

Design and Construction of Rescue Robot and Pipeline Inspection Using Zigbee

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Abstract: Now a days child often fall down in the borehole which is left uncovered and get trapped. It is very difficult and also risky to rescue the trapped children. A small delay in the rescue can cost the child his or her life. The objective of the project is to construct and design a bore well rescue robot (i.e to rescue a trapped baby from bore well). This project is a human controlled robot that gives an insight view of rescuing the baby safely and steps taken to achieve this. The project aims in designing "Robot to rescue of a child in a borehole" which is capable of moving inside the pipe according to the user commands given from PC. The project also used for Picking and Placing of objects based on arm design. The robot is operated through PC using wireless Zigbee technology and using wireless camera we can view both audio and video on the TV. This robot has a high power LED which acts as a light source when light intensity inside the pipe is low. It is a low cost robot used to monitor the changes of different parameters in the industrial pipes.

Keywords: L293D H- bridge motors, Motor control, Robot, Robot arm, Wireless camera, Zigbee

1. Introduction

The advent of new high-speed technology and the growing computer capacity provided realistic opportunity for new robot controls and realization of new methods of control theory. Robotics is one field within artificial intelligence. It involves mechanical, usually computer-controlled, devices to perform tasks that require extreme precision or tedious or hazardous work by people [1]. The field of search and rescue robotics, while growing rapidly in this decade, is still relatively new [2]. Robots have been very successful at manipulation in simulation and controlled environments. Outside of controlled environments, robots have only performed sophisticated manipulation tasks when operated by a human [3]. This technical improvement together with the need for high performance robots created faster, more accurate and more intelligent robots using new robot control devices, new drivers and advanced control algorithms. This project describes a new economical solution of robot control systems.

The presented robot control system can be used for different sophisticated robotic applications. One particular aspect of the rescue robotics domain eases the fruitful combination of highly challenging basic research and application oriented developments for large markets. This is the fact that rescue robots strongly benefit from autonomy while there is a human in the loop [4].

Recently, many accident reports of children (and even adults) falling in open bore-wells have appeared in the print and the electronic media. Very few of the victims have been saved in such accidents. To overcome such problems of these rescue operations, we have an alternative (feasible) proposal [6]. We are developing a robot machine that can take out the trapped body in systematic way. It will also perform various life-saving operations for the sufferers such as oxygen supply. It will be a light weight machine that will

go down into the bore well pipe and hold the trapped body systematically. In this alternative scenario, there will be no requirement of digging any hole parallel to the bore-well. The remotely controlled robot will go down the bore well and perform the action. A lot of other hassles will also be avoided by this alternative technique [6].



Figure 1: Image of a baby fell into borehole

2. Objective of the Project

The objective of the project includes:

1. Wireless controlling of Robot through PC using Zigbee technology
2. Live Audio and video can be seen on TV.
3. Implementation of pick and place concept to the robot.
4. DC motor based gripper operation for robotic arm.

3. Literature review and related work

3.1 What is the problem how big it is?

When the accident reports of children (and even adults) falling in open bore-wells has appeared there is no proper

technique to rescue victims of such accidents. When the make shift /local arrangements do not work, Army is called in. In most cases reported so far, a parallel hole is dug up and then a horizontal path is made to reach to the subject's body. It is not only a time taking process, but also risky in various ways. Moreover it involves a lot of energy and expensive resources which are not easily available everywhere. These ad-hoc approaches involve heavy risks including the possibility of injuries to the body of subject during the rescue operations. Also, the body may be trapped further in the debris and the crisis deepens even more [6].



Figure 2: Army members working for the borehole rescue



Figure 3: Depth of a borehole

3.2 Available solutions

(i) So far there is no proper solution available for giving relief in such accidents. Generally, a hole parallel to the bore-well is dug up then a horizontal path is created to reach to the subject's body. But it takes too much time to save the life of the sufferer. Moreover, it involves a lot of energy, and expensive resources which are not easily available everywhere. It also involves possibilities of damaging the body of sufferer during the rescue operation loom large.

(ii) In some cases makeshift arrangements are made to pull out the body of sufferer. In such methods some kind of hooks are used and sufferers' clothes or body organs get caught hold of. This may cause wounds on the affected body [6].

3.3 Possible Alternative Solutions

To overcome such problems of these rescue operations, we have an alternative (feasible) proposal. We can develop a robot machine that can take out the trapped body in

systematic way. It will also perform various life-saving operations for the sufferers such as oxygen supply. A video camera to observe the actual situation closely and continuous interaction with the sufferer could also be attached [6].

It will be a light weight machine that will go down into the bore well pipe and hold the trapped body systematically. In this alternative scenario, there will be no requirement of digging any hole parallel to the bore-well. The remotely controlled robot will go down the bore well and perform the action. In critical industries where human presence is avoided there we can use robots which are programmed to do a specific operation.



Figure 4: A Robot

4. Hardware Design

4.1 Architecture for design and construction of rescue robot and pipeline inspection.

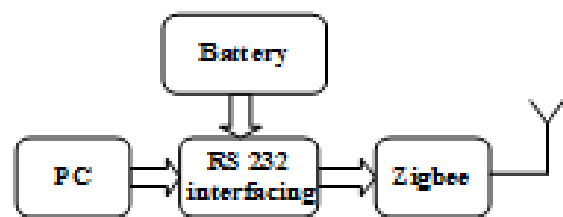


Figure 5: Block diagram of design and construction of rescue robot and pipeline inspection using zigbee for transmitter

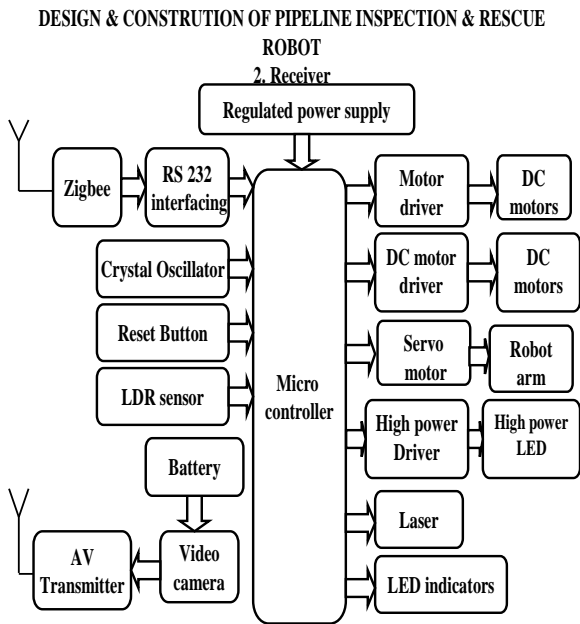


Figure 6: Block diagram of design and construction of rescue robot and pipeline inspection using zigbee for receiver

Description: In this project we are designing a robot which is operated through PC using wireless Zigbee technology and using wireless camera we can view both audio and video on the TV. This robot has a high power LED which acts as a light source when light intensity inside the pipe is low. It is a low cost robot used to monitor the changes of different parameters in the industrial pipes.

Zigbee is a PAN technology based on the IEEE 802.15.4 standard. Unlike Bluetooth or wireless USB devices, Zigbee devices have the ability to form a mesh network between nodes. Meshing is a type of daisy chaining from one device to another. This technique allows the short range of an individual node to be expanded and multiplied, covering a much larger area.

The controlling device of the whole system is a Microcontroller. Whenever the user presses a button from the keyboard of the PC, the data related to that particular button is sent through Zigbee module interfaced to PC. The robot also has arm to lift the obstacle using servo motor. The system also has head lamp vision with high power LED's and it gets ON when the LDR sensor detects the darkness inside the bore hole. This data will be received by the Zigbee module in the robot system and feeds this to Microcontroller which judges the relevant task to the information received and acts accordingly on robot and arm movement. The live images from the camera in the robot system can be sent to TV through AV transmitter system. The Microcontrollers used in the project are programmed using Embedded C language.

4.2 Zigbee module

There are a multitude of standards like Bluetooth and WiFi that address medium to high data rates for voice, PC LANs, video, etc. However, up till now there hasn't been a wireless network standard that meets the unique needs of sensors and controlled devices. The ZigBee Alliance is not pushing a technology; rather it is providing a standardized base set of solutions for sensor and control systems [7]. ZigBee technology is a bidirectional wireless communication technology of short distance, low complexity, low cost, low power consumption, and low data rate, mainly used in automatic control. It mainly works on 2.4GHz ISM band with 20~250kbit/s data rate, 100m ~1.5km maximum transmission range, and a typical 100m distance [5].

ZigBee is such a standard for embedded application software and has been ratified in late 2004 under IEEE 802.15.4 Wireless Networking Standards. 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. The devices could include telephones, hand-held digital assistants, sensors and controls located within a few meters of each other.

4.3 Microcontroller

A microcontroller is a small computer on a single integrated circuit consisting of a relatively simple CPU combined with support functions such as a crystal oscillator, timers, watch dog timer, serial and analog I/O etc. Microcontrollers are also used in scientific, high technology, and aerospace projects. These are designed for small or dedicated applications. In this project we are using PIC 16F877A microcontroller. PIC is a family of Harvard architecture microcontrollers made by Microchip Technology, derived from the PIC 1640 originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to "Peripheral Interface Controller".

A PIC's instructions vary from about 35 instructions for the low-end PICs to over 80 instructions for the high-end PICs. The instruction set includes instructions to perform a variety of operations on registers directly, the accumulator and a literal constant or the accumulator and a register, as well as for conditional execution, and program branching.

4.4 DC 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. Many types of electric motors can be run as generators, and vice versa. The input of a DC motor is current/voltage and its output is torque (speed). The DC motor has two basic parts:

the rotating part that is called the *armature* and the stationary part that includes coils of wire called the *field coils*. The stationary part is also called the *stator*.



Figure 7: DC Motor

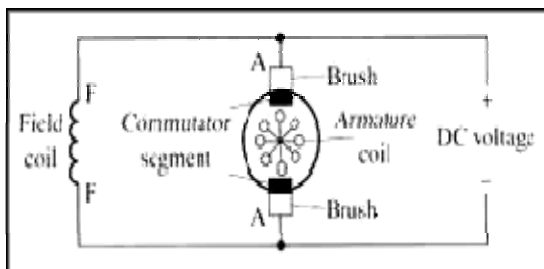


Figure 8: Simple electrical diagram of DC motor

4.5 Wireless Camera

The camera is with 1.2GHZ, with Audio and CMOS and receiver unit with manual frequency adjustment. This wholesale product is already popular with ChinaTronic customers because of consistent high quality.

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

5. Results, Conclusion and Future scope

5.1 Result

The project “**Design and Construction of Rescue Robot and Pipeline Inspection**” was designed to construct a Robot which is capable of climbing the pipeline. The robot was operated using computer wirelessly using zigbee from a remote location and also such that Robot can move either Forward by pressing button ‘f’ or Backward by pressing button ‘b’, from the PC through the Hyper Terminal. This robot has a high power LED which acts as a light source inside the pipe.

5.2 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.

5.3 Future Scope

In future we can use this project in several applications by adding additional components to this project.

- 1) By connecting temperature sensor to the robot we can get the temperature of dangerous zones in personal computer itself instead of sending human to there and facing problems at field we can send robot to there and sensor will detect the temperature and it gives information to the micro controller and micro controller gives the information to the transceiver from that we can get the data at pc side.
- 2) By connecting smoke sensor to the robot we can get the information related concentration of smoke or gases in respective field’s i.e. (coal mines, dangerous zones, etc). sensor sense the information and it give to the micro controller and it gives to the transceiver and from that we get the information in personal computer.

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