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Design and Implementation of Robot to Rescue Child from Bore Well

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Abstract— ***The aim of this work is to rescue a child trapped in the borewell by continuous monitoring and supply of necessities for survival using a very innovative method to handle the bore well rescue operations without human intervention. The dry bore well is generally left uncovered after the deep boring task, started claiming many innocent lives of the children, who accidentally fall in these bore wells and ultimately die. The present child rescue operation is carried out using large machinery such as cranes, drillers etc., with the larger involvement of manpower. It takes nearly 48 to 60 hours to rescue the child which is very long for the child trapped inside. This rescue operation of trapped child is not only difficult but also very risky. A delay in rescue operation can lead to the child's death. Also lifting the child out from the narrow confines of the bore well with safety is not an easy task. In this project, a robot is designed that is controlled by a human, which gives the insight of the rescue operation and the steps taken to achieve this. The robot is operated via computer with wireless R.F. module as the communication medium and wireless camera with which we can monitor both audio and video signals get the updates and it also has an ultrasonic distance sensor to measure the distance of trapped body from the ground level. This robot is equipped with LDR sensor, which senses the intensity of darkness inside. It consists of high power LED which acts as light source as the light intensity is very low inside the well. This method is time-saving, reliable and safe.***

Keywords— ***Direct Digital Controller (DDC), Light Emitting Diode (LED), LDR (Light Dependent Resistor), Radio Frequency (R.F) Module, Borewell rescue operation.***

INTRODUCTION

In the modern age, every country is advanced and everything gets sophisticated. With The advent of high speed technology and growing computer capability, realistic opportunities are provided for robotic control and efficient control algorithms are available. Robotics is used extensively with artificial intelligence [1]. Rescue robot technologies were previously developed, But they came in to light only after the World Trade Centre disaster in U.S.A in the year 2002[2]. The goal of this project is to design and implement a prototype robot involved in rescue operation of the trapped child, in an
efficient and safe manner avoiding injuries. The system is light in weight, fast and economical.

LITERATURE SURVEY

With increasing water scarcity, the ground water level is decreasing day by day. So to fulfill the necessity and demand, there is an increase in the number of bore wells dug and mostly ignoring the safety precautions. Such as leaving bore wells uncovered. These dry bore wells which are not paid any attention by the authorities' leads to the death of many children. When the casing pipes are available at a cost hardly between Rs.2000-3000 is removed, even a six inch borewell becomes wider and easily a child can be trapped. Around 45 deaths of children have been reported in the country since September 2001, in which there is only 19 with proof of newspaper [3-4]. According to survey only 4 children came out alive from the well, but 2 children were declared brought dead in hospital because of lots of injuries.

EXISTING METHODS

- Dig a hole parallel to the present borewell to the same depth and make a horizontal tunnel path till the borewell to reach the child.
- Tie some hook kind of material to strong rope, let it go inside the well.

The above both methods have failed in the operation because it requires a lot of manpower besides other equipment, even army should be called in for the purpose. The resources are quite expensive, requires lot of energy and are not available everywhere easily. These are very time consuming, which may lead to death of the child. In the hook system, the child's dress or body organ should be made to hold, which leads to many injuries.

POSSIBLE ALTERNATE SOLUTION

To overcome the above problems, the new robot proposed which can perform the rescue operation very safely, efficiently and economically within less time.

OBJECTIVES OF THE PROJECT

The objective of the project includes:

- Wireless controlling of robot through computer system using R. F. module technology

1. Serial communication to minimize wires.
2. Installation of night vision camera.
3. Installation of ultrasonic distance sensor.
4. Live audio and video can be seen on monitor.
5. Pick and place concept of the robot is implemented.
6. Geared DC motor based operation for robotic arm.
7. Soft gripper materials should be used.
8.

PROJECT DESCRIPTION

The low weight robot that is designed is operated through PC using wireless R.F. module technology. By using wireless USB camera, it is possible to get both audio and video live interaction on the monitor with the trapped child. It consists of LDR sensor, which makes high power LED to glow which acts as a light source when light intensity inside the well is low. By using distance sensor, we can measure the distance of the child and also can monitor the change of different parameters like temperature, oxygen level etc.

PIC microcontroller (16F877A) is the controlling device of the system. The microcontrollers are programmed using embedded C language and the controller used is DDC. According to the controller signal the arms does the movement and hold the baby to bring out of the well. The keypad is used to provide inputs to the controller, hence whenever the button is pressed, the related particular data (digitized data 0 or 1) is sent through R.F. module interfaced to PC. According to the controller's output, arms of robot operate by using DC geared motor. Motor direction of rotation can be controlled by H-Bridge driver.

BLOCK DIAGRAMS

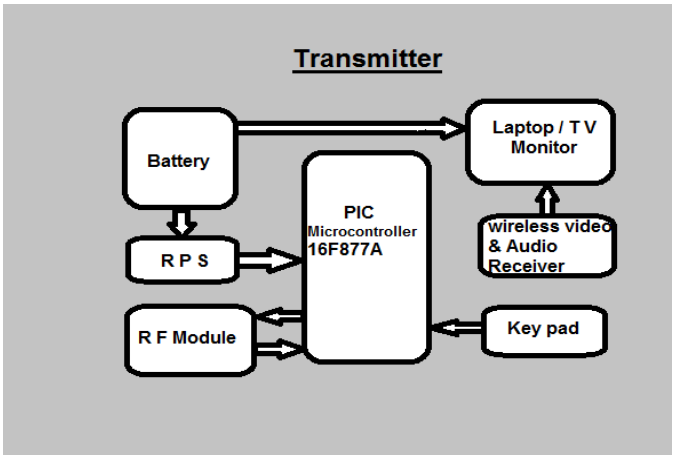

Fig.1 Block diagram of Transmitter

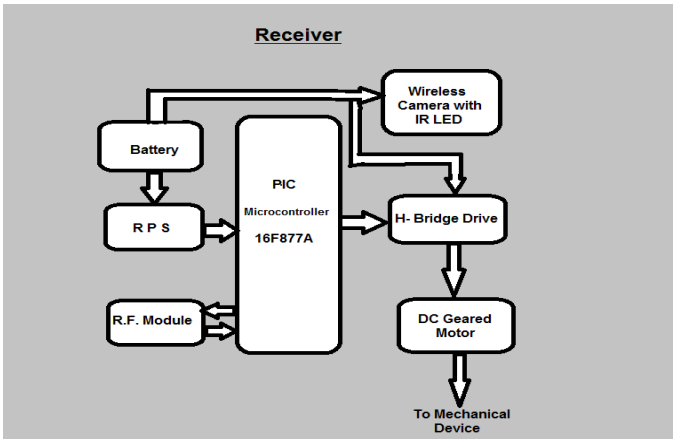

Fig.2 Block diagram of Receiver

Hardware Unit:

The hardware part consists of five main units: robotic module, controller unit, sensing unit, display unit and RF module.

I. Robotic Module:

a) Robot structure:

The figure 3 is showing the design of robot arm, which having gripper to hold a child safely. The operating voltage is 12 V DC.

Fig. 3 Robotic arm structure

The arms of robot are generally used to grasp and hold a child and place it at a desired location. Arms perform open and close operation.

b) Wireless Camera:

To provide a live video and audio of trapped child, a USB camera module is mounted on the robot and is powered by 12V DC supply, 2.4 GHz and transmission range is 100m.

c) DC geared Motor:

The input of a DC motor is current/voltage and its output is torque (speed).The geared DC Motor operates at 12V, 2A, and 50:1 ratio of rotation with low RPM and high torque.

II. Controller Unit:

a) PIC microcontroller:

The PIC 16F877A is the controlling device of this project which consists of 40-pin 8-bit CMOS FLASH microcontroller. The core is high performance RISC CPU. The main functions of this unit are to compute commands and to process the sensory information collected by the robot [5].

b) DDC:

The benefits of direct digital control over past control technologies (pneumatic or distributed electronic) is that it improves the control effectiveness and increases the control efficiency. The three main benefits of DDC are improved effectiveness, improved operation efficiency and increased energy efficiency. Digital data may also be called discrete data or binary data. The value of the data is either 0 or 1 and usually represents the state or status of a set of contacts. This type of data is sometimes called pulse input.

Table 1: D D C Logic outputs

D D C outputs are 0 or 1	
Logic output	**Robot arm movement**
0 (logic low)	Close (minimum)
1 (logic high)	Open (maximum)

c) H Bridge Drive :

L293D is a dual H-Bridge motor driver and with one IC we can interface two DC motors which can be controlled in both clockwise and counter clockwise direction and if you have motor with fixed direction of motion you can make use of all the four I/Os to connect up to four DC motors and the L293D has output current of 600mA and peak output current of 1.2A per channel. In this project one motor is used to control the movement of robot two arms [6].

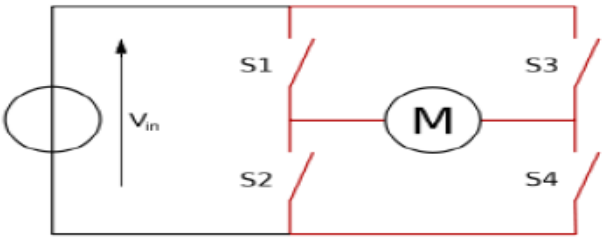

Fig.4 H Bridge drive

Table 2: Motor moves of H Bridge drive

S1	S2	S3	S4	Result
0	1	1	0	Motor moves right
1	0	0	1	Motor moves left
0	0	0	0	Motor moves freely
0	1	0	1	Motor brakes
1	1	1	1	Short power supply

III Sensor unit:

a) Ultrasonic Distance Sensor is used to sense the distance of trapped victim inside the borewell. This measures the distance of the trapped child from the ground level.

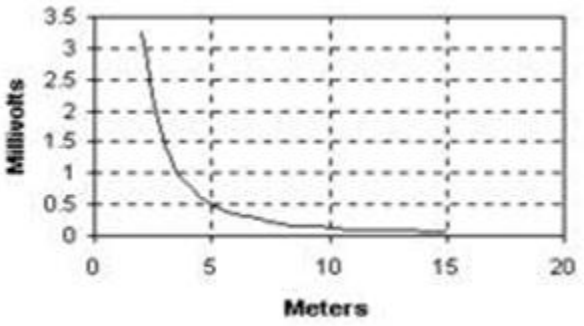

Fig. 5 Graph of Amplitude Vs Distance

b) Light Dependent Resistor is used to sense the darkness inside the borewell. As the darkness increases LED starts glowing.

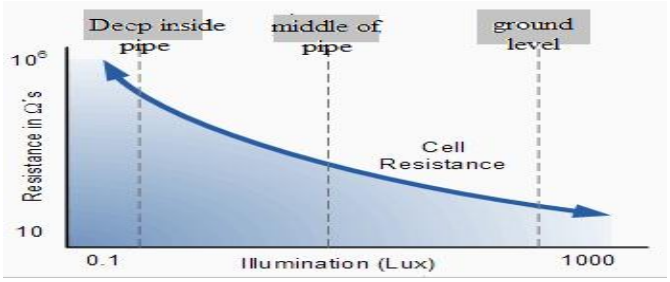

Fig.6 Graph of Resistance Vs Illumination

IV Display Unit:

This unit comprises of LCD (16X2) and Monitor. By using LCD, the information like distance and robotic arm operations such as open / close can be displayed.

This dot matrix LCD display module holds 32 characters - 16 on each line and has a green backlight with black text.

V RF Module:

An RF module (radio frequency module) is a small electronic circuit which is used to transmit and/or receive radio signals on one of a number of carrier frequencies. Output of the robot will be displayed on LCD by using this wireless equipment. The operating frequency used is 2.4 GHz.

Software Unit:

The software part of this project includes the programming of the controller unit using MikroC software and proteus8 software.

Steps to be followed for rescue operation:

1. Avoid the crowd around the borewell, create the platform and allow only 2 or 3 persons on the platform to carefully guide and operate the whole system.

2. Then our robot is to enter in to the bore well very slowly, a safety rope is provided which acts as a support for the robot. It is possible to lower the robot up to 20 feet inside the bore well. With the aid of camera the location and position of the child can be determined and with the help of ultrasonic distance sensor distance can be determined.

3. Using the oxygen cylinder fresh oxygen is supplied to the child through hoses, which is attached to the robot. And it maintains the temperature and humidity into the bore well.

4. By watching through the monitor, make the robot reach the child carefully.

5. Watching the position of the child on the monitor, make the robotic arm to hold the child, guiding it from platform by operating the switch pad mounted on transmitter.

6. Now the robotic arm clasps the child safely with soft gripper provided in the robot arm and the child is lifted up safely.

7. Medical attention was given to the child immediately after the rescue operation by the medical team.

TESTING

The proposed system was tested by using a child (toy) in an artificial borewell:

- The child (toy) is made to be trapped inside the borewell (approximately 10 feet depth).

- Then location and position of child (toy) was determined using the visualizing unit.
- Send the robot vertically inside the well.
- Using the oxygen cylinder, oxygen was supplied through the pipes.
- By using ultrasonic distance sensor, get the distance of child (toy) from the ground level.
- The robot arms were adjusted based upon the position of the child (toy).
- After grasping safely, carefully bring the child (toy) out of the borewell and child (toy) was recovered.

TESTED RESULT

The total time taken for the rescuing operation was approximately one hour. Figure 7 is showing the working model which is used for this test.

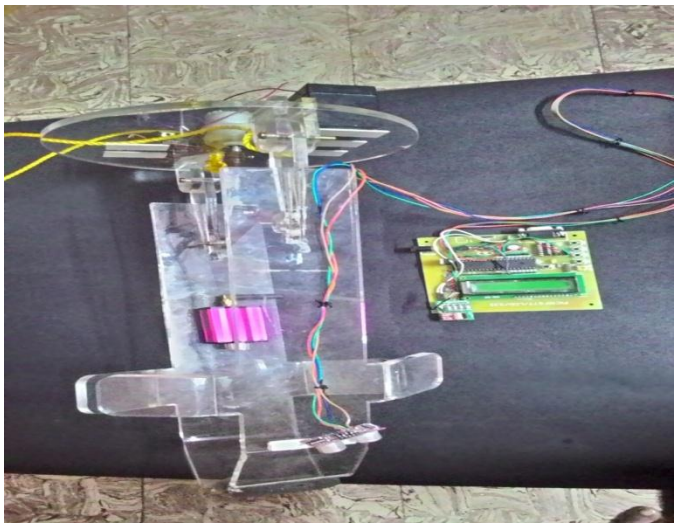

Fig.7 Image of the Robot

CONCLUSION

Robot to rescue child from bore well is a significant attempt to save life of the child from bore well accidents. The proposed system of rescue operation is better than ordinary rescue operation. The proposed system has several units by integrating all those, the specified task is achieved which will make the robot more efficient, safe, less operating time and also economical. This system has been successfully designed, implemented and tested.

FUTURE ENHANCEMENT:

By connecting temperature sensor to the robot we can get the temperature of dangerous ones in monitor itself instead of sending human. By connecting smoke sensor and oxygen sensor to the robot we can get the related information of concentration of smoke or gases and oxygen level inside the borewell respectively. In the same way passive sensor can be add to sense the motion of the trapped body. From this we came to know, the child is alive or not and also mike and speaker can also be installed to keep contact with baby.

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