# Development of Robo Child Rescue System from Borewell

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Abstract-In India, there have been several accidents of children falling into abandoned borewells which are left uncovered. This paper proposes an efficient system which is light weighted to rescues a trapped victim from borewell. This system consists of DC motors assembly which isautomatically controlled by motor driver. The structural design of this system makes it possible to have the adaption to the diameter of borewell and its walls. The trapped child is monitored through wireless camera on PC with help of robot arm and the victim can be safely rescued. Various sensors such as temperature, gas,PIRand UDM are interfaced with Arduino Uno to sense and monitor the temperature, harmful gases and distance of the victim inside the borewell and also to check if the victim is alive or not. In this system, when the robot arm is less than 3cm from the child automatically oxygen supply is provided inside the borewell with the help of pipe to maintain safe environment for the victim. Also, it is intended to reduce the risk involved during the child rescue operation by analyzing the situation.

**IndexTerms**— Brewell, Robot arm, Gas sensor, UDM sensor, PIR sensor.

#### I. INTRODUCTION

Most of the time in India, people are facing water scarcity and to overcome this issue borewell are dug. This case is encountered in rural area where they start to dig borewell for ground water, but ground water is easily not available because of which they go dip down. However certain borewell are abandoned and do not provide with ground water. Sometimes the borewell are dug and would be providing ground water but due to climate change or no rain these borewell ends up drying. So what happens in this case, the borewell is left uncovered and which becomes a death pit for children and animals in rural area. At times these borewell are covered with mud but due to rain and other calamity, the borewell still remains open and becomes a spot for accidents

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to occur. The children playing and animals wandering around the borewell unknowingly get trapped in this uncovered borewell. Parents unaware about this situation get delayed to rescue their child on time and safely. The help which will be provided to the child at times will be so late that they end up losing their life.



Figure 1: Image of an abandoned borewell

The borewell will be dug so deep that there won't be proper amount of oxygen supply inside which is the major cause of death. In most of the cases army officers are called for help and parallel pit is dug.

The army officer goes in this pit and then dig tunnel to reach victim. Victims are rescued safely or they might be injured. But at times, the entire manual action of removing the child from borewell takes hours together and sometimes it is delayed to such an extent that we lose innocent life.Even cases has been encountered where the victim has got stuck half way in borewell because of which to locate the position gets difficult.

In this paper we have tried to overcome all the issue faced to rescue the child from borewell. There are many papers approaching to this issue but there is no certain paper which deals with all the positive approaches in one. We have developed a smart child rescue system from borewell. The prototype is light weighted and can fit in any diameter of hole. It consists of a robot arm attached to pulley it can go for 20 feet down and it can be flexibly extended depending on the depth of the borewell. With the help of robot arm the victim can be lifted easily and brought up. The model consists of camera and LED attached to pulley to give a proper inside view of borewell which can be monitored using PC which is connected to wireless ZigBee. We are making use of sensors such as temperature sensors which is used to monitor the temperature inside the borewell as the temperature inside is almost double the amount of ground temperature. UDM sensor helps to find the distance of the victim in borewell. With the help of PIR sensor we can monitor the movement of the child to analyze its condition and last with help of gas sensor we can detect the poisonous gas which may be harmful and proper action to be taken to remove those gases and supply with oxygen. This provide safe environment for

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child to survive and rescue them as quickly as possible.

#### **III. LITERATURE REVIEW**

## II. GEOGRAPHICAL RESEARCH

In 90% of cases borewell has diameter of 6 inches usually tends for agriculture purpose and large apartments whereas diameter of 4.5 inches is used for domestic purpose. They lay down pipe casing for smooth flow of water or particles. Some borewell extend the pipeline till they reach ground water in some other cases they adapt 20 feet pipeline not be extended completely to certain level. The diameter of the borewell is 6 inches and the pipe thickness is 1-1.5 inches. Hence the rescue system should be 2.5-3 inches. The rescue operation system should lift the child using shoulder and not by head, preferable we should lift the baby from bottom. The main cause of children to fall in borewell is in rural cases where they close the borewell with mud due to seasonal change or because of rain or other natural circumstances this mud tends to loosen up and become soft which leads to children and animal to be a victim to the borewell under this case.

If any child or animal collapses or fall into uncovered borewell, if the pipe casing is extended till the end they tend to reach the bottom of the uncovered borewell because of the smoothness of pipe casing or else they get stuck in mid-way.The temperature under there is very hot almost double the ground temperature.



Figure 1: Image of Efforts Made By Govt. to Rescue Child in Haryana.

In the new advancement, the government is trying to carve a step or provide a ladder from top to down and increase the borewelldiameter. This advancement has not been inculcated in most of the places. Hence increase in diameter will increase the cost of pipe casing and installing the ladder and also increase chances of children or others being trap of this. The proposed system can be used for borewell with the help of advancement in technology. The length of the borewell depends on the availability of the water at provided place. As deeper the borewell is dug out the oxygen level will also decrease with depth of the borewell. The proposed work main aim is to provide a sufficient oxygen as robot arm goes inside the borewell Simi Simon et al. [1] published a paper on borewell rescue robot work presented in this paper describes the Robot used to rescue the children from unused borewells. This system monitors the trapped child through Infra-red water proof cameras and high-resolution TV monitor. This system uses Ultrasonic Sensors and temperature sensor. APR module is attached to Robot which is used to communicate with the child. This system lacks with gas sensor to monitor harmful gas and provide oxygen.

Kavianand et al. [2] published a paper on smart child rescue system which uses a PIR sensor to detect the motion of the child trapped in a borewell. The sensor is placed at the top of the borewell pipeline and the signals detected are sent to the raspberry pi controller. An alert message is sent to the nearby fire station and also the contractor in charge using the interfaced GSM module. This system lacks in measuring the distance of victim from borewell and temperature inside and does not use robot arm for immediate rescue of child.

Manish Raj et al. [3] published a paper in which where it used mechanical system and two arms and camera to rescue the child.this system lacked with sensors such as temperature sensor, gas sensor, PIR sensor.

Palwinderkaur et al. [4] proposed a system which is designed to rescue children trapped inside non operative borewells within short time. This system works based on wireless communication concept and the commands are given by the user. This system has power supply, gear motors, camera and microcontroller as the components. Gear motors are connected to Robot which uses three wheels with Rubber grip which fit exactly to the walls of the hole so that the Robot moves down easily without sliding and the arm of Robot is used to Pick the child from the borewell. This system does not provide oxygen supply and does not use temperature sensor.

Bharathi et al. [5] describes about robotic system which can be controlled by a PC using ZigBee technology .The audio and video of the victim is displayed using a wireless camera. A high power LED is attached to the robot as a light source.The proposed system doesnot include UDM sensor, gas sensor,oxygen supply pipe and PIR sensor which has been incorporated in our work.

Nish MohithKurukuti et al. [6] proposed a design to enlarge or adjusted as per the diameter of Borewell. Ultrasonic Sensor used to measure the distance from Robot wheel to borewell Wall and Logitech C270 camera is used to provide visual information to operator. Servo motor is used to control Robot Arms and DC motors to actuate the wheels of the motor. The Robotic system would adjust to the borewell size with help of Rack and Pinion mechanism to grab and hold the child. This system lacks with gas sensor and oxygen supply.

Gopinath et al. [7] proposed a system for rescuing children from borewell. The system uses a camera with LED for visualizing the victim. Temperature sensor, pressure sensor, gas sensors are used and are interfaced with ARM8 processor. The presented work does not include UDM sensor which has been incorporated in our work and thermistors are replaced by LM35 temperature sensors which gives better accuracy.

Arthika et al. [8] presented a paper which mainly aims to rescue children from Borewell and designed to have adjustable diameter robot and continuously monitoring of child by having Camera. The system measures the distance of child by infrared transmitter and receiver and temperature by temperaturesensor. The presented work does not include gas sensor to detect toxic gases present inside the borewell so that corrective actions can be undertaken on time to save the child.

There were many approaches made to rescue child from borewell but none of the paper have all the positive approach. In the proposed system, various gas sensors are used to detect harmful gases and action will be taken to remove it. This system also provides oxygen pipe to supply the oxygen for the victim to breathe easily in borewell. In addition to this, PIR sensor is incorporated to monitor the moment of child.

### **IV. PROPOSED WORK**

The proposed system consists of a two DC motors, in which one is used to control the pulley system and the other is used to control the robot armwhich is automatic and computerized by motor driver. A camera is mounted on the robot arm to give the internal view of the borewell and position of the child. The Arduino Uno communicates with PC with the help of wireless communication ZigBee. The moment of pulley to and fro is controlled by giving comments from PC. The robot arm is also opening and holding is also controlled with help of PC. As we go down the borewell it gets darker, so LED is added to system to provide proper lightening.

The temperature sensor is used to measure the temperature inside the borewell as it may vary as we go down. Gas sensor is used to check if any harmful gases are inside the borewell and actions been taken to remove them and supply with oxygen. The oxygen is supplied inside the borewell with the help of oxygen pipe automatically when distance is of robot arm is less than 3cm from child, which is mounted on the robot arm. UDM sensor is used to calculate the distance between the victim and the robot arm, which helps to find out how much the pulley should go down to reach the victim and release the robot arm. We are also making use of PIR sensor which is used to monitor the movement of the child inside the borewellifchild is alive or dead. Flow and all the components are showed in figure 3. which consist of receiver and transmitter part.



Figure 2: Block Diagram of the proposed system (a) Receiver Part (b) Transmitter Part

The hardware components and required software used in robo child rescue system and their specifications are discussed below.

**LM35 Temperature Sensor:** It is a precision IC temperature sensor whose output is directly proportional to the temperature. With LM35, the temperature can be measured accurately than with a thermistor or RTD. It also possesses low self-heating and does not cause more than 0.1C temperature rise in still air. It has a wide temperature range from -50C to +150C.

**UDM Sensor:**Ultrasonic sensor HC-SR04 is used here to measure distance in range of 2cm-400cm with accuracy of 3mm. The sensor module consists of ultrasonic transmitter, receiver and the control circuit. It offers excellent detection with high accuracy and stable readings. Operating voltage required is 5V and working current is 15mA.

**PIR Sensor:** A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. The term passive is used to denote that the PIR sensor does not radiate energy for the purpose of detection but rather work based on the Infrared radiation emitted by or reflected from objects. The PIR sensor range is up to 10 meters.

**Gas Sensor:**Gas leakages at homes and in industries can be detected by the MQ2 gas sensor module. H2, LPG, CH4, CO, Alcohol, Smoke or Propane is the different types of gases which can detect using MQ2 sensor module. Measurement can be taken as soon as possible, due to its high sensitivity and fast response time. Potentiometer is used to adjust the sensitivity of the sensor. When the concentration of gases increases, the output voltage increases .Operating voltage of the sensor is +5V can be used as a digital or analog sensor.

**ZigBeeModule:**Itis a wireless technology which operates on the IEEE 802.15.4 physical radio specification. This technology is of low-cost and low-power consumption and due to its excellent characteristics makes this communication best suited for several embedded applications. ZigBee's WPANs operates at 868 MHz, 902-928MHz and 2.4 GHz frequencies. The date rate of 250 kbps is best suited for periodic as well as intermediate two way transmission of data between sensors and controllers. It covers 10-100 meters within the range.

**Motor Driver:**It is a circuit used to run the dc motor and this can be easily interfaced with the motor. Motor drivers are basically current amplifiers. They act as an intermediate to the controller and the motor. The input which is given to the motor driver is a low current signal and therefore the motor driver is used to convert this low current signal to high current signal. Then this signal is given to the motor. The motor drivers provide high functionality, high current drive and provide protection of motors.

ArduinoUNO: The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller. Arduino Uno consists of USB interface, 14 digital I/O pins, 6 analog pins. It also supports serial communication using TX and RX pins. This controller has 2KB of SRAM, 32KB of flash memory, and 1KB of EEPROM. A 16 MHz frequency crystal oscillator is also equipped on the board.

Arduino integrated development environment (IDE) is a cross platform application which is used for writing, compiling and uploading programs to Arduino IDE compatible boards such as Arduino Uno. The code is written in different programming languages such as C,  $C^{++}$  and java using special rules of code structuring.

#### V. WORKING OF ROBOTIC MODULE

An algorithm is developed to read the output of the receiver part. The algorithm is implemented on Atmega328P microcontroller by writing suitable code using Arduino Integrated Development Environment (IDE).Figure4.shows the flow of process in the system.



First the entire system is passed down the borewell. The UDM sensor attached to the robot arm sense the distance of the victim from the opening of the borewell. This data is send with the help of ZigBee to PC the operator with the help of this data starts to move the pulley downwards. Continuous monitoring of temperature, distance, gases and position is done by four sensors which are temperature, UDM, gas and PIR sensor. With the help of this data we can decide when to supply the oxygen inside the borewell.

The data from ZigBee is read if the reading is 'F' then the pulley continues to move forward to reach the victim. If the reading is 'B' the pulley moves backward. When the pulley reaches the victim to hold the child we give command 'H' this will help to hold the child from shoulder. To release we give command 'H'. The child should be always held from shoulder as it is safe and pressure can be applied than any other part of child. And finally command 'D' is used to display the data of sensors.

Continuous checking of distance is done for moving the pulley forward or upwards. If the distance is greater than 3 cm the pulley continue to move forward if it's less than 3 cm child is detected and the pulley stops and oxygen supply automatically turns on and provide oxygen to child. The moment is continuously monitored with the help of camera.

#### VI. RESULTS AND DISCUSSION

The prototype of robo child rescue system from borewell is illustrated in figure 5. The pulley moves downward receiving the commands from PC. The camera will give inside view of borewell. Two dc motors are used one to control the pulley i.e. cable rope and the other one is robot arm. The DC motor is controlled by motor driver. The UDM sensor was placed in front of different obstacles. The distance is calculated and sends a feedback to PCwhich shows output in cm. With the help of which we can then move robot arm forward and backward. The temperature sensor LM35 was also put under test at different temperature as the borewell temperature under borewell is double. The sensor was precisely detecting the temperature. PIR sensor is used to sense the moment of the child in borewell and with the help of this data we can decide how to hold the child without hurting it.

Lastly we made use of gas sensor to detect any poisonous gas inside the borewell if found preventive actions are taken. So we passed different gases to test the system. As we increased the concentration of gas, the voltage increased. This helped to decide whether to let the oxygen supply to help child breath freely inside borewell and oxygen supply is provided automatically when the robot arm distance is less than 3cm from the child.

Figure 3: Working steps of the proposed system.



Figure 4: Illustration of Robo Child Rescue System.

This gave aid in easy recovery of child from borewell. As time taken by conventional method is very long which lead to death of child, this system will help to quickly recover child in short span of time without any delay. This system is very easy to use and handle. As we have incorporated four sensors which will make sure of the child condition and also provided with oxygen supply so that it can breathe easily so that it does not lose its life during taking out the child from borewell

### VII. CONCLUSION

As we see large of amount of lives are lost because of children or animal falling intoborewell. We have designed a system which can safely remove the child from borewell as quickly as possible. Continuous monitoring of system will help to provide a clear view of the borewell with the help of wireless camera. And with the help of temperature, UDM, PIR and gas sensor we can maintain safe environment. The system can be further be used to recover the victims from many industries, sewage, pipeline. This helps to provide immediate help during tragedy and help to save numerous amount of life.

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