

NAVIGATION CAMP – BOT

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Abstract - Autonomous navigation remains one of the primary challenges of mobile robot industry. Many control algorithms have been recently developed that are aimed to overcome this challenge. Several companies are moving towards the introduction of automation in their field. In this project, we introduce an algorithm for avoiding obstacles and minimizing the travel time to a target location along an optimized path. The user can select the desired destination where he needs to go, and the respective command is sent to the microcontroller (AtMega 2560) using Zigbee wireless module and control action is taken. Obstacles are monitored and detected using sharp sensor which is placed on the front side and controlled using AtMega2560 microcontroller. After reaching the destination, the robot gives an audio output from an Arduino Uno board (description of the location) and also displays the name of the destination in the LCD display. Using this project, the user can easily navigate to unknown places within the specified region.

Key Words: AtMega 2560, Zigbee, Arduino Uno, audio

1.INTRODUCTION (Size 11 , cambria font)

When we go to new or unknown places like museums we may not be familiar with the directions and locations of the building. Even with the direction plates positioned around the building some may tend to get lost inside very frequently. Hence the indoor navigation has become a major problem and it made many researchers to find an optimum solution for that. One such solution is to design a robot which will navigate you through all the places inside the building which we are unaware of.

In this project we provide one such solution for the indoor navigation problem. Here we made use of the ATMEGA 2560 controller as the brain of the bot. The c code is flashed into its memory. The overall layout of the building is firstly figured out and the timings and distance of each path and location is calculated.

This will give us the preloaded map that is to be dumped into the microcontroller. The user will give the command using the XCTU software. This is used to transfer the code from the CPU to the robot wirelessly. Both the coordinator and the router will have an X-Bee module of their own. The microcontroller on receiving the command will perform the corresponding action. The bot will start to move and reach to the destination location which the user has specified.

1.1 Fire Bird V ATMEGA2560

The Fire Bird V robot is the 5th in the Fire Bird series of robots. First two versions of the robots were designed for the Embedded Real-Time Systems Lab, Department of Computer Science and Engineering, IIT Bombay. These platforms were made commercially available from the version 3 onwards. All the Fire Bird V series robots share the same main board and other accessories.

Different family of microcontrollers can be added by simply changing top microcontroller adapter board. Fire Bird V supports ATMEGA2560 (AVR), P89V51RD2 (8051) and LPC2148 (ARM7) microcontroller adapter boards. This modularity in changing the microcontroller adapter boards makes Fire Bird V robots very versatile. You can also add your own custom designed microcontroller adapter board.

1.2 XBee Module - Specifications

USB 2.0 compatible (No legacy RS232 required), USB powered, RXD, TXD, RSSI, ASSOCIATE indicator LEDs, Supports AT and API commands, Achievable data rates: 2400-115200 bps, Data output: CMOS (2.8-3.4V) UART interface, Supported XBee wireless modules.

2. DESCRIPTION

2.1 Requirements

2.1.1 Hardware

MICROCONTROLLER OVERVIEW

The high-performance, low-power Microchip 8-bit AVR RISC-based microcontroller combines 256KB ISP flash memory, 8KB SRAM, 4KB EEPROM, 86 general purpose I/O lines, 32 general purpose working registers, real time counter, six flexible timer/counters with compare modes, PWM, 4 USARTs, byte oriented 2-wire serial interface, 16-channel 10-bit A/D converter, and a JTAG interface for on-chip debugging. The device achieves a throughput of 16 MIPS at 16 MHz and operates between 4.5-5.5 volts.

By executing powerful instructions in a single clock cycle, the device achieves a throughput approaching 1 MIPS per MHz, balancing power consumption and processing speed.

Table -1: Microcontroller Specification

Name	Value
Program Memory Type	Flash
Program Memory Size (KB)	256
CPU Speed (MIPS/DMIPS)	16
SRAM Bytes	8,192
Data EEPROM/HEF (bytes)	4096
Digital Communication Peripherals	4-UART, 5-SPI, 1-I2C
Capture/Compare/PWM Peripherals	4 Input Capture, 4 CCP, 16PWM
Timers	2 x 8-bit, 4 x 16-bit
Number of Comparators	1
Temperature Range (C)	-40 to 85
Operating Voltage Range (V)	1.8 to 5.5
Pin Count	100

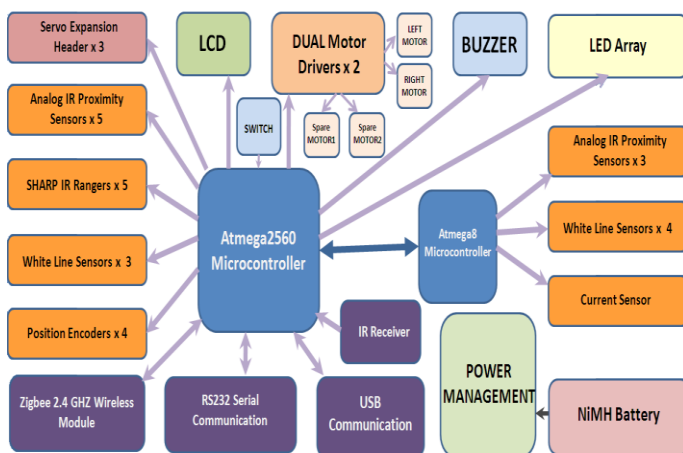


Fig 1 ATMEGA 2560 block diagram

XBEE WIRELESS MODULE

XBee USB wireless adaptor board is used for interfacing any of the series 1 XBee wireless modules with the PC. Using this USB adaptor board for XBee wireless modules you can communicate between PC to PC, PC to robot / embedded board with ease. You can also use this module to change configuration of the XBee devices using PC via USB port using XCTU software from Digi.

On the PC side this device is treated as the Communication Device Class (CDC) of USB family and it allows the user to treat USB port as a normal serial port (Virtual COM port).

XBee USB wireless adaptor board has five indicator LEDs which shows power, status of the data being transmitted or received, signal strength of the data reception and the association.

2.2 Serial Communication using UART

The Fire Bird V can communicate with other robots / devices serially using either wired link or wireless module. Serial communication is done in asynchronous mode. In the asynchronous mode, the common clock signal is not required at both the transmitter and receiver for data synchronization.

ATMEGA2560 have four USART (0 to 3) ports available for serial communication.

2.3 Software

AVR BOOTLOADER

All AVR microcontrollers can be programmed using various methods such as In System Programming (ISP), parallel programming and boot loading etc. Advantage with the boot loader is that you don't need any external hardware to load .hex file on the microcontroller. It also prevents any accidental changes in the fuse settings of the microcontroller

ATMEL STUDIO 6.0

Studio 7 is the integrated development platform (IDP) for developing and debugging all AVR and SAM microcontroller applications. The Atmel Studio 7 IDP gives you a seamless and easy-to-use environment to write, build and debug your applications written in C/C++ or assembly code. It also connects seamlessly to the debuggers, programmers and development kits that support AVR and SAM devices.

XCTU

XCTU is a free multi-platform application designed to enable developers to interact with Digi RF modules through a simple-to-use graphical interface. It includes new tools that make it easy to set-up, configure and test XBee RF modules.

XCTU includes all of the tools a developer needs to quickly get up and running with XBee. Unique features like graphical network view, which graphically represents the XBee network along with the signal strength of each connection, and the XBee API frame builder, which intuitively helps to build and interpret API frames for XBees being used in API mode, combine to make development on the XBee platform easier than ever.

3. BLOCK DIAGRAM

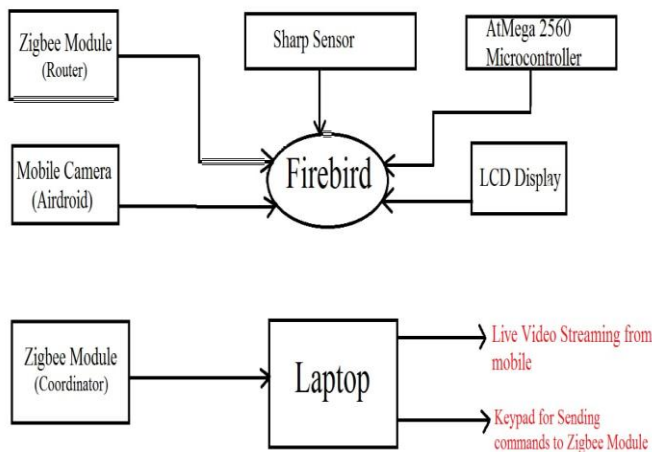


Fig 2 Overall Block Diagram

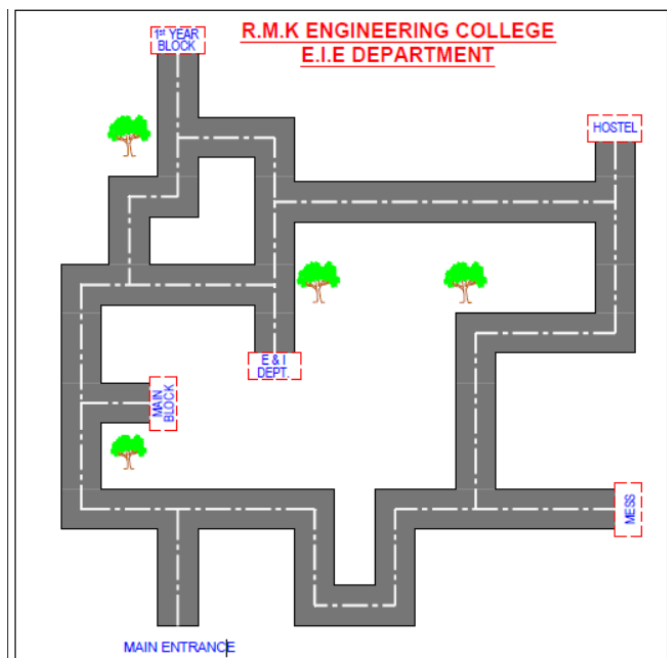


Fig 3 Pathway Layout

4. WORKING:

The command to the robot is sent by the user using the CPU. This is done using the X-Bee module. This wireless communication takes place using two modules. One is master and the other is the slave. The master module is attached to the CPU and the slave is connected to the robot.

The command is sent through the XCTU software. On receiving the code the robot will start to execute the function automatically. In this experiment we have made use of 5 blocks inside a campus. They are Main entrance, Main Block, EIE Department, 1st year block, Hostel, and Mess.

In each location there will be a display showing the whole map and its corresponding destination number. After identifying the place where the user needs to go, he or she can enter the corresponding command in the type pad to execute it. Now the code is sent to the ATMEGA 2560 microcontroller which will execute the corresponding code. Now the bot will move from the start place to the desired location where the user has entered to go. The controller will calculate the optimum path to travel based on the control logic flashed into it.

On moving to the location when there comes any obstacle in its path, it will be detected the Sharp Sensor which is positioned on the front side of the robot. The bot will stop immediately after detecting it for 5 seconds herewith it produces a beep sound. The duration of 5 seconds is to ensure whether the object is a stationary one or it will be moved in that particular duration of time.

After the defined interval of time the robot will move towards the right or left side by calculating the dimension of the object in front of it. (Mezouar, 09 July 2008) This calculation is done by the IR sensors positioned on either side of the bot.

5. PROPOSED SYSTEM:

In this project, we introduce an algorithm for avoiding obstacles and minimizing the travel time to a target location along an optimized path. The user can select the desired destination where he needs to go, and the respective command is sent to the microcontroller (AtMega 2560) using Zigbee wireless module and control action is taken. Obstacles are monitored and detected using sharp sensor which is placed on the front side and controlled using AtMega2560 microcontroller. After reaching the destination, the robot gives an audio output from an Arduino Uno board (description of the location) and also displays the name of the destination in the LCD display. Using this project, the user can easily navigate to unknown places within the specified region.

6. RESULTS AND CONCLUSION:

On giving the command on the PC the robot will automatically travel to the destination location which is given by the user. On placing the obstacles in the path the robot will stop automatically and produce a beep sound. Even if the obstacle is in the path beyond the defined time interval the robot will move towards right or left then it will calculate the dimension using the IR sensor positioned on either side of the bot.

7. REFERENCES

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