# Design and Fabrication of Borewell Child Rescue Robot

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**Abstract –** The latest incidents where children have accidentally fallen into uncovered bore wells have become an area of grave concern regarding their safety, which often leads to mortal tragedy because of the rescue operations. Many such cases have happened recently in India. Forty-five deaths of children have been reported in India since September 2009, from which we have nineteen cases with evidence from a newspaper. The conventional rescue methods, such as digging parallel pits are time-consuming and intensive resource and demands a significant danger to both the victim and rescue personnel. This work consists of design and fabrication provides a faster, safer, and cost-effective alternative for rescue operations. The robot developed is controlled wirelessly through a user-friendly android application using Bluetooth communication, minimizing human involvement in hazardous conditions. In addition, an Iot module integrated with temperature, humidity, and gas sensors continuously monitors environmental conditions inside the bore well and transmits data to a cloud platform for real-time assessment. The compact design, low cost, and ease of operation make the system suitable for rapid deployment during emergencies.

## 1. INTRODUCTION

The major issues faced by human society in the modern era are water shortages, which resulted in the construction of numerous bore wells. Those water-bearing waterbores that are now depleted are left without any cover. A strong enough cover with bright colors to cover the mouth of the waterbores will prevent such mishaps. The above-mentioned waterbores have also resulted in the demise of numerous innocent lives. To assist in such rescue operations, equipment is vitally important. The development of a remote-controlled robot will dive into the waterbores and accomplish this task. The objective of the work is to construct and design a bore-well rescue robot with the help of electronic devices. The existing technique involves digging the parallel hole to rescue the child next to the bore-well in which the child is trapped. Moreover, it involves a lot of energy and expensive resources, which are not easily available everywhere. The conventional process always needs big space around the trapped bore that we can dig a parallel bore-well. Such ad hoc measures are very prone to risks such as bodily injuries of the subject during the rescue operation. Moreover, it may get further trapped in the debris, and thus the situation may become more disastrous, resulting in death. Mostly, in such circumstances, there are some ad hoc arrangements made. In such techniques, some hooks are used to grasp the clothes and body of the suffering ones. It can create lesions on the body of the subject, too. Manual work involves the successive technique. Not only is the process time-consuming, but it also requires so many risks.

The coming of new high-speed technology, advancement of electronics, and availability of user-friendly operating systems brought. It was the growing computer capacity that provided a realistic opportunity for the development of new robot controls. After reviewing all such cases, an attempt has been made to develop a robotic machine, which can go through a trapped bore-well without support. The present work consists of IoT parts where two sensors attached are dht11 and smoke/ gas sensor from which we get data of the bore-well like temperature, humidity, and air quality.

## 2. OBJECTIVES AND PROBLEM STATEMENT

### 2.1 OBJECTIVES

The main purpose of the bore well rescue machine is to maximize safety during rescue activities by taking safety as the foremost design variable. The design takes into account ease of use by rescuers in order to be operated by rescuers with less training, thereby facilitating quick rescue activities during emergencies. Since direct human involvement in the rescue activities is minimized by the machine, it reduces human effort and risk during the rescue activity. The machine offers real-time visual observations of the trapped child using an integrated camera system, thereby facilitating precise and safe rescue activities by rescuers. Also, environmental observations within the bore wells, like temperature, humidity, and toxic gases, using IoT-based sensors, take place by the machine to offer a rescue environment that is free from danger. The rescue system offers a compact and light rescue mechanism that can be used in narrow bore wells and offers smooth vertical motion with an efficient motor and rope system

### 2.2. PROBLEM STATEMENT

In some regions, the hazard of open or inadequately secured bore wells is significant, and this has caused numerous deaths of children who fall unintentionally into deep bore wells. The rescue actions that are currently available involve digging a parallel pit, and this is unsafe and time-consuming and often unsuccessful within the survival time of a victim of a bore well accident.

Thus, there arises an urgent need to develop an efficient, compact, remote-controlled bore well child rescue robot that can easily travel inside a bore well, track in real-time the health status of the child, provide sufficient oxygen, and then rescue the child from that bore well without causing injury to the child. The need is to devise and manufacture such a robot that can easily function in bore wells with varying diameters, offer real-time audio-visual information, stabilize the injured child, and then effect quicker rescues.

## 3. PROPOSED CONCEPTUAL DESIGN

The conceptual design of the bore well child rescue robot will comprise a compact vertically positioned robotics system that is also designed to be capable of functioning within the tight and deep bore wells. The system is designed and constructed using a light yet robust cylinder body that can be easily moved to engage within bore wells of all diameters. The system utilizes stabilizing arms that can be adjusted to expand on the bore well walls to prevent any rotations during functioning. Additionally, a high-resolution camera system paired with bright LED lights is positioned at the bottom part of the system to ensure effective real-time feedback within the darkness of the bore well. Furthermore, the system incorporates a two-way audio communication system for the purpose of consoling and communicating with the trapped child. In consideration for the survival of the trapped children during the rescue, an oxygen supply line and environmental sensors will be included to check the level of availability of oxygen, temperature, and other dangerous gases within the trapped environment. The rescue system is made up of soft gripping arms or a harness system intended to hold the children firmly without any possible injuries. All the robotic functions of the system will be controlled and performed using a microcontroller system operated from the surface. The overall system will be dependent on a trusty power source that is also safeguarded for emergency conditions. The conceptual design for this bore well child rescue robot system is intended to be significantly more successful within short rescue times and higher success ratios compared to contemporary rescue processes conducted manually.

## 4. COMPONENTS USED & SPECIFICATION

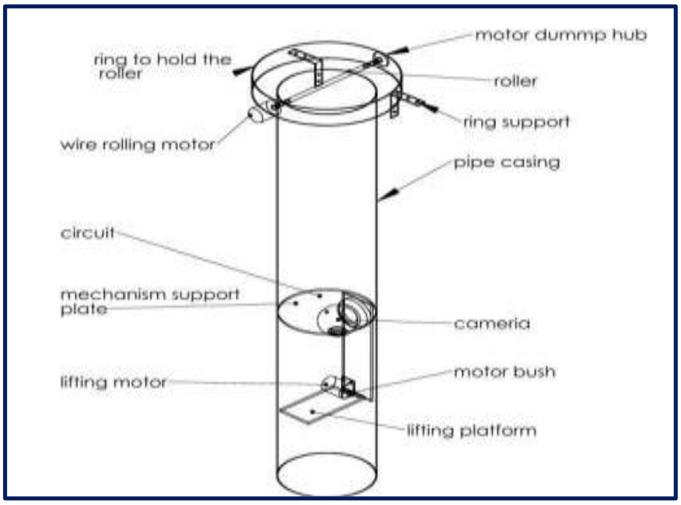


**Fig-1 Design of the Project**

**High-Speed and Accurate Operation**

The rescue system necessitates high-speed motors and precise controls to ensure that the robot can operate in real- time and carry out rescue missions effectively and without delay. Wireless operation is achieved by using Bluetooth communication between the Android app and the robot, which ensures smooth interaction and no lag in control.

**Modular Design**:
The system is built using modular components, which allows for easy upgrades and repairs in the future. If necessary, the core design can be modified to include additional functionalities, such as better cameras, more powerful motors, or additional sensors as shown in Fig-1.

**Intuitive Software Interface**:
The Android app provides a user-friendly interface to remotely control the robot, including options to move it forward, backward, rotate, and control the servo motor. Even without technical knowledge, the app's clearly labeled buttons make it easy to operate.

**Easy Operation**:
The system's design ensures that it can be operated by someone with minimal knowledge. The app interface is accessible to all users, regardless of whether the operator is trained or not. The app will also have built-in error detection to ensure smooth operation and provide feedback on any malfunction or failure, guiding users on how to proceed.

**Arduino Microcontroller**: Serves as the primary control, processing commands from the Bluetooth module and overseeing the actions of the DC motor, servo motor, and camera. As Fig 2: Arduino Uno Board Arduino Uno is an Arduino microcontroller that uses ATmega328P, as depicted in fig 2 above. It has 14 digital input/output pins where 6 can provide Pulse Width Modulation, 6 analog inputs, 1 16 MHz quartz crystal oscillator, 1 USB interface, 1 power jack, 1 ICSP header, and 1 reset button. It provides every component that can help it support its microcontroller, with nothing else to do but connect it to a PC using a USB cable or an AC to DC adapter/battery to start programming for it to act.. One of its most significant benefits is that users of the UNO do not have to be afraid to start experimenting to see if they end up doing something wrong. “Uno,” in fact, is “one,” and Arduino Uno version 1.0. Arduino Uno and Arduino Software (IDE) version 1.0 were considered to be the leading versions of Arduino, though they have already developed into new and upgraded versions. Arduino Uno is considered to be the first Arduino in a series of USB Arduino boards and is considered to be the reference board for Arduino circuits, for a full and detailed and up to date listings of all Arduino boards, see Arduino Index of Boards.

**Figure-2, Ardiuno Controller ATmega328P**

**DC Motor and L298N Motor Driver**: It was responsible for the movement of the robot. The DC motor is used in the vertical up-and-down movement of the robot, while the L298N motor driver gives the power control required for the motor.

**Servo Motor**: Used to lift the child from the base of the bore.well with precision, using a gentle mechanism to avoid any harm.

**Wireless Camera**: A live video feed is provided to the operator, allowing them to guide the robot and evaluate the condition of the trapped individual.

**Bluetooth Control (HC-05)**: The robot is controlled by the operator wirelessly through an Android app. The robot's Bluetooth module receives signals from the app and transmits them to the Arduino to carry out actions.

**Rope and Roller Mechanism**: The rope is utilized to lower the robot into the bore well and lift it up again. The roller mechanism functions by being powered by the DC motor and managing the winding and unwinding of the rope.

**Material Compatibility**

The robot was constructed with conventional and widely available materials that are suitable for use in an outdoor and harsh environment, such as a bore well. Arduino, motors, Bluetooth module (HC-05), camera, and servo motors are common, well-tested components that ensure durability and ease of replacement or repair. All the components used, including wires, motors, modules, cameras, and structural materials (e.g., plastic casings and shafts), are readily available in the market, making the system cost-effective and easily scalable for future applications.

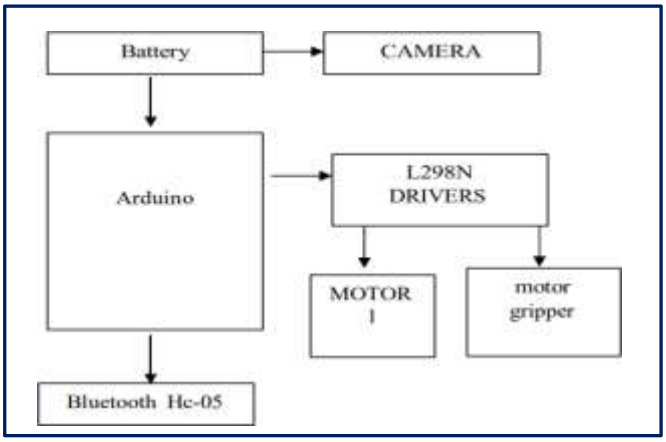


**Fig- 3 Block Diagram of system components**

**Microcontroller**: Arduino's versatility, programming ease, and compatibility with various components make it the preferred controller.

**Motors**: A DC motor (for movement) and a servo motor (for lifting) are selected for their reliability and precision.

**Camera**: A wireless camera is employed to provide real-time feedback to the operator, aiding them in monitoring the rescue process its shown in Fig-3 Block Diagram.

**Communication**: The HC-05 Bluetooth module makes wireless control possible through an Android app.

**Power Supply**: A rechargeable battery ensures portable power for the system, making it self-sufficient during the rescue.

**Mechanics**: A roller and rope system is used to control the ascent and descent of the robot, ensuring safe movement within the narrow confines of the bore well.

**4.1 COMPONENTS**

1. Casing Plastic
2. Shaft Roller
3. Dc Motor
4. Wire
5. Motor
6. Camera
7. Arduino Uno
8. Fasteners
9. HC -05
10. Roller
11. Rope
12. L298n Drivers
13. Jumper Wire
14. Bug Convertor
15. Form Sheet
16. Battery
17. Esp 32 Board
18. Esp32 Expansion Board
19. Dht11 Sensor
20. Smoke And Gas Sensor
21. LCD With I2c Module
22. Battery
23. Battery Holder.

**4.2 TECHNICAL SPECIFICATIONS:**

The technical specifications of components are listed below

| | |
|---|---|
| Microcontroller | ATmega328P |
| Operating Voltage | 5V |
| Input Voltage | 7-12V |
| Input Voltage (limit) | 6-20V |
| Digital I/O Pins | 14 (6) PWM output) |
| PWM Digital I/O Pins | 6 |
| Analog Input Pins | 6 |
| DC Current per I/O Pin | 20 mA |
| DC Current for 3.3V Pin | 50 Ma |
| Flash Memory | 32 KB (ATmega328P) |
| Boot loader | 0.5 KB |
| SRAM | 2 KB (ATmega328P) |
| EEPROM | 1 KB (ATmega328P) |
| Clock Speed | 16 MHz |
| Length | 68.6 mm |
| Width | 53.4 mm |
| Weight | 25 g |

**Table -1**

**4.3 FABRICATION**

The fabrication of the Arduino-Based Child Rescue System involves a series of well-planned steps to build and assemble the components into a fully functional & Its Technical specifications as shown in Table 1.

**Component used.**

Based on the design requirements, The Key components include DC Motor for movement -Servo Motor for lifting the child, Arduino Microcontroller for control, Wireless Camera for live feed, L298N Motor Driver for motor control, Bluetooth Module (HC-05) for wireless communication,

Rope and Roller for lifting and lowering, Battery (preferably rechargeable), Frame Material (plastic casing, metal parts), Fasteners (screws, nuts), Jumper Wires, Connectors, etc. The frame material should be lightweight, durable, and resistant to corrosion. For this, plastic casing or aluminum can be used

**Mounting the Motors**

The DC motor mounted to the frame for facilitate vertical movement. The motor should be connected to a roller mechanism that can wind/unwind the rope to lower or lift the robot. It can manipulate the lifting mechanism (which will be used to lift the child from the bore well). Ensure the motors are aligned properly to avoid mechanical failures and ensure smooth operation. After mounting, connect the motors to the L298N motor driver to ensure that both forward and backward motions are controlled correctly.

**Integration of Rope and Roller Mechanism**: Attach one end of the rope to the robot and the other end to the roller connected to the DC motor. The motor will wind or unwind the rope to control the robot's position inside the bore well. Ensure that the rope is long enough to reach the required depth but does not get tangled or caught during operation. The roller should be motorized and able to rotate to wind and unwind the rope as needed. This will control the ascent and descent of the robot. Install the roller securely on the frame, ensuring that it turns smoothly without resistance.

## 5. WORKING

With this arrangement, the presence of a very advanced micro-controller, an accurate mechanism, and a visual feedback mechanism using a high-resolution camera, the project will be a success. This is demonstrated in the next block diagram, in which the main elements of the process can be identified. 2 motor are used dc motor the dc motor is used for the machine to send down in a safer way the motor is attached to the roller so that it will roll the rope on it and lift and lower down the system as the servo is used to lift the child from the base as we have seen in the other equipment grippers are used but the gripper may affect the child hand and proper grip is not possible as this machine consists a simple equipment and which all the devices are easily available in market the control of the equipment is done on app which is controlled from the android app which is wireless operated and battery is provided so in order to make it remote operated the Adriano , l298n driver is used for the dc motor to switch on and off jumpers wires are used for the connection rechargeable battery is used. roller and rope is used to lift and lower the system embedded c program is used for the coding language, wireless camera is used for the visual inside the bore well. The IOT part is included in this project due to which we get the data on cloud and we can get the temperature, humidity and air quality value on LCD.

Instead of having to press a physical button for a reset prior to an upload, an onboard resetting through software packages on a connected computer has been included in Uno's design. Recall that one of the flow control pins on the ATmega8U2/16U2 chip is connected through a 100 Nano farad capacitor to the reset pin on the ATmega328. When this flow control pin is made low (i.e., it goes to zero), a reset pulse occurs that resets the AVR chip. This functionality in the Arduino software (IDE) means that a timeout on the boot loader can be made short enough due to a well-coordinated DTR resetting signal for an upload. As it happens, there is more potential in this layout. When the Uno is linked either to an OS X Mac computer or a Linux computer, it automatically resets with every connection established with it by the software (USB connection). In the next half second, essentially until the Uno has completely booted, the boot loader will be operating on the Uno microcontroller. It was obviously created with an ignore-all-but-new-code mentality but will extract the initial data bits sent to it after the connection has been established. There is a trace on the Uno board that can be cut to disable the auto-reset. The spots side by side from which a connection can be attached to re-enables the jumper. "RESET-END." One can theoretically also disable an auto reset circuit with a 110 ohm resistor between 5V and reset; see also this Stack Overflow thread. As shown in Fig-4 Team Designed and fabricated the final model of Project.

**Fig-4 Model of the Project**

## 6. FUTURE SCOPE OF THE PROJECT

For future purposes, we can implement this project in various tasks by integrating other devices within this project. The design erected will be strong enough to withstand any possible load, although it may also be flexible enough to accommodate a wide range of bore diameter and any variation in the diameter of bore. we may deploy such robots in danger zones, as we have integrated the iot component within our project. The best part of this project will be additional. Thus, we may implement automation and link our camera with the ai tool such that automation can be induced.

## 7. RESULTS AND DISCUSSION

The test carried out on the device was to see if it was able to grasp and then lift the dummy of the child. The device functioned well. The geared motor was very useful in the function of the lifting arms as well as grippers. The curved surface of grippers tended to provide more area to grasp the dummy and also helped in applying the pressure evenly in the dummy body, as opposed to applying pressure on one part of the body.

## 8. CONCLUSIONS

We have embarked on this project as real-world challenges in the field. There were very few obstacles faced by the project at the start and after the completion of the project work. With the facility created by our project, the device is tested. The device has quite good man severability, and the operations are quite simple. For the device to be utilized commercially, the efficiency can be increased by increasing the size of the device. IoT components can also be utilized for further improvement. The device was also tested for the function of gripping and lifting the dummy of the child (doll). The device worked very smoothly and with accurate control. The geared motor was ideal for use in lifting the arms, and also for gripper arms. The curved surfaces on the grippers enabled more area for gripping the dummy doll.

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