

IOT Based Child Rescue System from Borewell

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Abstract—Borewell accidents, particularly involving children falling into uncovered or abandoned narrow shafts, have emerged as a pressing concern in rural areas of many developing countries. These incidents often result in fatalities due to the lack of oxygen, limited space, darkness, and the difficulty of accessing the trapped victim. Traditional rescue efforts are time-consuming and frequently constrained by technical and logistical challenges. To address this critical issue, we present an IoT-based Child Rescue System from Borewell, a smart, real-time solution leveraging embedded systems, sensors, robotics, and cloud-based applications to assist in rapid and safe rescue operations. The proposed system integrates a robotic unit equipped with a grappling mechanism for securely lifting the child, ESP32 microcontroller for processing and communication, ESP32-CAM for live video streaming, and BMP180 sensor to continuously monitor environmental parameters such as temperature, pressure, and altitude inside the borewell. Real-time data including live video and environmental metrics are transmitted to rescuers via the Blynk IoT mobile application, enabling remote monitoring and control of all operations.

Index Terms—Child rescue, Borewell accident, IoT, ESP32, ESP32-CAM, BMP180 sensor, Robotic grapppler, Blynk app, Real-time monitoring, Oxygen supply, Live video streaming, Smart rescue system, Remote control.

I. INTRODUCTION

In many rural regions, especially in developing countries, open or abandoned borewells pose a serious safety hazard, particularly to children. Over the years, there have been numerous incidents where children have accidentally fallen into these narrow, deep shafts. Due to the limited diameter, low light, lack of oxygen, and confined space, traditional rescue methods are not only time-consuming but also extremely risky and often result in tragic outcomes. The absence of immediate and effective rescue mechanisms highlights a crucial need for technological intervention in such emergencies.

Advancements in Internet of Things (IoT), robotics, and embedded systems have opened up new avenues for designing smart rescue systems. By integrating sensors, cameras, actuators, and wireless communication, it is now possible to monitor critical situations in real-time and remotely control life-saving equipment. The proposed system utilizes an ESP32 microcontroller along with an ESP32-CAM for live video streaming, a BMP180 sensor for monitoring temperature, pressure, and altitude, and a robotic grapppler mechanism for retrieving the trapped child. Additionally, an oxygen pump ensures that breathable air is continuously supplied within the borewell during the rescue operation.



Fig:Child rescue method using technology

II. LITERATURE SURVEY

For finalizing objective of our project work we have reviewed following research papers majorly being related with the technology which we have used in our project work “Child Rescue System from Open Borewells”, apart from books and websites.

1. Sumit Pandey. Is explained is based on rescuing infants who have fallen into the borewell. An abundance child death reports have been reported so far. Due to scantiness of water level, bore well are dig to more depth. The basis of this project is to rescue the infant. The rescue is done by digging a parallel pit, which takes more than a day and even have not found

a genuine result. The high point of this project is that the child will be rescued before it reaches high depth, which is based on communications using Infra-Red Signals. When the IR signal, placed two inches diametrically under the ground surface of bore-well, breaks due to any obstructing object, a buzzer starts sounding as an alert in mobile phone. After a stake that is kept a few feet lower in the bore-well, closes the bore in order to prevent the infants falling deeper into the well. These accidents are substantially found in agricultural borewell.

2. Prof. Chandra Kumar H S, explain several accidents of children falling into an abandoned bore-well which is left uncovered and get trapped. Abandoned bore wells seems to be death pits for children. These bore-wells in turn have started to take many innocent lives. In such cases normal operations of child rescue from bore-wells is very complicated process with big machines and large man power. The aim of this paper is to rescue children falling in to bore-wells, this implies a new design which has a sensor kept at top of borewell hole which helps to sense the child if he falls inside. If the system senses the child the automatic horizontal closure kept at around 3ft dept closes and prevents the children from falling beneath. It has the facility to monitor the trapped child, and provide a supporting platform to lift up the child driven by motors. The motor placed at the top turns a gear mechanism which, in turn, pushes 3 blocks arranged at 120 degrees from each other towards the side of the bore well. The whole system is firmly to the bore-well wall.

3. M R Chaitra explain generally based on the child rescue in the bore well. Nowadays child falls into an abandoned bore well, which is left uncovered and get trapped. Normal operation to rescue the child is to pit a dig nearer to the bore well. That logic is difficult and also risky to rescue the trapped child. It takes extra time to recover the child from the bore well. Here we are proposing a robotic system which will attach a harness to the child using pneumatic arms for picking up. A teleconferencing system will also be attached to the robot for communicating with the child. The mechanical system moves inside the uncontrolled bore well. Accordance with the user command given to the Arduino, the mechanical setup is controlled. The hardware is attached to the PC, to stimulate the DC motor. This kind of system can release trapped baby from the bore well securely within lesser time. In order

to implement this, we are using IP camera, Bluetooth, Microcontroller 8051(newton).

III. METHODOLOGY

The proposed IoT-based child rescue system from borewell is designed to address the increasing number of accidents involving children falling into open borewells. The system combines mechanical, electronic, and IoT components to perform real-time monitoring and aid in the safe rescue of a trapped child. The methodology involves deploying a compact, sensor-integrated robotic system into the borewell, which can be remotely monitored and controlled through a mobile application.

The entire setup is mounted on a supporting frame and lowered into the borewell using a pulley or cable system. Once deployed, the ESP32-CAM module provides a live video feed from inside the borewell, which helps the rescue operator locate the child and assess their condition. Simultaneously, the system uses a BMP180 sensor to continuously measure the temperature, pressure, and altitude within the borewell. These readings are important for evaluating the environment the child is in and are displayed in real-time on the Blynk IoT application.

To improve visibility in the otherwise dark borewell, a high-intensity LED is turned on to illuminate the surroundings. This not only aids the camera in capturing clear footage but also helps the operator accurately control the grappler mechanism. The grappler, which is attached to the system, can be maneuvered to securely grip the child. Once the child is held safely, the system is carefully lifted to bring the child out of the borewell.

An oxygen pump is included in the system to ensure that the child receives a continuous supply of fresh air while the rescue operation is underway. This is crucial because the air in narrow borewells is often limited and can become a serious health hazard. The pump can be activated manually through the Blynk app or set to operate automatically based on pressure or oxygen level indicators.

All components of the system are connected to the ESP32 microcontroller, which acts as the central control unit. It manages sensor inputs, camera data, actuator control, and communication with the Blynk IoT platform. The Blynk application serves as the user interface, allowing remote access to the camera feed,

sensor data, and control options for the LED, oxygen pump, and grapppler.

This methodology ensures that the entire rescue operation can be performed with minimal delay, precise control, and constant monitoring. The combination of real-time data, video surveillance, and controlled rescue mechanisms provides a safer, faster, and more efficient solution to rescue children from borewells.

SYSTEM DESIGN AND COMPONENTS

The child rescue system from borewell is a multidisciplinary project that integrates IoT (Internet of Things), embedded systems, mechanical control, and real-time monitoring. Each technology plays a critical role in ensuring the safe, efficient, and timely rescue of a child trapped in a borewell.

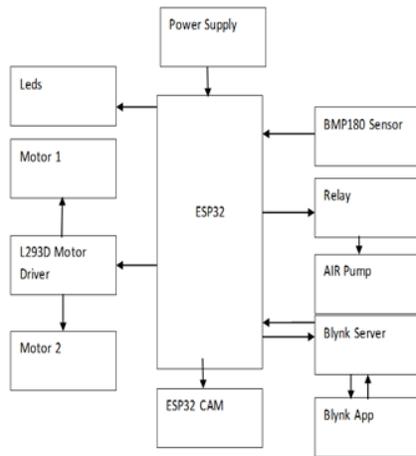


Fig:Block Diagram

ESP32 MICROCONTROLLER:

The ESP32 is a powerful, low-cost, and highly versatile microcontroller developed by Espressif Systems. It is widely used in IoT applications due to its built-in Wi-Fi and Bluetooth connectivity, making it ideal for wireless communication, remote monitoring, and automation tasks. In the context of the Child Rescue System from Borewell, the ESP32 plays a central role as the brain of the entire system, managing sensor inputs, controlling actuators, and enabling real-time data transmission to the cloud through the Blynk IoT platform.

- Dual-core Tensilica LX6 processor (up to 240 MHz)
- Built-in Wi-Fi and Bluetooth (BLE)

- Support for SPI, I2C, UART, PWM, ADC, and DAC
- Low power consumption, ideal for portable and battery-powered devices
- Compact size and low cost

ESP32 CAMERA MODULE:

The ESP32-CAM is a low-cost development board that combines the powerful ESP32 microcontroller with an integrated OV2640 camera module, enabling real-time image and video capture. It supports both Wi-Fi and Bluetooth communication, making it ideal for wireless surveillance applications. In this project, the ESP32-CAM plays a crucial role by providing live video streaming from inside the borewell, which is transmitted to a smartphone through the Blynk IoT app. This video feed helps the rescue team visually locate the child and accurately control the grapppler mechanism. The module's compact size allows it to fit easily into the borewell system, while its onboard processing power handles camera operations and data transmission efficiently. Paired with an external LED for better visibility, the ESP32-CAM significantly improves the effectiveness and safety of the rescue operation, allowing for remote, real-time monitoring in environments where traditional visibility tools fall short.



Fig: Esp32 Cam

BMP180 SENSOR:

The BMP180 is a digital barometric pressure sensor developed by Bosch, capable of measuring atmospheric pressure, temperature, and indirectly altitude. It is widely used in environmental monitoring and embedded systems due to its small size, low power consumption, and accurate output. By providing real-time readings of temperature and pressure, the sensor enables the system to estimate the altitude (depth) at which the child is located and detect any critical changes in air quality or pressure. These readings are

sent to the ESP32 microcontroller and displayed on the Blynk IoT app, allowing the rescue team to make informed decisions quickly. Its inclusion adds a layer of environmental awareness, improving both the precision and safety of the rescue operation.



Fig:BMP180 Sensor

GRAPPLER:

The grappler or robotic arm is a mechanically controlled device used to safely grab and lift the child. It is operated manually with precision using live video feedback from the ESP32-CAM. The grappler is designed with soft grip material or padding to ensure that it does not harm the child during the rescue.

LED LIGHTING:

The LED in the child rescue system serves as a critical lighting source within the dark, confined environment of the borewell. Since visibility inside a borewell is limited, especially at deeper depths, the LED helps illuminate the area around the trapped child, ensuring clearer video footage from the ESP32-CAM and providing the rescue team with better guidance during the operation. Controlled by the ESP32 microcontroller, the LED can be turned on or off remotely via the Blynk IoT app, allowing the rescue team to conserve energy while ensuring optimal visibility when needed. This lighting system significantly enhances the precision and safety of the grappler mechanism, ensuring that the child can be safely located and retrieved without additional risk.

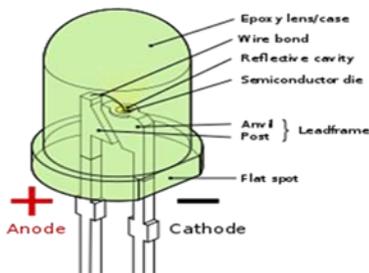


Fig:Led

OXYGEN PUMP:

To ensure the child does not suffer from oxygen deficiency, an oxygen pump is included to supply breathable air directly into the borewell. It can be activated through the Blynk app or automated based on sensor readings. This feature adds a significant safety layer to the system.

BLYNK IoT PLATFORM:

Blynk is an IoT application that allows remote monitoring and control of devices through a smartphone. In this project, it is used to:

- Display live video from the ESP32-CAM
- Show real-time sensor data (temperature, pressure, altitude)
- Control the oxygen pump, LED light, and grappler
- Send alerts and updates during the rescue process

SOFTWARE INTEGRATION

ARDUINO IDE:

The Arduino Integrated Development Environment (IDE) serves as the primary platform used for programming and uploading code to the ESP32 microcontroller in this project. It is an open-source software environment widely favored for its simplicity, flexibility, and support for a wide range of microcontrollers. The IDE allows users to write code in a simplified version of C/C++, compile it, and upload it directly to the microcontroller via a USB connection. For this IoT-based child rescue system, the Arduino IDE was chosen due to its compatibility with ESP32, ease of integration with various sensors and modules, and its strong community support.

To begin using the ESP32 with the Arduino IDE, additional board definitions must be installed, as ESP32 is not included by default. This involves adding the ESP32 board manager URL to the preferences section in the IDE and installing the board files via the Board Manager. Once installed, the user can select the ESP32 board type and appropriate COM port from the Tools menu, allowing the IDE to recognize and communicate with the hardware. This setup enables seamless uploading of code and serial communication for debugging purposes.

The IDE also features a built-in serial monitor and serial plotter, which were crucial for real-time

debugging and data visualization during development and testing. The serial monitor allowed the developer to verify if the sensor readings were accurate and whether commands from the Blynk app were being received and executed correctly. Any errors, such as sensor initialization failures or Wi-Fi connectivity issues, could be quickly identified and resolved using this tool.

Overall, the Arduino IDE provided a reliable and developer-friendly environment for building, testing, and refining the embedded software used in the child rescue system. Its compatibility with third-party boards, straightforward interface, and support for numerous libraries and examples made it ideal for rapid prototyping and implementation. The use of the Arduino IDE significantly contributed to the successful integration of hardware and software components in this life-saving IoT application.

IV. RESULTS

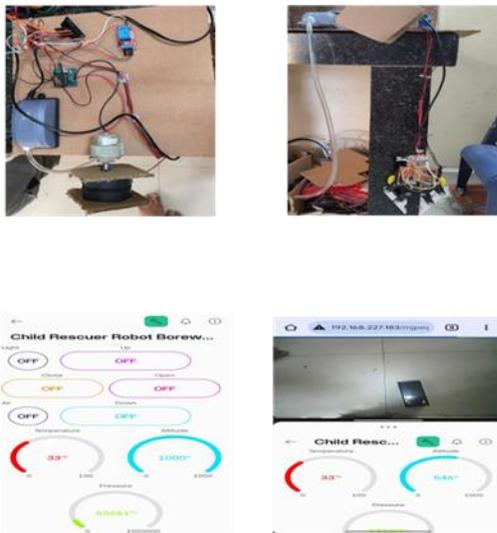


Fig: Result

PROJECT OUTCOMES:

The IoT-Based Child Rescue System from Borewell successfully demonstrates how modern technology can be used to address life-threatening emergencies in a more efficient, safer, and smarter way. The project has met its core objective of designing a remotely operated rescue system capable of locating and retrieving a child trapped in a borewell with real-time monitoring and environmental awareness.

Key outcomes of the project include:

- Successful integration of ESP32-CAM for live video monitoring, providing a clear visual feed from inside the borewell to guide the rescue operation remotely.
- Accurate environmental monitoring using the BMP180 sensor, which measures temperature, pressure, and altitude to help assess the borewell conditions.
- Remote control of essential rescue components like the LED light, oxygen pump, and grapppler through the Blynk IoT platform, enhancing ease of use and operator safety.
- Improved safety and speed of the rescue process, reducing dependency on manual digging and minimizing risks to both the child and the rescue team.
- Cost-effective and compact design, making the system accessible for deployment in rural and under-resourced areas.

ADVANTAGES:

Real-Time Monitoring: Continuous tracking of borewell conditions and child safety.

Early Detection: Sensors detect disturbances, alerting authorities quickly.

Quick Response: Automated alerts reduce response time for rescue teams.

Cost-Efficient: Reduces need for manual monitoring.

Remote Accessibility: Data can be accessed from anywhere.

Improved Accuracy: Precise data helps in accurate decision-making.

Automatic Alerts: Instant alerts for emergencies.

24/7 Monitoring: Continuous surveillance without human supervision.

APPLICATIONS:

Borewell Safety: Monitors borewell conditions to prevent accidents.

Automated Rescue: Sends alerts and activates rescue mechanisms during an emergency.

Smart Covers: IoT-enabled covers to ensure safety and prevent unauthorized access.

Search and Rescue: Provides real-time location data for effective rescue operations.

Public Awareness: Alerts communities about hazardous borewells.

Environmental Monitoring: Tracks conditions around borewells for stability.

Child Tracking: Wearable devices alert if a child approaches a borewell.

Emergency Coordination: Helps coordinate rescue teams and resources.

Post-Rescue Data: Stores data for future analysis and improved rescues.

V. FUTURE SCOPE

In future this project will be used in several applications by adding additional components to this project. 1. This proposed system can send these robots to dangerous zones by connecting smoke sensor to the robot we can get the information related concentration of smoke or gases in respective fields and sensor will detect the poisonous gas and it gives information to the Microcontroller and microcontroller gives the information to the transceiver from that we can get the data on the PC side. 2. The future upgrade of our task is to incorporate Gas sensor which is utilized to check any lethal gas present inside the bore well. Although this, an oxygen test can be associated which is utilized to supply oxygen to the kid. 3.Future versions could implement voice recognition or audio systems to allow two-way communication with the child if conscious, providing comfort and instruction during the rescue. 4. One promising idea for future development is the integration of a vacuum-based extraction mechanism. This system could use a controlled suction technique to gently lift the child without the need for physical gripping, thus reducing the risk of injury during the rescue.

VI. CONCLUSION

In conclusion, the IoT-Based Child Rescue System from Borewell offers an innovative and practical solution to a serious real-world problem that continues to claim innocent lives, especially in rural areas. By integrating modern technologies such as the ESP32 microcontroller, ESP32-CAM for live video streaming, BMP180 sensor for environmental monitoring, an oxygen pump for life support, and the Blynk IoT platform for real-time control and data visualization, the system enables quicker, safer, and more efficient rescue operations compared to traditional manual methods. The ability to monitor the

child's condition, control the rescue mechanism remotely, and supply oxygen during the process greatly increases the chances of survival. This project demonstrates how IoT and embedded systems can be applied to life-saving operations, providing a cost-effective, portable, and intelligent solution. With further improvements and real-world deployment, this system has the potential to revolutionize borewell rescue operations and serve as a vital tool for emergency response teams.

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