

Communication b/w Mobile-Robots' and PC controller Based On ZigBee Network

H.Vijaya Laxmi, M.Narender

M.Tech,Student(Embedded Systems) ,Sr Asst.professor& Guide Dept.of ECE,SREC Warangal506371,AP,Dept.of ECE,SREC Warangal506371,AP

Abstract: *mobile robots using Zigbee protocol for the purpose of navigation using personal computer, implemented with wireless vision system for remote monitoring and control. Its main feature is its use of the Zigbee protocol as the communication medium between the mobile robot and the PC controller. The hardware system is based on the ATmega8 microcontroller and an Xbee module. The system provides continuous visual monitoring through the small camera attached to the mobile robot, sending data to the control unit when necessary. Remote testing is done on the mobile robot for search and rescue missions via an established radio frequency (RF) communication using DIGI XBee RF module.*

Keywords – MobileRobots, Communication, ZigBee, microcontroller

I.INTRODUCTION

The wireless communication technologies are rapidly spreading to many new areas, including the automation and the importance of the use of wireless technologies in the data acquisition, building control, monitoring systems and automation of manufacturing processes will grow. Intelligent mobile robots and cooperative multiagent robotic systems can be very efficient tools to speed up search and research

operations in remote areas. Robots are also useful to do jobs in areas and in situations that are hazardous for human. They can go any where that is not reachable my humans and can go into gaps and move trough small holes that are impossible for humans and even trained dogs. Our preliminary aim in this project is to build an autonomous robot, which could be able to send the environmental status, the temperature condition, and if there is any obstacle on its path, and what is the obstacle in any remote place which is not reachable by the humans and it will be controlled by zigbee communication.

II.ZIGBEE PROTOCOL TECHNOLOGY

ZigBee is the name of a specification for a suite of high level communication protocols using 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. 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.

III. DESIGN

This chapter explains and describes the methodology that was used for completing the project. The hardware and software development are summarized. This project requires 2 modules of XBEE (Fig. 2) in order to communicate using Zigbee protocol between the PC controller and the mobile robot. The XBEE circuit is a bit different from other typical PCB circuit because it uses 3.3 V DC supply. This low dc voltage can be obtained by feeding the output of 5V to the voltage regulator LM317

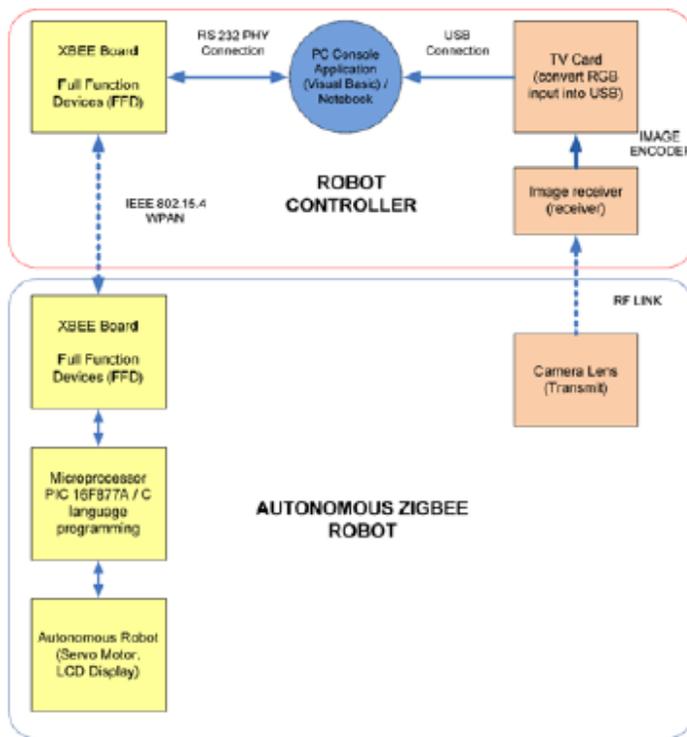


Fig. 1 System Block Diagram

. This low voltage input is one of the advantages of using XBee in autonomous robot because the battery life time will be

retained much longer. The SKXBEE used 5 pins to interface with microcontroller circuit which are Tx (RC7), Rx (RC6), 5V, GND and reset.

The Digi's ZigBee / XBee RF modules have many characteristics that are desired in wireless communication. Digi offers two different versions of wireless modules, the XBee and the XBee-Pro. Both of these modules have the same set of instructions and operate in the same manner, but the XBee-Pro offers over more than double the range of XBee. In this application for wireless mobile robot, the regular Xbee is selected. Transmit power output is rated at 1mW with an operating frequency of 2.5GHz with operating current running around 45-50 mA and RF data rate of 250k bps. The XBee-Pro edition runs at a 10mW output power, enabling it to transmit much further. The XBee module is low power, small, and easy to integrate into any project with short-range wireless communication.

IV . WORKING PROCESS

A. User Interface

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, 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, Right) will be controlled via wireless medium. ZigBee-based Robot Localization and Control project uses wireless nodes to simultaneously localize and control the robot

B. 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 move on the rough surface the material and size of the base must be suitable. In this project, the robot must be capable to carry microcontroller circuit, XBEE circuit, camera device, 6V battery holder and 2 pieces of 9V battery. The 6V servo motor is enough to carry this load.

C. C Programming with CAVR IDE

To move the robot, it needs to be programmed. The C language is suitable for a robotic project because the users can see the structure of the robot operation. The programming includes initializing the PIC, configuring the LCD port, communicating with the wireless XBEE, controlling motor through driver control, and activating switch and buzzer. There are a lot of C compilers available but CAVR IDE was chosen because it had been develop with the same

manufacture with the AVR which is ATMEL. CAVR Integrated Development Environment (IDE) is a free, integrated gcc-based toolset for the development of embedded applications employing AVR microcontrollers. The CAVR IDE runs as a 32-bit application on Microsoft Windows, and includes several free software components for application development, hardware emulation and debugging. CAVR IDE also serves as a single unified graphical user interface for additional Microchip and third-party software and hardware development tools.

D. X-CTU Software for Zigbee setup

X-CTU is a Windows-based application provided by Digi. This program was designed to interact with the firmware files found on Digi's RF products and to provide a simple-to-use graphical user interface to them. In this project the XBEE modules is chosen to be controlled with this software. X-CTU is designed to function with all Windows-based computers running Microsoft Windows 98 SE and above. Initially, the XBEE functions need to be set-up: PC setting, range test, terminal access using AT commands and modem configuration.

V. RESULTS

This section discusses the results based on the development of hardware and software described in the previous section.

Navigational Control

The results of the mobile robot directional control is The motor can run in two modes which is normal and turbo. When in normal mode, the PWM speed was determined for 200 rpm whereas 255 rpm was set

for turbo mode. The default speed is 200 rpm. The higher the speed the more the power required and the quicker the battery discharged.

VI. CONCLUSION

Based on the results, the objective of developing wireless mobile robot using Zigbee protocol has been achieved. Zigbee has been proven as a practical solution for low cost monitoring and controlling devices. The project demonstrated that implementing Zigbee network protocol 802.15.4 with microcontrollers ATMEGA8L can be done successfully. The wireless communication technologies are rapidly spreading to many new areas, including the automation and the importance of the use of wireless technologies in the data acquisition, building control, monitoring systems and automation of manufacturing processes will grow. Intelligent mobile robots and cooperative multi-agent robotic systems can be very efficient tools to speed up search and research operations in remote areas. These robots are also useful to do jobs in areas and in situations that are hazardous for human. They can go any where that is not reachable by humans and can go into gaps and move through small holes that are impossible for humans and even trained dogs. As such, the scope of this project to demonstrate the successful wireless mobile robot navigation can be further improved. The next step is to build an autonomous robot, which is able to send the environmental status, the temperature condition, with smart obstacle avoidance system.

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