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RESEARCH ARTICLE

Borehole Robot for Rescue of a Child

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Abstract— This paper borehole robot for the rescue of a child is to rescue a child from borehole, children often fall down in the bore well which have been left uncovered and get trapped. The rescue of this trapped child is not only difficult but also risky. A small delay in the rescue can cost the child his or her life. To lift the child out the narrow confines of the bore wells is also not very easy. The child who has suffered the trauma of the fall and is confined to a small area where, with a passage of time the supply of oxygen is also reduces. This Robot for bore well rescue offers a solution to these kinds of situations. It is fast, Economical and safe. Moreover, it has the facility to monitor the trapped child and provide a supporting platform to lift up the child. Borehole robot consists of 3 wheels with rubber grip for which motors are connected and these wheels have spring suspension also. So that, the wheels will exact fit to the walls of the hole which make the robot to move inside down without any sliding and Robot consists an arm which is used to pick up the baby from the borehole.

I. INTRODUCTION

Now days we can see nearly everything which was once controlled by human being are being automated using machines and electronics circuits. An embedded system is a computer system designed to perform one or a few dedicated functions often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. By contrast, a general-purpose computer, such as a personal computer (PC), is designed to be flexible and to meet a wide range of end-user needs. Embedded systems control many devices in common use today. Microcontrollers are commonly referred to as general purpose processors as they simply accept the inputs, process it and give the output. In contrast, a microcontroller not only accepts the data as inputs but also manipulates it, interfaces the data with various devices, controls the data and thus finally gives the required result.

The main aim of this project is to design a rescue robot, can control with either computer with MATLAB or with joystick with the help of Zigbee technology, which can get into the borehole and save the child fallen in borehole. The controlling device of the whole system using pic Microcontroller. Whenever the user presses a button in PC with MATLAB, the data related to that button is sent through ZIGBEE. This data will be received by the ZIGBEE receiver in the robot system and fed this to Microcontroller input which judges the relevant direction to move the

robot, which is connected to DC motors. The live images from the camera in the robot system can be sent to TV through AV system.
The Microcontroller is programmed using Embedded C language which provides effective environment for performing the task of this project.

A. Features of this project:

1. Video surveillance.
2. Controlling of robot with ZIGBEE.
3. Highly efficient and user friendly design.
4. Low power consumption.
5.

II. SYSTEM DESIGN

The block diagram of the project and design aspect of independent modules are considered

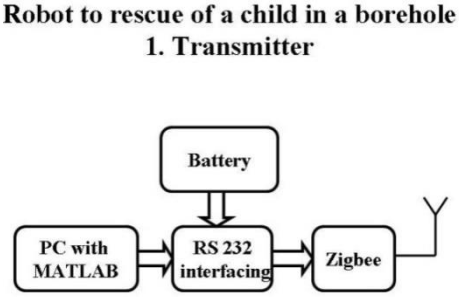


Fig 2.1: Transmitter.

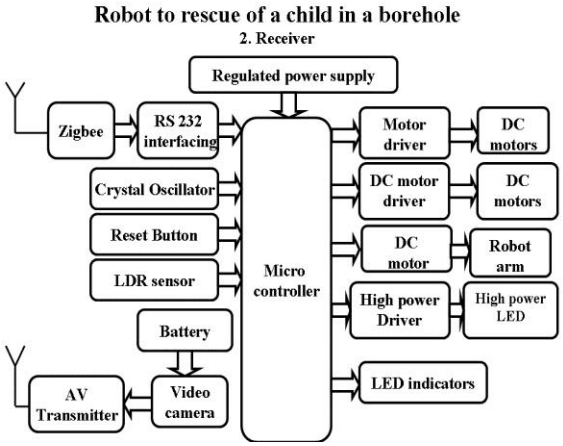


Fig 2.2: Receiver.

Robot to rescue of a child in a borehole
3. AV Receiver

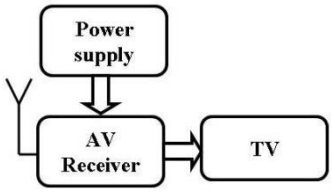


Fig:2.3: AV Receiver.

A. The main blocks of this project are:

1. Regulated power supply.
2. Micro controller.
3. Reset.
4. LDR.
5. Zigbee
6. AV Transmitter and Receiver
7. DC Motors with driver
8. Crystal oscillator

B. Project Description

In this schematic diagram and interfacing of PIC 16F877A microcontroller with each module is considered. The above schematic diagram of rescue robot explains the interfacing section of each component with micro controller and input output modules.

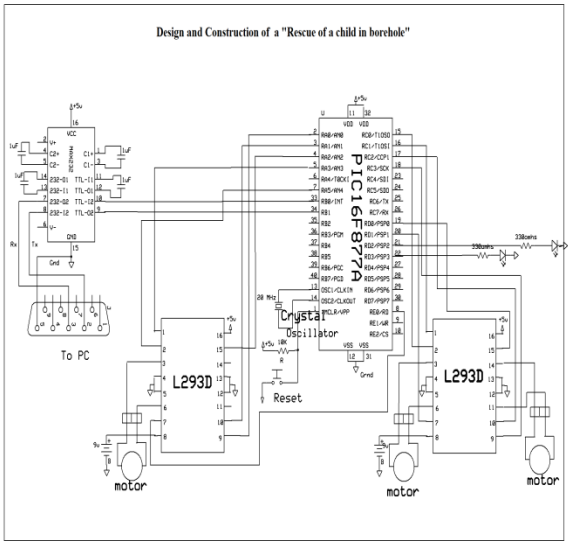


Fig:2.4: Design and Construction

III. HARDWARE COMPONENTS

A. PIC Microcontrollers:

The microcontroller used in this project is PIC16F877A . PIC stands for Peripheral Interface Controller given by Microchip Technology to identify its single-chip microcontrollers. These devices have been very successful in 8-bit microcontrollers. The main reason is that Microchip Technology has continuously upgraded the device architecture and added needed peripherals to the microcontroller to suit customer's requirements. The development tools such as assembler and simulator are freely available on the internet at www.microchip.com

Popularity of the PIC microcontrollers is due to the following factors**.**

1. Speed: Harvard Architecture, RISC architecture, 1 instruction cycle = 4 clock cycles.
2. Instruction set simplicity: The instruction set consists of just 35 instructions (as opposed to 111 instructions for 8051).
3. Power-on-reset and brown-out reset. Brown-out-reset means when the power supply goes below a specified voltage (say 4V), it causes PIC to reset; hence malfunction is avoided. A watch dog timer (user programmable) resets the processor if the software/program ever malfunctions and deviates from its normal operation.
4. PIC microcontroller has four optional clock sources.

    - Low power crystal
    - Mid-range crystal
    - High range crystal
    - RC oscillator (low cost).

5. Programmable timers and on-chip ADC.
6. Up to 12 independent interrupt sources. I/O port expansion capability.

CPU Architecture**:** The CPU uses Harvard architecture with separate Program and Variable (data) memory interface. This facilitates instruction fetch and the operation on data/accessing of variables simultaneously. Architecture of PIC microcontroller

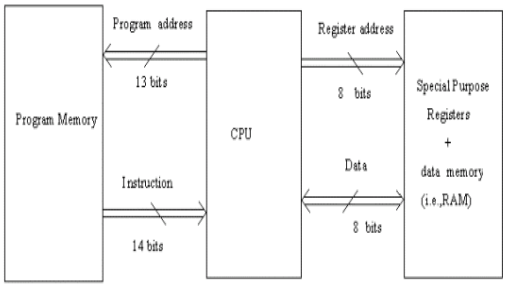


Fig 3.1.Architecture of PIC microcontroller.

:

- RISC instruction set with around 35 instructions _9 Digital I/O ports.
- On-chip timer with 8-bit prescaler.
- Power saving SLEEP mode.
- EPROM (or OTP) program memory.

Peripheral features**:**

- High sink/source current 25mA.
- Timer0: 8-bit timer/counter with 8-bit prescaler can be incremented during sleep via external crystal/clock.
- Timer2:8-bit timer/counter with 8-bit period register prescaler and post scalar.

- Compare is 16-bit, max resolution is 200 ns.
- PWM max, resolution is 10-bit.
- 8-bit 5 channel analog-to-digital converter.
- Synchronous serial port (SSP) with SPI (Master/Slave) and (Slave).

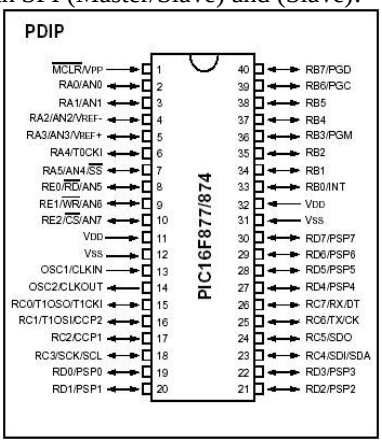


Fig. 3.2 :PIN DIAGRAM OF PIC16F877

PIC 16F877A Specification**:**

- RAM 368bytes
- EEPROM 256bytes
- Flash Program Memory 8k
- Operating Frequency DC to 20MHz I/O port .

B. WIRELESS A/V CAMERA:

Wireless security cameras are closed circuits (CCTV) cameras that transmit a video and audio signal to a wireless receiver through a radio band. "Wireless" refers to the transmission of video/audio.

Fig 3.3: Wireless A/V camera

A/V transmitter. The camera is with 1.2GHZ, with Audio and CMOS and receiver unit with manual frequency adjustment.

- Linear Transmission Distance: 50-100m.
- Transmission Signal: Audio, Video.
- Receiving Signal: Audio, Video.

C. Zigbee:

Fig3.4: Zigbee

ZigBee is an established set of specifications for wireless personal area networking (WPAN), i.e., digital radio connections between computers and related devices. This kind of network eliminates use of physical data buses like USB and Ethernet cables.

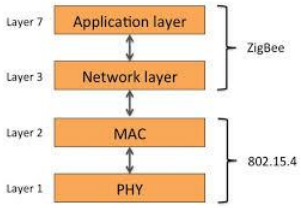


Fig:3.5 :ZIGBEE ARCHITECTURE

Though WPAN implies a reach of only a few meters, 30 feet in the case of ZigBee, the network will have several layers, so designed as to enable interpersonal communication within the network, connection to a network of higher level and ultimately an uplink to the Web. The ZigBee Standard has evolved standardized sets of solutions, called 'layers'. These layers facilitate the features that make ZigBee very attractive: low cost, easy implementation, reliable data transfer, short-range operations, Very low power consumption and adequate security features.

D. DC MOTOR AND H- Bridge:

D.C. Motor**:** A dc motor uses electrical energy to produce mechanical energy, very typically through the interaction of magnetic fields and current-carrying conductors. The reverse process, producing electrical energy from mechanical energy, is accomplished by an alternator, generator or dynamo. The input of a DC motor is current/voltage and its output is torque (speed).

Fig3.6: DC Motor

The H-Bridge is designed to drive a motor clockwise and anticlockwise. To reverse a motor, the supply must be reversed and this is what the H-Bridge does. and also be used to 'brake' the motor, where the motor comes to a sudden stop, as the motor's terminals are shorted, or to let the motor 'free run' to a stop, as the motor is effectively disconnected from the circuit. An H-Bridge can be made with SWITCHES, RELAYS, TRANSISTORS or MOSFETS.

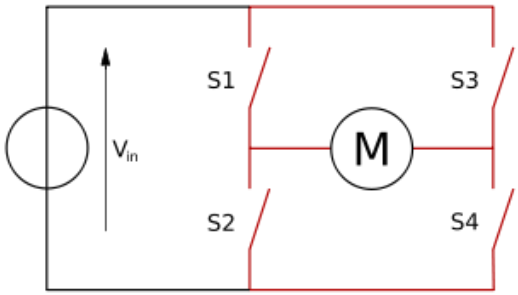


Fig3.7: H-Bridge

IV. SOFTWARE DESCRIPTION

This project is implemented using following software's

- Express PCB – for designing circuit.
- PIC C compiler - for compilation part.
- Proteus7 (Embedded C) – for simulation part.

A. Express PCB:

Express PCB is a software tool to design PCBs specifically for manufacture by the company Express PCB (no other PCB maker accepts Express PCB files). It is very easy to use, but it does have several limitations.

Express PCB comes with a less then exciting list of parts. So before any project is started head over to Audio logic and grab the additional parts by morsel, ppl, and tangent, and extract them into your Express PCB directory. At this point start the program and get ready to setup the workspace to suit your style.

B. Proteus:

Proteus is software which accepts only hex files. Once the machine code is converted into hex code, that hex code has to be dumped into the microcontroller and this is done by the Proteus. Proteus is a programmer which itself contains a microcontroller in it other than the one which is to be programmed. This microcontroller has a program in it written in such a way that it accepts the hex file from the pic compiler and dumps this hex file into the microcontroller which is to be programmed. As the Proteus programmer requires power supply to be operated, this power supply is given from the power supply circuit designed and connected to the microcontroller in proteus. The program which is to be dumped in to the microcontroller is edited in proteus and is compiled and executed to check any errors and hence after the successful compilation of the program the program is dumped in to the microcontroller using a dumper.

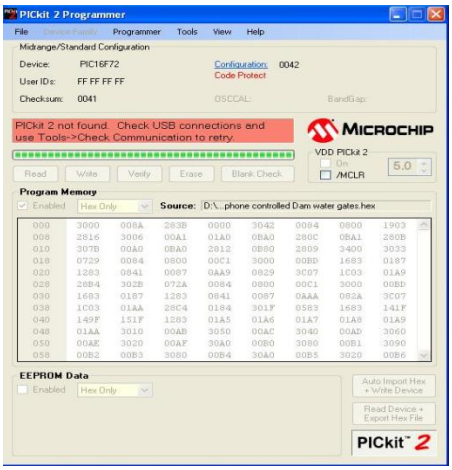
C. PIC Compiler:

PIC compiler is software used where the machine language code is written and compiled. After compilation, the machine source code is converted into hex code which is to be dumped into the microcontroller for further processing. PIC compiler also supports C language code.
It's important that you know C language for microcontroller which is commonly known as Embedded C. As we are going to use PIC Compiler, hence we also call it PIC C. The PCB, PCM, and PCH are separate compilers. PCB is for 12-bit opcodes, PCM is for 14-bitopcodes, and PCH is for 16-bit opcode PIC microcontrollers.

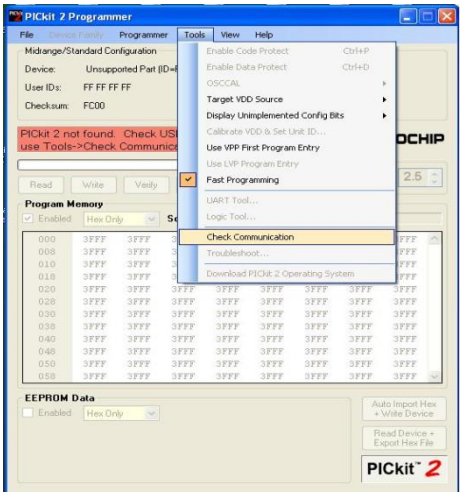
Program Dumping steps:

The steps involved in dumping the program edited in proteus 7 to microcontroller are shown below:

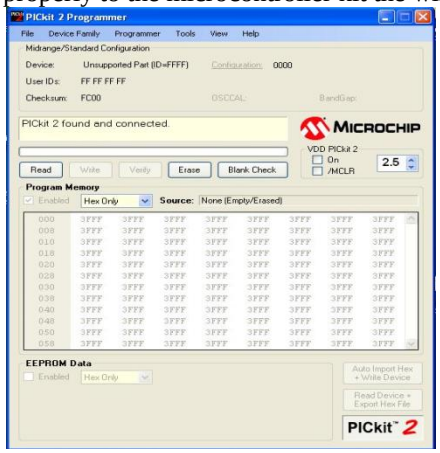
1. Initially before connecting the program dumper to the microcontroller kit the window is appeared as shown below.



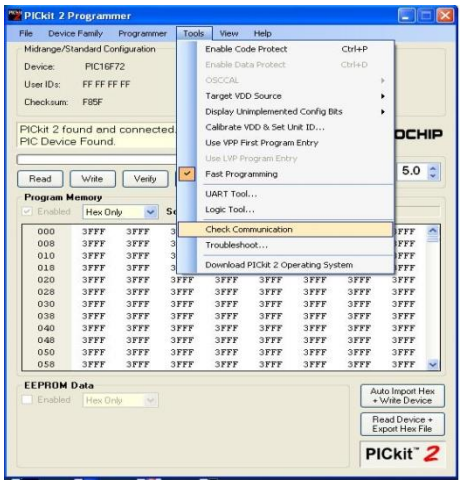
2. Select Tools option and click on Check Communication for establishing a connection as shown in below window.



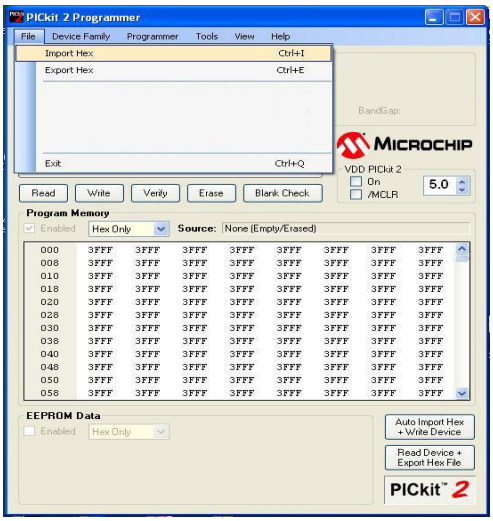
3. After connecting the dumper properly to the microcontroller kit the window is appeared as shown below.



4. Again by selecting the Tools option and clicking on Check Communication the microcontroller gets recognized by the dumper and hence the window is as shown below.

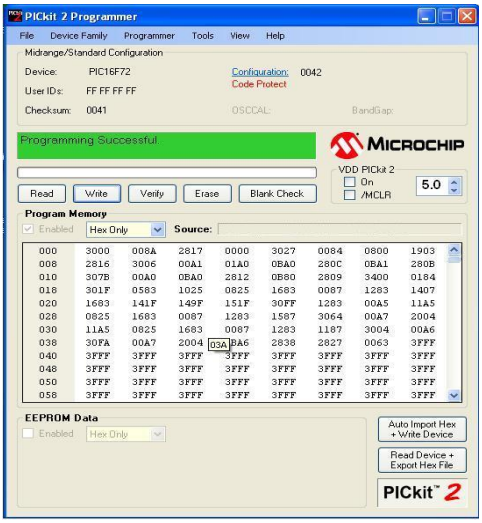


5. Import the program which is '.hex' file from the saved location by selecting File option and clicking on 'Import Hex' as shown in below window.



6. After clicking on 'Import Hex' option we need to browse the location of our program and click the 'prog.hex' and click on 'open' for dumping the program into the microcontroller.

7. After the successful dumping of program the window is as shown below.



V. RESULT

The project "Borehole Robot for Rescue of a Child" was designed such that the robot is operated from PC wirelessly through zigbee.

VI. CONCLUSION

Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC's with the help of growing technology, the project has been successfully implemented. Thus the project has been successfully designed and tested.

VII. FUTURE SCOPE

Our project "Borehole Robot for Rescue of a Child" is mainly intended to operate the robot into a borehole through PC with MATLAB using Zigbee. This project can be extended adding bomb diffusion, GPS to set location and digital compass to self-navigation.

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