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RFID BASED MOBILE ROBOT IN INDUSTRIES USING ZIGBEE

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ABSTRACT: In recent years, radio frequency identification (RFID) system has become most popular in service industries and logistics, manufacturing, as it is inexpensive and reliable device for automatic identification. Therefore, RFID system would be useful in a problem of mobile robot self-localization, if tags are distributed in the environment, and the robot is equipped with a RFID reader to communicate with the tags. In fact, there are millions of robots working for us today. There are some essential characteristics Sensing, Movement, Energy, Intelligence [1]. The robot must have and this might help to decide what is and what not a robot is. It will also help you to decide what features you will need to build into a machine before it can count as a robot. In this paper, we propose in service industries method for learning-based localization with a RFID system by using ZIGBEE communication. We also propose a method that enables a user to easily place tags in effective locations. In experiments with a mobile robot, the performance of the proposed method is demonstrated. In experiments with a mobile robot, the performance of the proposed method is demonstrated - Communications and communication protocols play an important role in mobile robot systems.

KEYWORDS: Robot; RFID tag; RFID reader; ARM7 TDMI; ZIGBEE; WPANs

1. INTRODUCTION

The Concept proposed in 1949 was developed for the Missile Tracking in Defense Industry past 20+ years. In 1960's, the RFID was first considered as a solution for the commercial world. The first commercial applications involved by RFID are during the 70's and 80's. These commercial applications were concerned for identifying some asset inside a single location. They were based on proprietary infrastructures. Already in Europe, the RFID is used in large scale for the purpose of Animal Tagging, and in US, it is used for Parking/Toll Roads. Many companies in India are using RFID for Supply Chain Management (SCM).Attempts to provide unique identification and backend integration that allows for wide range of applications. The third era of RFID was started in 1998. Researchers at the "Massachusetts Institute of Technology (MIT) Auto-ID Center" began to research new ways to track and identify objects as they moved between physical locations. Radio Frequency Identification (RFID) technology has been attracting considerable attention with the expectation of improved supply chain visibility for both suppliers and retailers. It will also improve the consumer shopping experience by making it more likely that the products they want to purchase are available.

A. RFID Tag or RFID Transponder:

An RFID tag is a tiny radio device that is referred as a transponder, smart tag, smart label, or radio barcode. This tag comprises a simple silicon microchip (typically less than half a millimeter in size) attached to a small flat aerial and mounted on a substrate. The whole device can then be encapsulated in different materials (such as plastic) dependent upon its intended usage. The finished tag can be attached to an object, typically an item, box, or pallet, and read remotely to ascertain its identity, position, or state. For an active tag there will also be a battery.

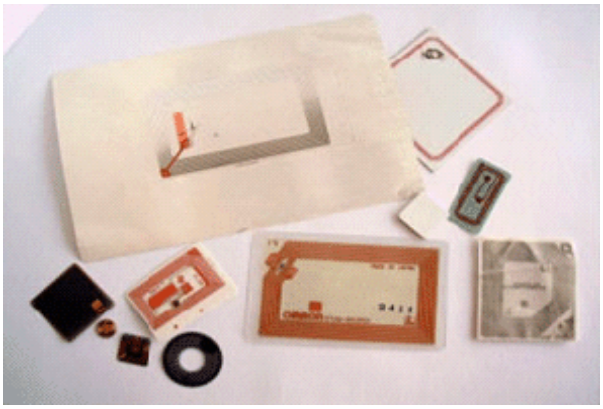


Fig.1.1 Variety of RFID Tags

B. Reader or Interrogator:

The reader is also named as interrogator or scanner, which sends and receives radio frequency data to and from the tag via antennas. A reader may have multiple antennas that are responsible for sending and receiving radio waves.

Fig. 1.2 RFID Reader with dual antenna

RFID tags are of two categories:

1. **Active RFID Tags**
2. **Passive RFID Tags**

Active RFID Tags: These are battery powered. They broadcast a signal to the reader and can transmit over the greatest distances (100+ meters).

Passive RFID Tags: These do not contain battery. Instead, they draw their power from the radio wave transmitted by the reader. The reader transmits a low power radio signal through its antenna to the tag. passive tags can transmit information over shorter distances (typically 3 meters or less) than active tags. They have a smaller memory capacity and are considerably lower in cost (less than £1).

2. ARCHITECTURE AND DESCRIPTION FOR DESIGNED SYSTEM

The basic RFID system comprises a transponder, a reader and an antenna. Data is stored in a transponder device called as tag. Current tags, depending on application, can hold up to 2 Kbits of data. Tags can be read-only or read/write. the ZigBee Wireless Sensor Network (WSN) has been developed for remote monitoring using wireless microcontroller hardware The ZigBee has been programmed for data transfer to a coordinator. Since the sensor array device was already equipped with RS-232 it was necessary to use an RS232/USB converter before the wireless transmission took place [4]. Also, with the permission of the developer, the source code was modified so that it would Operate on a quiet channel In order to ensure that the data transmission was taking place properly the transmitted information was initially observed on the java oscilloscope

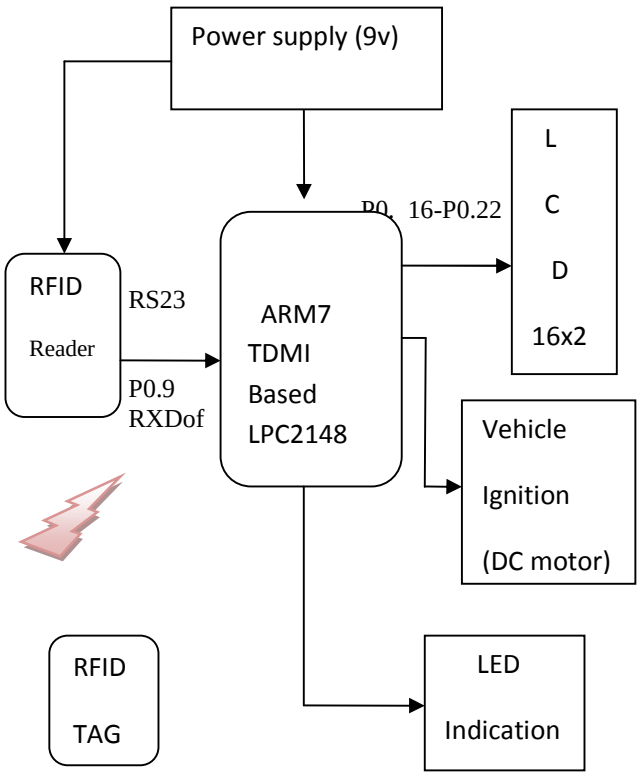


Fig 2.1 Overview of the communication between Readers and Tags

3. ZIGBEE PROTOCOL TECHNOLOGY

ZigBee is a high level communication protocol which uses small, low-power digital radios based on the IEEE 802.15.4 standard for wireless personal area networks (WPANs), such as wireless headphones connecting with cell phones via short-range radio. The technology is intended to be simpler and cheaper than other WPANs, such as Bluetooth. ZigBee is targeted at radio-frequency (RF) applications that require a low data rate, long battery life, and secure networking ZigBee is a low-cost, low-power, wireless mesh networking standard. it has a defined rate of 250 Kbit/s best suited for periodic or intermittent data or a single signal transmission from a sensor or input device

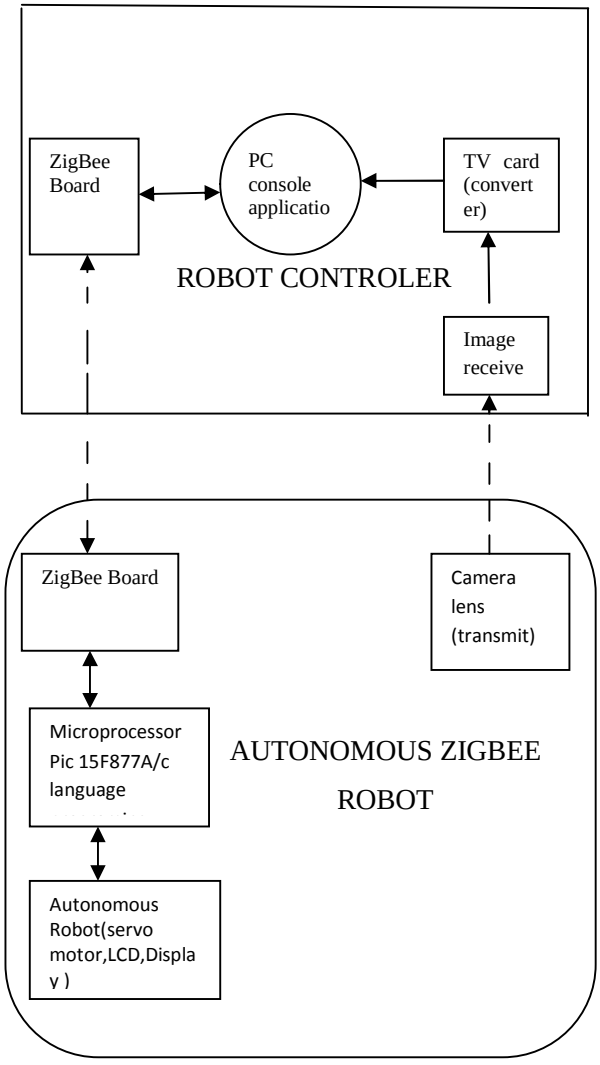


Fig.3.1 system block diagram

. The low cost allows the technology to be widely deployed in wireless control and monitoring applications, the low power-usage allows longer life with smaller batteries, and the mesh networking provides high reliability and larger range [3]. The current ZigBee protocols support beacon and non-beacon enabled networks. In general, the ZigBee protocols minimize the time the radio is on, so as to reduce power use. The robot will be controlled by remote server, which has the application design for this project. It will be connected with ZigBee transceiver, Video Receiver, Display terminal. This server will automatically acquiring the monitor data and store it into customized database at frequent interval of time. This project can be divided into two parts, i.e. Robot end and user interface (control) end. Robot has monitored and controlled by remote place. Robot has array of sensors for monitoring environmental status (Temperature, Humidity, and Light Intensity). Since it started to move, it will check whether is there any obstacles in its path and if there is any obstacle it will detect the obstacle material, and the current environmental condition of the place where robot is situated and also the gripping force of the robot by means of PIR sensor. To design and build a wireless transmitter that works over the FM frequency and allows the transfer of all the data's over a certain distance to a FM tuner. From the user end we will get the data acquisition of monitoring parameters at the robotic end and the system will automatically stores the database of data acquired from other end at the frequent interval of time (in seconds). Robot's movements (Forward, Reverse, Left, and Right) will be controlled via wireless medium. ZigBee-based Robot Localization and Control project uses wireless nodes to simultaneously localize and control the robot.

4. MOBILE ROBOT BASE

Mobile robot base is a platform that carries the load of the robot. Robot base design is depending on the application of the robot. If the robot moves on to the rough surface, the material and size of the base must be suitable. The robot must be capable to carry microcontroller circuit, XBEE circuit, camera device, 6V battery holder and RFID reader, 2 pieces of 9V battery. The 6V servo motor is enough to carry this load [3].

Fig. 4.1 Complete Robot with included all devices

5. SIGNAL STRENGTH DETECTOR

Fig. 5.1 shows the 315 MHz RF signal strength detector residing inside the RF reader module. The schematic of the detector is shown in Fig. 5.1a. When an RF signal in the range of 120 dBs to 45 dBs is transmitted to the antenna, the signal is filtered and fed to the power detector, which is then converted and amplified to a DC voltage ranging from 0 to 5 V. Fig. 5.1b shows the picture of the detector that has a width of 54 mm and a height of 24 mm. The input and out-put ports include the RX input from the antenna, the 5 DCV input from the robot USB port, and the DC output fed to the signal analyzer. Fig.5.1c shows the input–output Characteristics, where the input signal within the range of 115 dBs to 45 dBs is converted linearly to the DC voltage [5].

6. OVERVIEW OF THE PROPOSED SYSTEM

By using ZigBee communication in computer to control how the robot was working and also the robot based RFID it operating machines in OFF and ON stages, The system overall development was done between the computer, robot and machine. In this development computer consists all operations belongs to the robot with ZigBee transducer, this ZigBee transducer acts as data transmitter and data receiver. output characteristic of the detector[3]

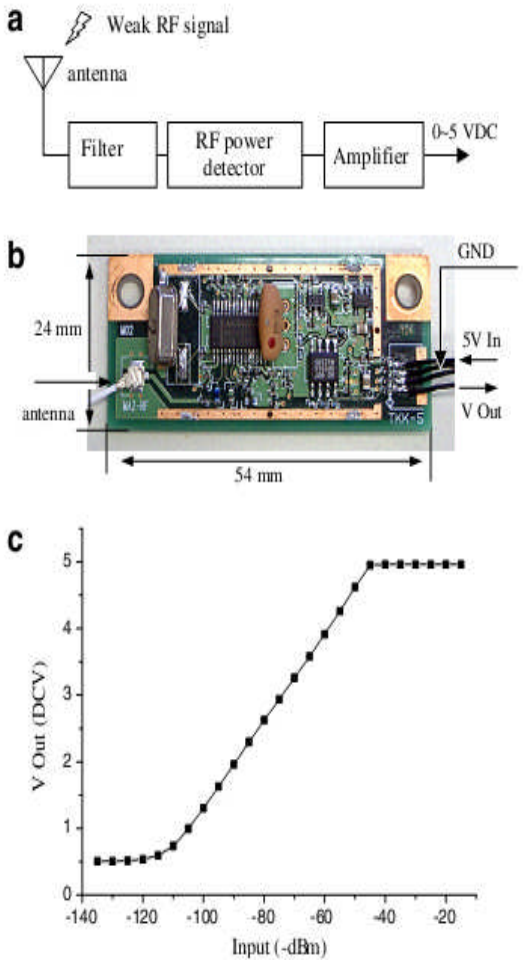


Fig 5.1 Signal strength detector: (a) schematic of the detector, (b) picture of the detector and (c) input–

If the robot moves on to the rough surface, the material and size of the base must be suitable. The robot must be capable to carry microcontroller circuit, ZigBee circuit, camera device, 6V battery holder and RFID reader, 2 pieces of 9V battery. The 6V servo motor is enough to carry this load. All RFID tags information was stored in the RFID reader, this tag contain different frequencies. These frequencies are used for the identification of the RFID tags of machines. RFID was programmed with on/off conditions.

For example, let us consider a big Industry and more number of machines in that each machine was tagged with RFID tag and programmed with ON/OFF conditions if you want to stop particular machine send signal from computer to robot by using ZigBee protocol while the robot moves to tag 1 and receives the commands of ON, then the RFID reader will make some control actions to ON the machine1 conform the commands. While the robot moves to tag 2, the commands of OFF and slow down were received, the RFID reader will once again make some control actions to OFF the machine2 conform the commands. Therefore, the robot will then move in moving path 1 automatically.

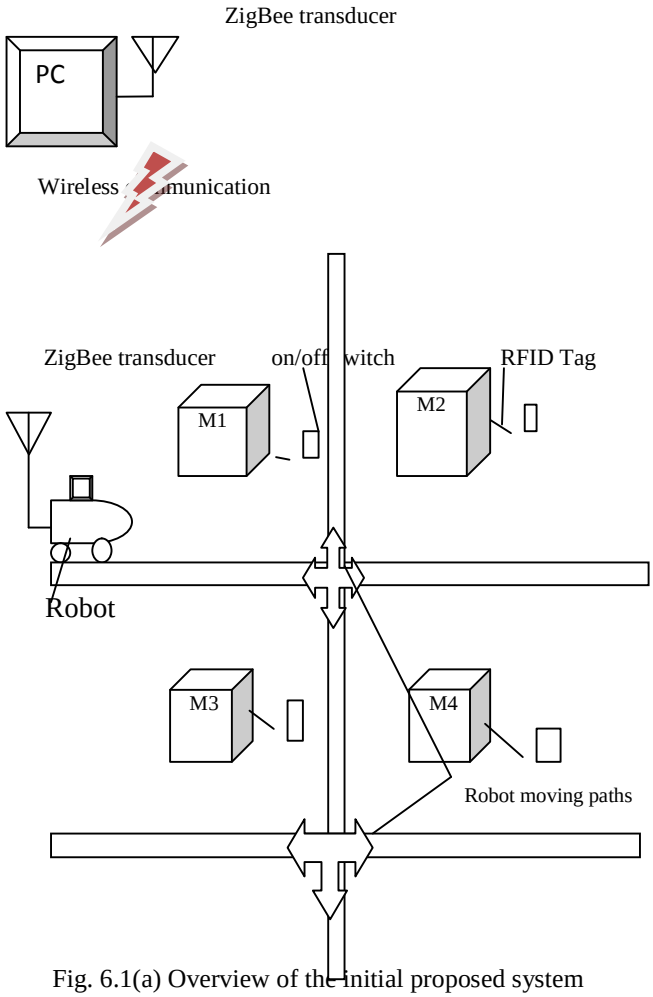
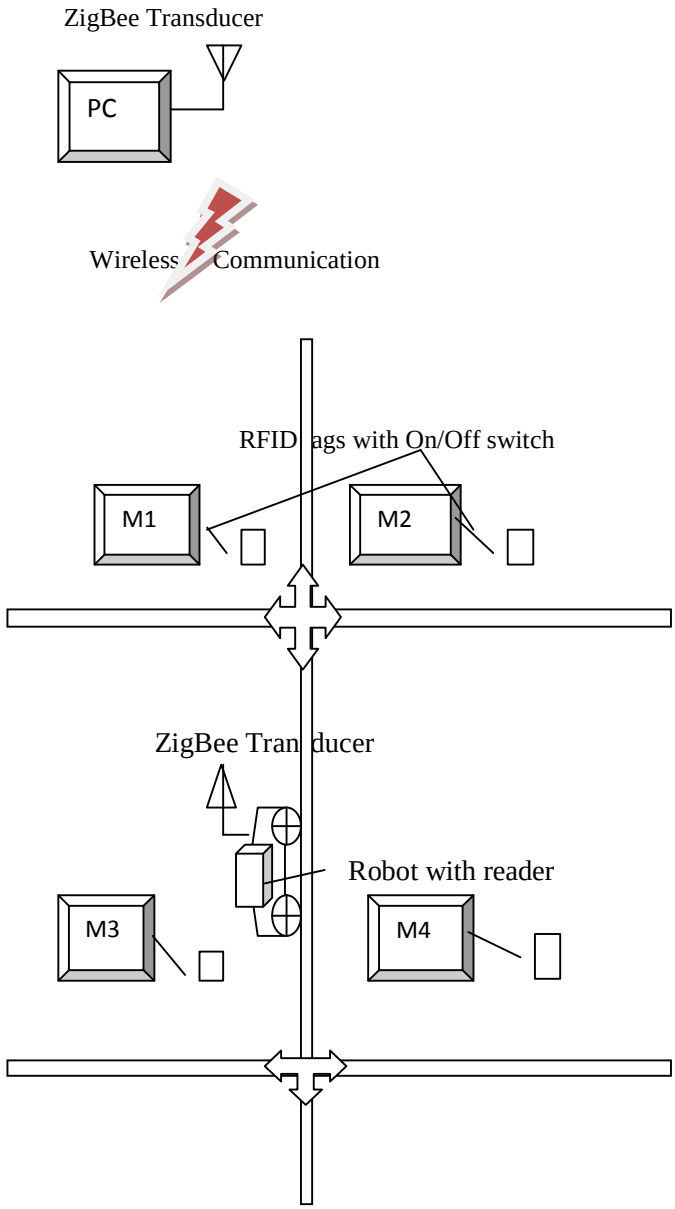


Fig. 6.1(a) Overview of the initial proposed system

Of course, the robot can also move in the other paths according to the commands received from tags. Fig. 6.1 shows the physical hardware of the proposed RFID-based autonomous mobile robots. [There are many different versions of RFID that operate at different radio frequencies. Three primary frequency bands have been allocated for RFID]



6.1(b) Overview of the running proposed system

7. FUTURE WORK

The future scope of this project on the RFID mobile robot using ZIGBEE communication and can be extended using the GSM, MANET. In this section, two experiments are presented. The first experiment aims at measuring the signal quality of WLAN and Bluetooth communication nodes in indoor environments with different kind of wall materials. The second experiment deals with radio based positioning of robots in dynamic environment. Before discussion of the experiments the platform is presented.

8. CONCLUSION

A RFID-based robot with ZigBee communication system is proposed in this paper. The proposed algorithm is very modular as it can be easily implemented to RFID based robotic systems and working area of industries.

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