OPEN ACCESS

International Journal of Emerging Science and Engineering (IJESE)
ISSN: 2319–6378 (Online), Volume-13 Issue-8, July 2025

Proximity-Based Alarm System for Child Safety Near Open Borewells & Drains

S. Aiswarya, S. Akshayasri, V. M. Srihari, K. Priya Gupta, S. Deviga

***Abstract:** This work focuses on designing a safety mechanism using proximity sensors and alarm systems to prevent children from falling into uncovered bore wells or open drainage pits. For this, the Arduino board, proximity sensor, and ultrasonic sensors are used to monitor the presence of objects near the bore wells. It detects both humans and animals. The ultrasonic sensor detects the distance from the sensor to the object. The proximity sensor detects object movement within a 1– to 10-foot range and triggers an audible alert to prompt timely action. By using sensor-based technology, this solution tackles a serious and recurring safety issue. It supports real-time hazard detection and gives immediate warnings in public spaces. Then, the servo motor automatically closes the borehole with the temporary lid for a specific period. With the help of WiFi, the monitored details are sent as a message to the authorities. The setup is low-cost, easy to use, and suitable for both rural and urban areas. This method plays a crucial role in enhancing safety near open and hazardous zones.*

***Keywords:** Proximity Sensor, Ultrasonic Sensor, Bore Well, Open Drainage Monitoring.*

I. INTRODUCTION

Uncovered bore wells and open drainage pits continue to pose significant safety hazards, particularly in both rural and urban areas, where they are often left unattended. Despite growing public awareness, reports of accidents, particularly involving children, remain alarmingly frequent. These accidents can lead to severe injuries or even fatalities, highlighting the urgent need for more effective safety measures. This study introduces a clever safety mechanism designed to mitigate such risks through the use of proximity sensors. The system detects human movement within a 1– to 10-foot radius of danger zones, such as open boreholes and drainage pits.

Manuscript received on 14 May 2025 | First Revised Manuscript received on 04 June 2025 | Second Revised Manuscript received on 19 June 2025 | Manuscript Accepted on 15 July 2025 | Manuscript published on 30 July 2025.
*Correspondence Author(s)

Dr. S. Aiswarya*, Department of Electronics and Communication Engineering, University College of Engineering, Dindigul (Tamil Nadu), India. Email ID: aiswaryaucedgl@gmail.com, ORCID ID: 0000-0001-9028-7559

S. Akshayasri, Department of Electronics and Communication Engineering, University College of Engineering, Dindigul (Tamil Nadu), India. Email ID: sriharimanohar134@gmail.com

V. M. Srihari, Department of Electronics and Communication Engineering, University College of Engineering, Dindigul (Tamil Nadu), India. Email ID: akshayasris21@gmail.com

K. Priya Gupta, Department of Electronics and Communication Engineering, University College of Engineering, Dindigul (Tamil Nadu), India. Email ID: priyagupta18399@gmail.com

S. Deviga, Department of Electronics and Communication Engineering, University College of Engineering, Dindigul (Tamil Nadu), India. Email ID: sdeviga2004@gmail.com

Upon detecting movement, the system activates an audible alarm to alert nearby individuals. Additionally, a servo motor is deployed to temporarily close the bore well lid, providing immediate physical protection against accidental falls.

Incorporating both GSM and Wi-Fi technologies, the system can send real-time alerts to designated users, such as caretakers, authorities, or residents, ensuring a rapid response even in remote locations. The proposed system is both cost-effective and energy-efficient, making it suitable for installation in public areas with minimal infrastructure requirements.

The design is simple, ensuring easy installation and minimal maintenance. By leveraging the power of proximity sensors, real-time alerts, and automated mechanisms, this solution provides a proactive approach to child safety, addressing the critical issue of open bore wells and drainage pits. Ultimately, it aims to significantly reduce accidents, thereby promoting a safer environment for children and the broader community.

II. LITERATURE SURVEY

Let us now discuss some of the significant contributions in the existing literature that address this domain. Several researchers have explored various approaches to tackle similar challenges, as outlined below.

Nitin Agarwal et al. [1] introduce a system designed to rescue children trapped in open borewells. The authors propose using a robotic arm controlled through wireless communication, paired with a camera for real-time monitoring and a gas sensor to detect harmful gases within the borehole. Additionally, the system integrates lighting and audio communication to facilitate interaction with the victim. However, the challenge lies in accurately controlling the robotic arm within the confined and dark borehole environment, which could potentially limit the system's effectiveness during real-time rescue operations.

U. Penchalaiah et al. [2] describe a mechanical rescue system designed to save children trapped in bore wells. The system features a robotic setup equipped with a harness mechanism, cameras for visual guidance, and safety-monitoring sensors, including gas detectors. Additionally, it features a manually controlled lifting mechanism to facilitate the retrieval of the child. However, relying on manual operation may introduce delays or errors in high-stress rescue situations, which limits its suitability for fully automated rescue operations.

Kuppusamy Udaiyakumar et al. [3] introduce a rescue mechanism that employs a robot equipped with a pneumatic arm. The system integrates cameras for live visual feedback and gas sensors to monitor toxic gases within the borewell. Additionally, a gear mechanism is used to ensure precise control of movement. However, the reliance on pneumatic systems may lead to pressure control issues or require a continuous air supply, which can limit the system's overall reliability.

To address this issue, we are developing a proactive safety mechanism to prevent accidental falls into uncovered borewells and open drainage pits, with a particular focus on child safety. Utilizes proximity sensors with a detection range of 1 to 10 feet, integrated with an audible alarm system to alert nearby individuals of potential danger. The system continuously monitors open hazardous zones and triggers real-time alerts when movement is detected, enabling quick human intervention.

III. PROPOSED METHOD

The proposed system is designed to prevent accidental falls into open borewells by detecting the presence of nearby individuals, especially children, using proximity sensors and triggering a safety response. The core of the mechanism involves integrating an ultrasonic proximity sensor, a microcontroller (such as Arduino or a similar device), a servo motor, and a buzzer for alerts.

When the proximity sensor detects an object (or person) within a critical range (e.g., 1-10 feet), it sends a signal to the microcontroller. The microcontroller processes this input and activates two primary actions:

A. Audible Alert

The buzzer is triggered to emit a loud sound, warning people nearby and drawing attention to the danger.

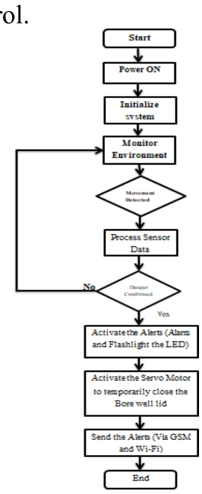
B. Temporary Lid Closure

A servo motor is used to rotate and temporarily close the bore well lid, preventing accidental falls.

This system ensures a quick and automated response, eliminating the need for human intervention, making it particularly useful in unattended or rural areas. The mechanism is energy-efficient, low-cost, and can be easily installed over existing bore wells or open pits.

C. Flow Diagram

The flow diagram outlines the step-by-step operation of the bore well safety system, beginning with motion detection and proceeding through alert activation and safety response. It visually represents the logical sequence managed by the microcontroller for real-time hazard prevention and control.



[Fig.1: Flow Diagram for Borewell and Drains Pits Prevention]

Fig 1. illustrates the system's operation, which begins in an idle state where the proximity sensor continuously monitors the surrounding area. When an object or person is detected within a 1–to 10-foot range, the sensor sends a signal to the microcontroller.

The microcontroller then verifies the detection and immediately activates an audible alarm to alert nearby people. Simultaneously, the microcontroller can trigger a servo motor to temporarily close the borewell lid. If a wireless module is integrated, it also sends an alert to a remote device. After the warning is issued, the system returns to its idle state and resumes monitoring. This loop ensures continuous safety around open hazards.

D. Methodology

The proposed safety mechanism is designed to detect the presence of individuals, especially children, near uncovered borewells or open drainage pits using a proximity sensor system. The methodology involves a combination of sensor-based detection, automated response, and alert generation, implemented through the following steps:

i. Sensor Integration

A proximity sensor (such as an ultrasonic or infrared sensor) is installed at the top of the borewell or open pit. The sensor is configured to continuously monitor a predefined radius, typically ranging from 1 to 10 feet, to detect any approaching object or person.

ii. Signal Processing

The sensor is connected to a microcontroller (e.g., Arduino or ESP32), which acts as the control unit. The microcontroller receives input signals from the sensor and interprets the distance data to determine the presence of an object within the danger zone.

iii. Alert System Activation

If the sensor detects movement within the critical range, the microcontroller activates an audible buzzer or alarm system. This immediate response serves as a warning to nearby individuals and helps attract attention to the potentially hazardous situation.

iv. Preventive Mechanism (Optional)

To enhance safety, a servo motor is connected to a temporary lid mechanism over the borehole opening. Upon detection, the microcontroller sends a signal to the servo motor, which rotates to partially or fully cover the borewell entrance, minimizing the risk of falling.

v. Wireless Communication (Optional Feature)

For remote alerting, a wireless communication module (such as a GSM, Wi-Fi, or LoRa module) can be integrated. When activated, this module sends real-time notifications to parents, caretakers, or local authorities.

vi. Continuous Monitoring Loop

After the alert and/or preventive action, the system resets and returns to its idle monitoring state. This enables the system to operate continuously and autonomously, without requiring manual intervention.

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

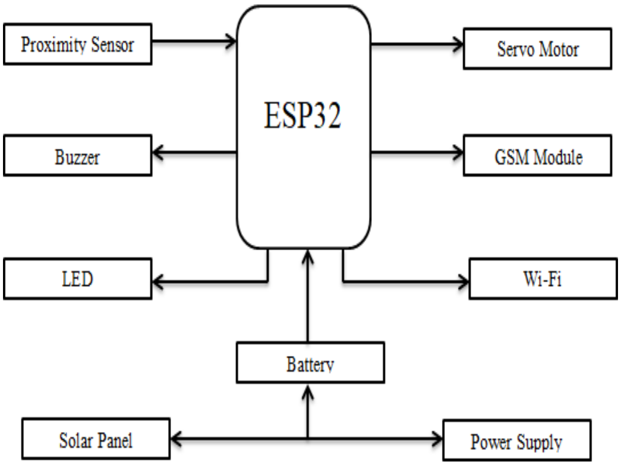
vii. Power Supply and Durability

The entire system is powered by a stable power source, such as a rechargeable battery or solar panel, ensuring reliability in outdoor conditions. All components are enclosed in a weather-resistant casing to support long-term deployment.

This methodology ensures a proactive approach to accident prevention by combining real-time detection with immediate alerts and physical intervention, ultimately enhancing child safety near open hazards.

E. Block Diagram

The block diagram illustrates
the functional structure of the borewell safety system, depicting the interactions between sensors, the microcontroller, output devices, and communication modules. It highlights the flow of data and control signals within the system.



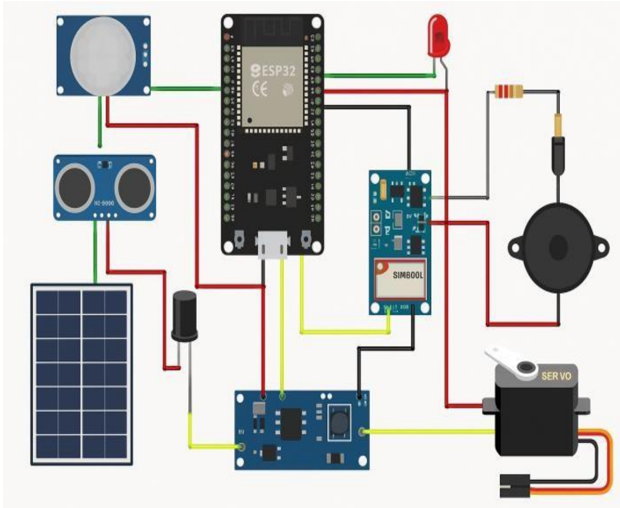
[Fig.2: Block Diagram for Borewell and Drains Pits Prevention]

Fig. 2 shows the block diagram of the Borewell Safety Mechanism. It illustrates the integration of sensing, processing, alerting, and mechanical control components to prevent accidents near uncovered borewells. The system is powered by a 3.7V lithium-ion battery, supported by a solar panel for uninterrupted operation. Voltage regulation is handled using a buck converter (LM2596), a boost converter (MT3608), and a charging module (CA033T). The ESP32 microcontroller receives input from a proximity sensor (IR or PIR) placed 10 feet in front of the borewell to detect human motion.

On detection, the ESP32 activates a buzzer and LED for immediate alerts, while also sending mobile notifications via Wi-Fi and the GSM module (SIM800L). A servo motor (SG90) is triggered to temporarily close the borewell lid, adding a physical safety layer. The entire circuit is constructed on a breadboard using jumper wires and supported by passive components, such as resistors and capacitors, to ensure voltage stability.

F. Circuit Diagram

The circuit diagram illustrates the connections between key components, including the ESP32 microcontroller, sensors, servo motor, buzzer, and power modules. It provides a clear view of the electrical layout required for system functionality.



[Fig.3: Circuit Diagram for Borewell and Drains Pits Prevention]

Fig. 3 illustrates the circuit design, where an ESP32 microcontroller serves as the central controller, powered by a solar panel with a lithium-ion battery backup. A boost converter ensures a constant 5V supply to all components, while a buck converter regulates voltage where necessary. A PIR sensor is placed 10 feet ahead of the borehole to detect human motion approaching the hazard.

An ultrasonic sensor is included to measure the distance and confirm the presence of an object or child near the borehole. Once motion is detected, the ESP32 triggers an LED and buzzer to provide immediate local audio-visual alerts. A resistor is connected in series with the buzzer to control the current and prevent damage to the buzzer. A servo motor (SG90) is used to close the borewell lid as a temporary safety measure.

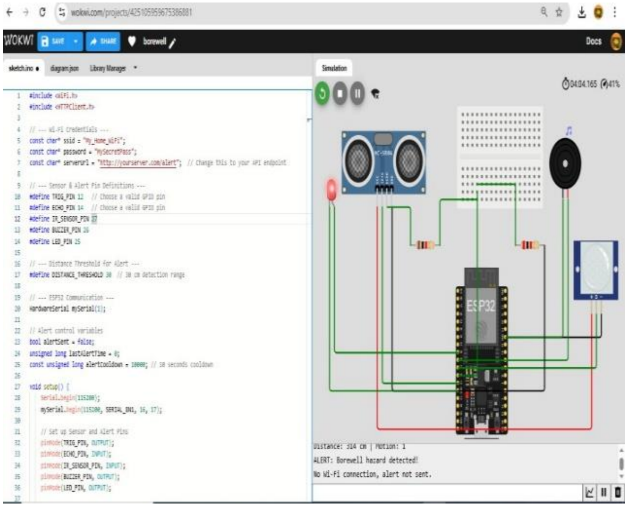
The SIM800L GSM module is activated to send an SMS alert to pre-registered emergency contacts. If Wi-Fi is available, the ESP32 can also send alerts to cloud-based platforms, such as Blynk or ThingSpeak. A capacitor is included to stabilize the voltage and filter any fluctuations. This setup allows for continuous, autonomous operation even in remote locations. Overall, the system provides a reliable and cost-effective safety solution for borewell and drainage-related hazards.

IV. RESULTS AND DISCUSSIONS

The hardware components, including the sensor, servo motor, and alert modules, responded accurately during testing, ensuring real-time operation. The software reliably processed inputs and triggered both local and remote alerts through GSM and Wi-Fi. Overall, the system demonstrated effective integration and consistent performance in detecting and responding to potential hazards.

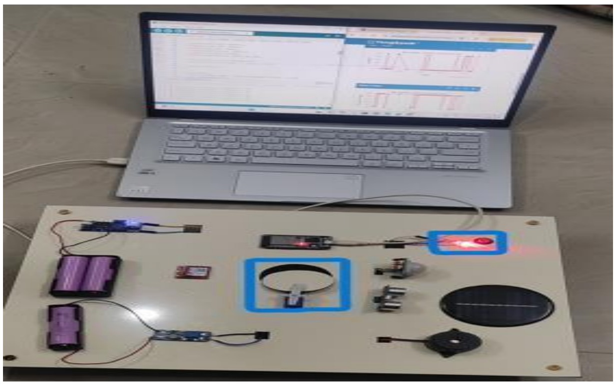
Retrieval Number:100.1/ijese.E466414050625
DOI:10.35940/ijese.E4664.13080725
Journal Website: www.ijese.org

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)



[Fig.4: Software Setup Output]

Fig. 4 shows the software output of the borewell safety mechanism, demonstrating practical real-time functionality during testing. Upon detecting motion within the sensor's range, the system successfully activated the alarm and triggered the servo motor to simulate the closing of the borewell lid. The microcontroller processed the sensor input promptly, ensuring immediate response times. The software proved to be reliable, accurately responding to movements and ensuring that safety measures were in place as intended. This confirms the system's potential for real-world applications in enhancing safety around open borewells.



[Fig.5: Hardware Setup Output]

Fig.5 shows the working model of the borewell safety mechanism using a proximity sensor. The setup includes an ultrasonic sensor, Arduino board, buzzer, servo motor, and indicator LEDs, all connected via a breadboard. When a person comes within the sensor's range, it detects the presence and sends a signal to the microcontroller. The buzzer is activated to alert people nearby, and the servo motor rotates to simulate the closing of a borewell lid. The system is programmed and monitored using a laptop, as shown in the image. During testing, the system responded quickly and accurately to movement, confirming the successful functioning of the safety mechanism for real-time applications.

V. CONCLUSION & FUTURE SCOPE

The proposed borewell safety mechanism provides a robust solution to prevent accidents associated with open borewells and drainage pits. It combines proximity sensing, automated mechanical responses, and wireless communication to ensure rapid detection and intervention of hazards. The system uses IR or PIR sensors to detect human presence within a defined range (1-10 feet). Upon detection, the microcontroller activates an audible alarm and triggers a servo motor to close the borewell lid, providing temporary protection.

Wireless communication through GSM and Wi-Fi modules enables the system to send real-time alerts to remote devices, notifying caretakers or authorities of potential dangers. The modular design, combined with solar-powered operation, ensures the system can function autonomously in both rural and urban environments, even in areas with limited electricity access.

The integration of solar panels and a lithium-ion battery backup ensures continuous operation, with voltage regulation managed by boost and buck converters to provide a consistent power supply.

Experimental results demonstrate that the system responds quickly and accurately, providing timely alerts and activating safety measures without delay. The simplicity of the design, combined with its low cost and ease of installation, makes the system highly adaptable for deployment in public spaces, parks, residential areas, and even remote locations.

The system's scalability ensures it can be expanded to cover larger areas, thereby increasing its potential for widespread adoption. Furthermore, the system's efficiency and energy-saving design make it a sustainable solution for long-term operation. By addressing safety concerns and integrating innovative technology, this borewell safety mechanism represents a significant step forward in creating safer public spaces and promoting sensor-driven safety infrastructure.

Future development of the system can include a protective lid designed for rainwater harvesting, featuring perforated holes and a fine mesh to filter out waste while allowing clean rainwater to recharge the borewell. A filter chamber can purify the incoming water, and an automated cleaning system can remove debris from it. Additionally, a lid health monitoring sensor can alert users to potential repairs, ensuring long-term functionality. This integrated system enhances safety, sustainability, and groundwater replenishment, especially in drought-prone areas.

DECLARATION STATEMENT

After aggregating input from all authors, I must verify the accuracy of the following information as the article's author.

- **Conflicts of Interest/ Competing Interests:** Based on my understanding, this article has no conflicts of interest.
- **Funding Support:** This article has not been funded by any organizations or agencies. This independence ensures that the research is conducted with objectivity and without any external influence.

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

- **Ethical Approval and Consent to Participate:** The content of this article does not necessitate ethical approval or consent to participate with supporting documentation.
- **Data Access Statement and Material Availability:** The adequate resources of this article are publicly accessible.
- **Author's Contributions:** The authorship of this article is contributed equally to all participating individuals.

REFERENCES

1. Nitin Agarwal, Hitesh Singhal, ShobhitYadav, Shubham Tyagi, Vishaldeep Pathak, "Child Rescue System from Open Bore Wells", Published by: International Journal of Trend in Scientific Research and Development (IJTSRD) Volume 3, Issue 4, May-June 2019, pg:no:639-642. DOI: http://dx.doi.org/10.31142/ijtsrd23847
2. Dr. U. Penchalaiah, Singamaneni Kranthi Kumar, Thambisetty Yaswanth, Vangallu Ashok, Simbothu Madesh "DESIGN AND FABRICATION OF BOREWELL CHILD RESCUE SYSTEM" Journal of Science and Technology, Vol. 09, Issue 06, June 2024, Published: 14-06-2024. https://jst.org.in/index.php/pub/article/view/968
3. Kuppusamy Udaiyakumar, S.Karthik, D.K.Mohan Kumar, K.Chandramohan, September 2020, "Investigation and analysis on child rescue system from open bore well" Published by: IOP Conference Series: Materials Science and Engineering. DOI: http://doi.org/10.1088/1757-899X/912/2/022022

AUTHOR'S PROFILE

Dr S. Aiswarya, the corresponding author, completed her B.E. in Electronics and Communication Engineering with First Class with Distinction, followed by an M.E. in Applied Electronics with First Class with Distinction, during which she was also a University Rank Holder. She earned her Ph.D. in image processing in 2023. She has actively participated in numerous national and international conferences and has published her research work in various reputed journals. Currently, she is working as a Teaching Fellow at the University College of Engineering, Dindigul. Her academic excellence and research contributions reflect her dedication to the field of electronics and image processing.

V. M. Srihari is a graduate in Electronics and Communication Engineering from University College of Engineering, Dindigul. As part of the Naan Mudhalvan scheme, I participated in the Niral Thiruvizha project Hackathon, where our project was selected and appreciated. This achievement motivated me to deepen my knowledge in core electronics. I am currently pursuing a course in Embedded Systems and IoT in online mode at Elewayte, Tamil Nadu. With a strong interest in embedded technology and IoT applications, I am focused on gaining practical skills and industry-relevant experience to contribute effectively to the evolving field of intelligent systems and automation.

S. Akshayasri, a graduate in Electronics and Communication Engineering from University College of Engineering, Dindigul. During my academic journey, I participated in the Niral Thiruvizha project Hackathon conducted under the Naan Mudhalvan scheme, where our project was selected for recognition. This opportunity boosted my confidence and interest in technology. Currently, I am enhancing my skills by pursuing a Python Full Stack Development course at Q Spiders, Bangalore. I am passionate about software development and aim to build a strong career in the IT industry by combining my engineering background with practical programming knowledge and hands-on project experience.

K. Priya Gupta, a graduate in Electronics and Communication Engineering from University College of Engineering, Dindigul. During my studies, I participated in the Niral Thiruvizha project Hackathon conducted under the Naan Mudhalvan scheme, where our project was selected for recognition. This experience strengthened my interest in core electronics, and I am currently pursuing a specialization in VLSI at Cranes Varsity, Bangalore. I am passionate about semiconductor technologies and eager to contribute to the growing field of chip design and embedded systems through continuous learning and hands-on project involvement.

S. Deviga, a graduate in Electronics and Communication Engineering from University College of Engineering, Dindigul. During my undergraduate studies, I actively participated in the Niral Thiruvizha project Hackathon organized under the Naan Mudhalvan scheme, where our project was selected and appreciated. This achievement enhanced my passion for electronics and innovation. I am currently pursuing my M.E. in Applied Electronics at RVS College of Engineering and Technology, Dindigul, Tamil Nadu. With a strong foundation in core electronics and a keen interest in research and development, I aim to make meaningful contributions to advancements in the field of electronics and embedded systems.