the parking spaces available in the lots of major cities. At entrances, exits vehicle detectors are installed in individual parking space to collect and calculate the number of occupied and available spaces. Loop detectors, ultrasonic, machine vision, infrared, microwave detectors can be used for this purpose. 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.

2.2. Automated Parking

Automatic parking is a computer-controlled mechanical system that allows customers to drive their cars into one of several bays, lock their cars, and let the computer do the rest . To pick up their cars, the customers just punch in their codes and passwords, then the machine will retrieve their cars and ready to leave in just a few minutes. Automatic parking allows for an efficient use of expensive and limited parking spaces.

A variety of vehicle detectors are installed in this system. 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.

2.3. E-Parking

E-parking employs advanced technologies to combine and streamline parking reservation and payment systems. Using this system, a driver could inquire about the availability, reserve for a parking space at a given destination, and pay when leaving.

The system is accessed via cell phone, PDA and/or internet. Still conventional detectors are needed to detect approaching vehicles. However, the system must be able to identify customers and/or their vehicles making reservation and allows them the access to reserved space. The identification process at the parking lot may employ confirmation code access that the customer receives on cell phone.

These type of systems will take a long time to get implemented in India as they are quite expensive and involves a lot of work. Unlike the above mentioned parking guidance systems, the proposed idea is cost efficient, simple and effective.

III. PROPOSED WORK

PIR sensors are present at the entry, exit of the parking lot and at each of the parking space. When a vehicle enters the parking lot, it gets sensed and the availability of space is checked. An RFID tag is given to the vehicle which gets stored to the corresponding parking space in the memory. Directions on the board guide the vehicle to the free parking space which is intimated by the blinking LED. The light at the space gets turned on/off based on the vehicle movement. RFID tag information gets communicated via zigbee/wi-fi module. TI RTOS is used in MSP430 for task scheduling. The system can also be considered as a portable one as it is based on an RTOS.

There are two types of major modules.

(i) Master controller/module

(ii) Zone controller/module

The block diagram of the proposed work is as follows.

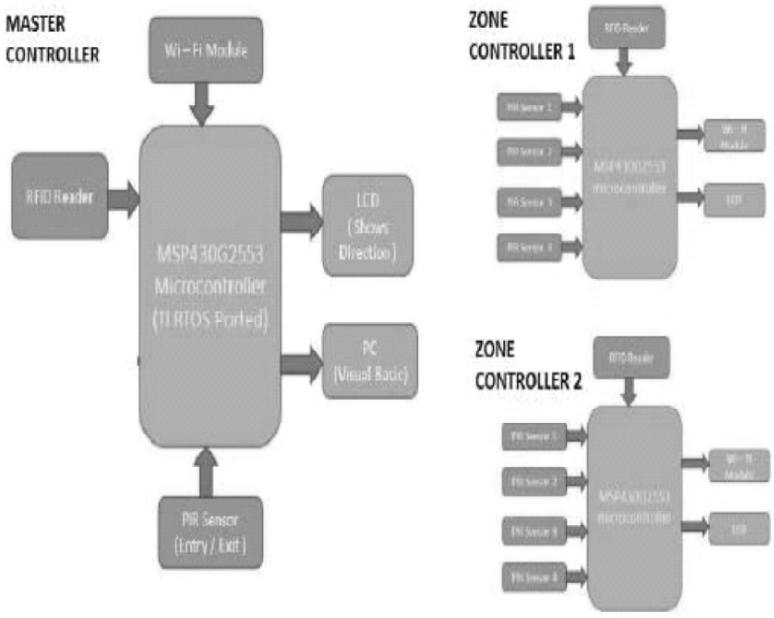

Figure 1: Block Diagram of Automated Parking Systems

3.1. Block Diagram Description

3.1.1. Master Module

The master module which uses MSP430F5529 uses the input from the PIR sensor present at the entry and exit of the parking lot. Once the vehicle is detected, it checks for the availability of the parking space and displays it. RFID reader reads the tag that is given to the owner of the vehicle. The zigbee/wi-fi module interfaced with the MSP430 sends the RFID tag number to the corresponding zone controller. The directions are then shown in the LCD with instructions like “go straight”, “take left”, “take right”. TI RTOS is ported into the MSP430.

3.1.2. Zone Module

The slave module consists of a processor MSP430G2553, PIR sensors, RFID reader , LEDs. One slave module is capable of sensing four parking spaces at a time. The PIR sensor keeps sensing for any motion in the environment. Once the vehicle enters the parking spot, it gives the data to the processor which turns on the LED to indicate that the parking spot is not free. RFID reader reads the tag of the incoming vehicle to verify that it is the correct vehicle scheduled to be parked. Zigbee/Wi-fi module is used to transmit the data of the parking spot to the master module. Once the vehicle leaves the parking space, the LED stops glowing and the information that the parking space is free gets passed on to the master module which updates the number of parking spaces free at the entrance.

3.2. RTOS (Real Time Operating System) USED

Some of the RTOS that supports MSP430f5529 are listed in fig. 2. But TI RTOS is chosen because of its scalable nature of the kernel.

RTOS	SCHEDULER
BRTOS	Preemptive
ChibiOS	Preemptive
CocoOS	Cooperative
ERIKA	Priority
FreeRTOS	Preemptive
FunkOS	Preemptive
Nano RK	Preemptive
nOS	Preem/Coop
TIRTOS	Preemptive

Figure 2: Scheduler of Various RTOS

TI-RTOS is a scalable, one-stop embedded tools ecosystem for TI devices. It scales from a real-time multitasking kernel (SYS/BIOS) to a complete RTOS solution including additional middleware components and device drivers. By providing essential system software components that are pre-tested and pre-integrated, TI-RTOS enables you to focus on differentiating your application[4]. TI-RTOS contains its own source files, pre-compiled libraries (both instrumented and non-instrumented), and examples. Code Composer Studio is used for coding in which TI RTOS can be downloaded from the CCS App Center.

TI RTOS follows pre-emptive scheduling in which priority levels should be given to the various interrupts that occur. The interrupts of this proposed idea are as follows in the decreasing order of priority.

- Parking spot information from the zigbee
- Sensor detection at the entry of a vehicle
- Update to the front end and memory
- Real time clock

IV. IMPLEMENTATION

A prototype of the project is made with a sample parking layout formed in a thermocol sheet. The sample parking layout is fig. 3.

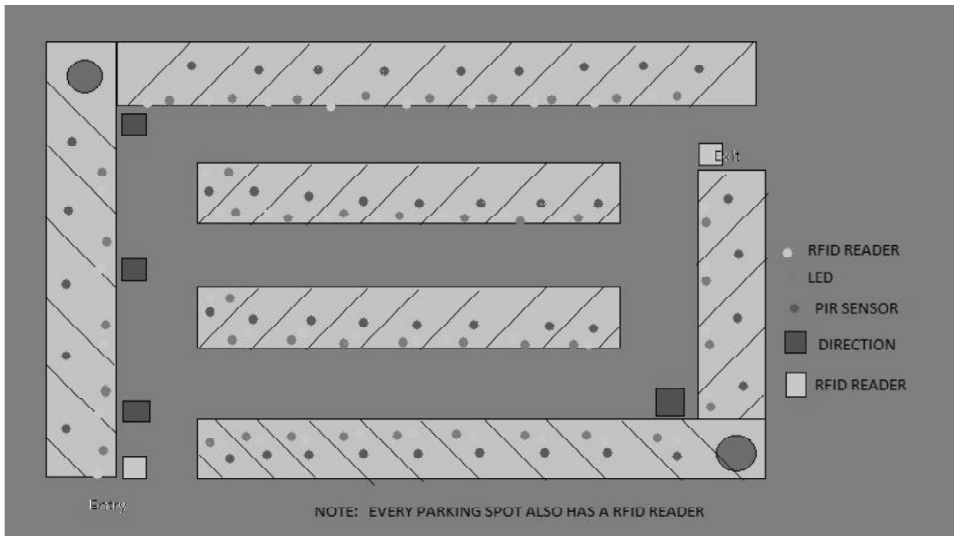

Figure 3: Parking Layout

Each parking spot should have a PIR sensor, LED, RFID reader. The zone controllers are connected to a certain number of PIR sensors and zigbee module/Wi-Fi module.

Various names like left zone, right zone, and center zone are given to the controller in order to differentiate them. LCD is kept at selected spots and turnings so that it is capable of giving proper directions to the incoming vehicles. Master controller is placed at the entrance which gets input about the entry and exit of the vehicles.

The connections of the MSP430G2 launchpad to a single PIR sensor are shown in fig.4 which can be extended to the required sensor count.

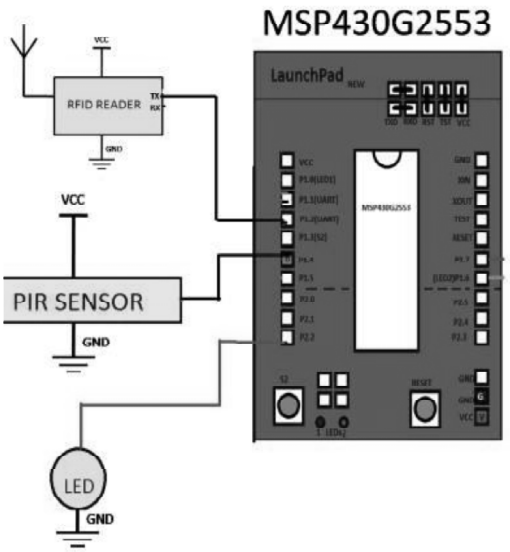

Figure 4: Sample System Connection

The flow chart of the entire working of the proposed idea is in fig.5

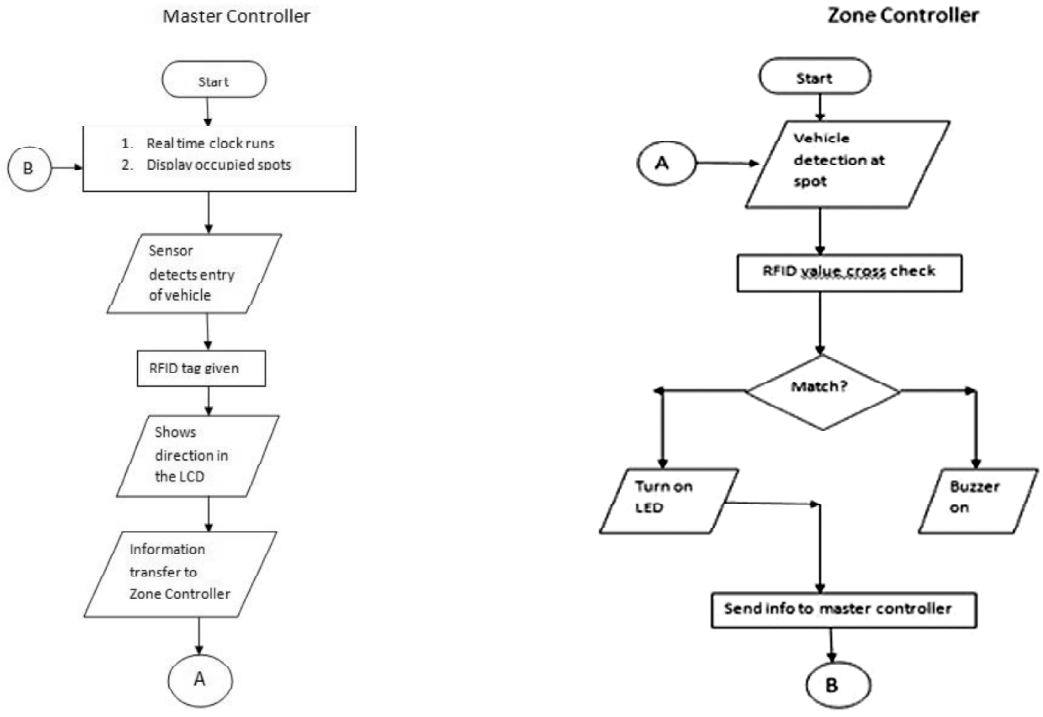

Figure 5: Flowchart Description of proposed System

V. EXPERIMENTAL RESULTS

The zone controller in fig.6 includes the PIR sensors, LED, RFID reader interfaced with MSP430G2 launch pad. This is capable of showing whether the spot is free or parked which can be viewed in the serial window of Energia while transmitting the same to the master controller.

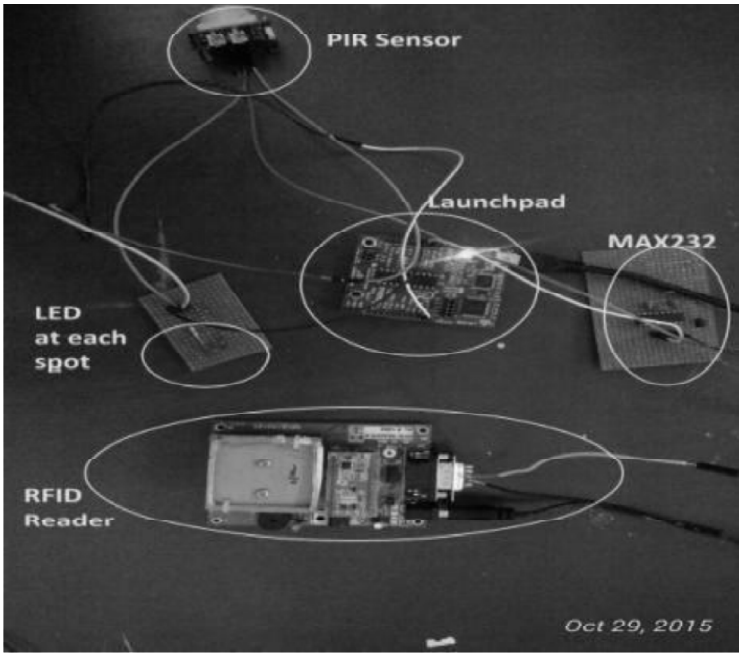

Figure 6: Snapshot of Zone Controller

Energia is an arduino similar IDE used to program the launch pad in a simple and easy manner. A serial window is available in which the transmission and reception of data can be seen in fig.7.

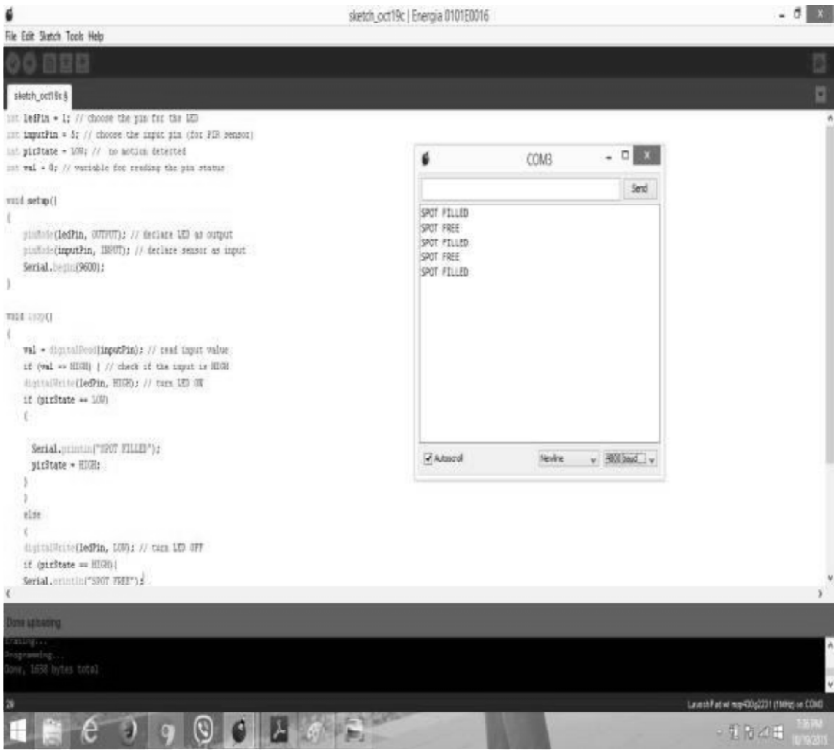

Figure 7: Transmission and Reception of Data

The master controller in fig.8 includes the PIR sensor, LCD, RFID, Zigbee module interfaced with the MSP430F5529. The LCD output shows the directions as to where the vehicle has to go.

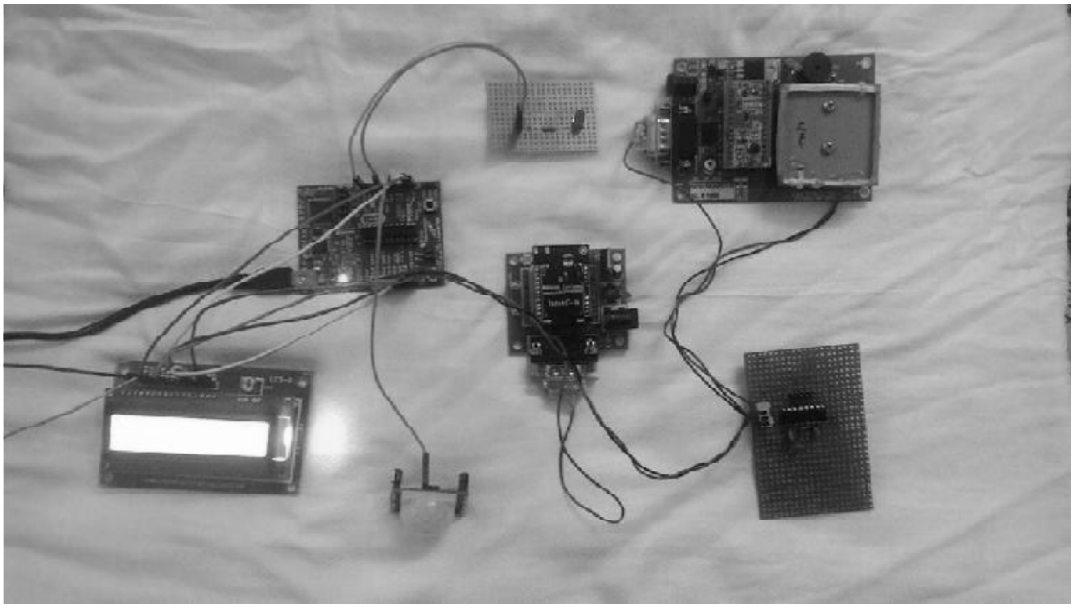

Figure 8: Snapshot of Master Controller

Zigbee module can be configured in master – slave network of which the module interfaced with the master controller acts as the master and the other modules interfaced with the zone controllers will act as the slaves as in fig. 9.

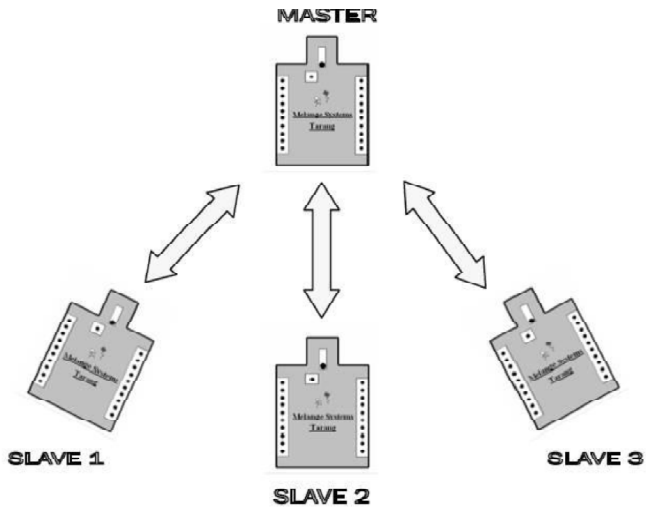

Figure 9: Master Slave Configuration

X-CTU is used to configure the zigbee modules in the master-slave mode as in Fig. 10, 11. The source and destination addresses are given via the AT commands thus making the master to get information from all the slave modules and the slave modules can transmit information only to the master module.

VI. CONCLUSION

This paper introduces an RTOS based Parking Lot Guidance System(PLGS) that is capable of not only indicating the number of parking spaces available but also guiding the vehicle to its parking space by

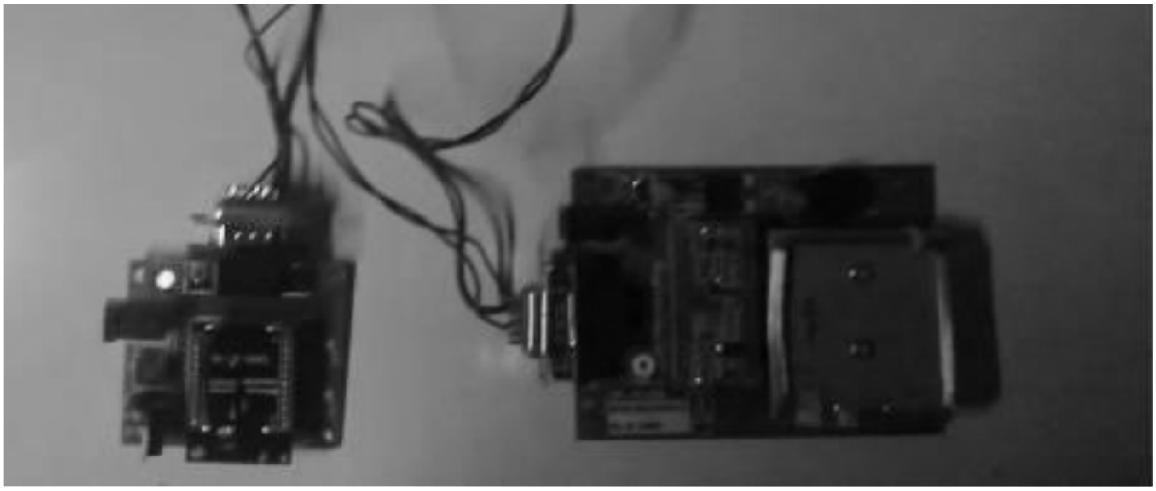

Figure 10: Zigbee and RFID reader

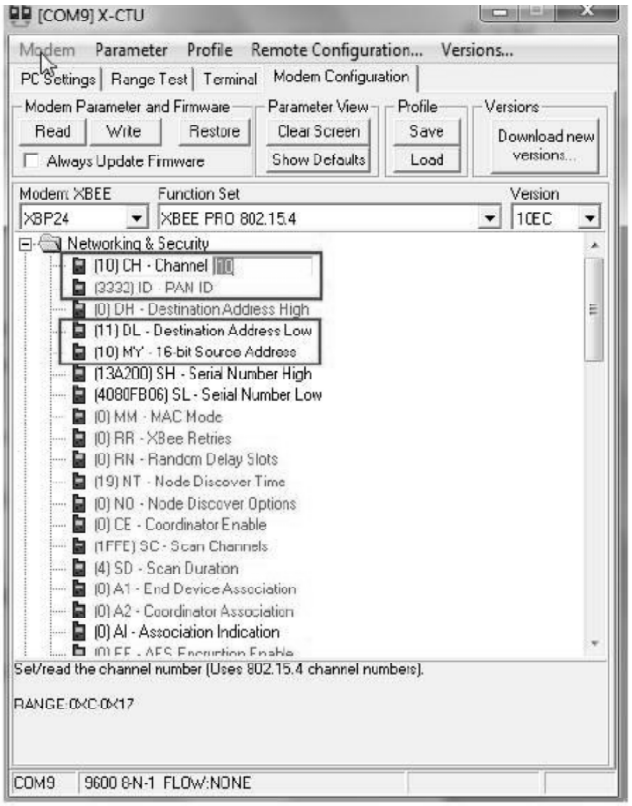

Figure 11: Configuration of Zigbee

showing directions once it enters the parking lot. With the help of RFID, the security and proper parking of the vehicle is taken care of. The future work of this idea involves the license plate of the vehicles being noted down across the RFID tag numbers thus maintaining a database for a longer time. Furthermore any implementation of IOT can also be done thus resulting in booking of a parking space even before arriving at the parking lot.

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