

Design of Multifingered Rescue Hand Robot with Teleoperation

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ABSTRACT: In the past few years, there have been several accidents of children falling into abandoned bore wells in India. It is very difficult and also risky to rescue the trapped children. The objective of this project is to construct and design multifingered robot to rescue a trapped baby from bore well. It is a human controlled robot that gives an insight view of rescuing the baby safely. The Robot is capable of moving inside the borewell according to the user commands given from PC. It is operated through PC using wireless Zigbee technology. Also both audio and video signals can be viewed by PC using wireless camera. It also includes Temperature sensor, Heart beat sensor, Tactile sensor and Oxygen supply unit. Temperature sensor is used for measuring the temperature inside the borewell hole, heart beat monitoring sensor is used for monitoring the heart beat ratio of the baby, tactile sensors are used for providing touch sensitivity to the hand and oxygen supply unit is used for providing enough amount of oxygen to the baby. The robot has a high power LED which acts as a light source when light power inside the borewell is low. This type robot can rescue trapped baby from bore well in minimum amount of time and safely.

KEYWORDS: Borewell, Rescue robot, Teleoperation, Zigbee, Wireless camera

I. INTRODUCTION

Growing water scarcity is being recognized as an important problem facing India. The most dramatic change in the groundwater scenario in India is that the share of bore wells in total irrigated areas went up from a mere 1 percent during 1960-61 to 40 percent during 2006-07. The estimated number of wells and bore wells in India is now around twenty-seven million, with bore wells accounting for more than 50 percent. Water well or Bore well is an excavation or structure created in the ground by digging, driving, boring, or drilling to access groundwater in underground aquifers. The well water is drawn by a pump, or using containers, such as buckets, that are raised mechanically or by hand.

Farmers started drilling bore wells from the early 1990s and shallow open wells gradually dried up due to falling groundwater levels. Over the last 15 years, the number of bore wells grew rapidly in these villages. Due to indiscriminate drilling of bore wells and unscientific groundwater exploration, many bore wells failed either at the time of drilling or after drilling.

Furthermore, drilling bore wells as deep as 300 ft. resulted in drying of shallow, open dug wells and shallow bore well. These bore wells are left unclosed after identifying that ground water is not abundant at the place. Without a prior scientific testing, bore wells are started digging and later left abundant. This resulted in vast increase in number of bore wells.

A. Baby Fell in Bore well

Now a day's child often fall down in the borehole which is left uncovered and get trapped. A single accident creates a big hue and cry spreading a sense of panic among the masses. Forty five deaths of children have been reported in the country since September 2001. From that we have only nineteen with the proof of newspaper that shown below. Their deaths are caused due to uncovered dry bore wells.

Rescuing has following difficulties:-

- It takes up to 30 hours to dig the parallel pit, by that time the child would have died.

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- Lack of oxygen inside the bore well.
- Lack of visualization causes the major difficulty during the rescue operation.
- There is no such special equipment for rescuing the child trapped inside the bore well

B. Rescue Robot

Robots are replacing humans in the activities of performing repetitive and dangerous tasks which humans prefer not to do due to size limitations, extreme environments, etc. It involves mechanical, usually computer-controlled, devices to perform tasks that require extreme precision or tedious or hazardous work by people. 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. Robot is designed in such a way that it will be a light weight machine that goes down into the bore well pipe and hold the trapped body systematically. It will also perform various life-saving operations.

II. RELATED WORK

Many accident reports of children falling in open bore-wells have appeared in the print and the electronic media. When the accident reports of children falling in open bore-wells has appeared there is no proper technique to rescue victims of such accident. When the make shift /local arrangements do not work, Army is called in. The rescue process to save the child from bore well is a long and complicated process.

In existing method, 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. Rescue teams spend hours and sometimes days in futile attempts to save these little kids. A lot of money is also spent in these missions. The rescue team tries to approach the victim from a parallel well that take about 20-60 hours to dig. This complicated process makes 70% of the rescue operations fail. 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.

III. PROPOSED SYSTEM

In proposed method, the robot is designed in such a way that it will be a light weight machine that goes 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.

This robot is a human controlled robot which is operated through PC using wireless technology as Zigbee. With the help of wireless camera we can view both audio and video on the PC at the base station. It senses the position of child from bore well and transmits to the PC via wireless transmitter. This robot has a high power LED which acts as a light source when light intensity inside the pipe is low. The PIR sensor placed along with camera on the bottom will detect the distance and motion of the victim from the ground. The Tactile sensor is built on the finger of robot hand should be able to sense and detect the touching of a sensor and object. The Temperature sensor is used to sense the body of the object and it converts the temperature value into electrical value. Oxygen supply will be provided by oxygen pipes which will go with the robotic system. There will also be a supplementary oxygen mask which can be used by the robotic arms in emergency situations. The robot has multi degrees of freedom and can adjust its position according to safety and comfort of child. Then with the help of stepper motors, the child mounted on the legs of rescue robot is pulled upward safely in the fastest possible time. The basic concept of this project is to bring the victim to ground without any injuries in a very short span.

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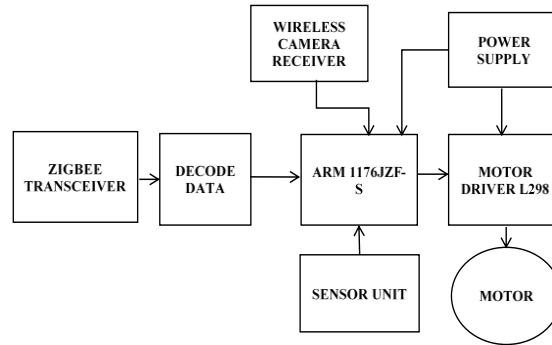


Fig 1. Block diagram of Robot module

The heart of this system is the ARM1176JZF-S Processor. The wireless receiver module receives the wave signal transmitted by the wireless transmitter module. Then the module decodes the wave signal and sends to the ARM1176JZF-S Processor through UART. Then the microcontroller sends the motor controlling signal to the L298 motor driver IC according to received wireless signal. By counting the number of pulse the microcontroller calculate the current position of the arm internally and if any error found with the position of the arm and receiver module received position then the position is fixed by sending the necessary signal to the motor driver.

The robot firstly goes down the borewell with by adjusting its legs according to the dimensions. It is controlled by the operator over wireless communication using Zigbee technology. The video camera mounted on it gives the insight view of the position and location of the baby. This video will be monitored on PC. The robot then grasps the baby by contracting or expanding its gripper according to the requirement. Temperature sensing is also done by the robot which is monitored on PC. Heart beat sensor is useful to know the health condition of baby and it is also monitored on PC. The robot holds the baby tightly with the help of tactile sensors and brings it out of the borewell safely. PIR motion sensor is used to detect whether a human is presented in or out of the sensors range.

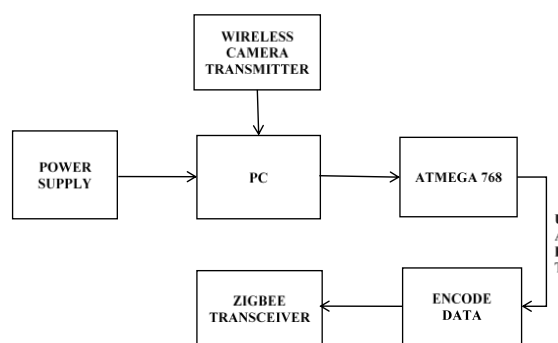


Fig 2. Block diagram of Control module

Control module controls the overall operation of the robotic system. The Personal Computer (PC) is used to control the motion of the robotic hand. Based on the live video displayed on the PC monitor, the control commands are transmitted through the UART. It is widely used as protocol for communicating with the microcontroller. The wired connection is made between the control unit and the Personal computer. UART (RS232) port is available in the control unit and by connecting the serial port with it the computer can communicate with the control unit. Microcontroller (Atmega768) processes the controls from PC and transmits over the wireless medium. For the wireless transmission the encoder is needed. Encoding is the process of arranging a sequence of characters into a specialized digital format for efficient transmission. After encoding it is transmitted over the wireless medium. The wireless connection is made

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between the robotic hand and the control unit. It is achieved with the help of ZIGBEE transceiver attached with the control unit. By using ZIGBEE as a communication medium it communicate with the robotic module.

A. Wireless Camera

Wireless camera receiver is used to receive the video signal. It has an antenna is act as a transducer. It converts the video signal into electrical signal and process it. The wireless camera provides the adapter to connect it with the television/ computer directly. After connecting it with our computer we can watch the live video captured by the camera. Control unit continuously monitor the live video received by the wireless camera receiver.

B. ZIGBEE

ZIGBEE transceiver allows two way communication. So the base station can send/receive the information simultaneously. The contextual information which is detected by the various sensors are transmitted over the air medium and it is received by the ZIGBEE receiver. The information are further processed by the control unit and it is transferred to the computer via RS232 port. In the same manner the control commands from the computer is transferred to the control unit and it is transmitted to the robotic hand using ZIGBEE transmitter.

C. Sensing unit

The unit has different type of sensor and each has its own functionality. Temperature sensor is used for sensing the temperature inside the well. Tactile sensor is used for sensing the touch and it produces force feedback. Heart beat monitoring sensor is used to sense the heart beat ratio per minute. Each sensor is an integrated circuit sensor that can be used to measure various parameters as an electrical output proportional to it. All the sensors are powered by the power supply connected to the robotic unit.

D. Oxygen Supply Unit

Human beings depends on oxygen to survive. Oxygen is most essential for breathing and it is more useful for the circulation of the blood inside the body. Each and every organ of the human body needs blood for the proper function. So we have to providerequired amount of oxygen with the help of oxygen supply unit. Oxygen unit is not included in the robotic hand because of its huge size and enormous weight. Oxygen unit is kept outside the hole and the lengthy pipe is inserted inside the hole as usual as the traditional rescue operation.

IV. RESULTS AND FUTURE WORK

It is concluded that the rescue robot can provide the safest and fastest way to save victims trapped in borewell. This project is used to reduce human efforts for rescuing operations from bore well. If this could be implemented into prototype, it could save many people who are trapped in the bore wells every year. Our rescue robot can also be used in other applications where people are trapped in between structures like during earth quakes.

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