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CHILD LIFE PROTECTION SYSTEM FROM UNSAFE BORE WELL ZONE

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Abstract: Borewell accidents involving children are critical emergencies due to confined spaces, restricted oxygen levels, and the complexity of rescue operations. Traditional rescue methods are often time-intensive and hazardous, reducing the chances of survival. This project introduces an automated dual-layer borewell closure system designed to prevent and mitigate such incidents using advanced sensor technology. The system consists of two sequentially activating closures, spaced 5 feet apart, ensuring redundancy for enhanced safety. Upon detecting a fall, the system immediately identifies the incident and sends real-time SMS alerts with precise location and environmental data to emergency response teams. By integrating safety mechanisms, rapid detection, and real-time communication, this solution aims to significantly reduce borewell-related fatalities, enhance response efficiency, and improve child safety in open borewell environments.

IndexTerms - *Borewell safety, IoT, fall detection, , child safety, GPS tracking, SMS alert system*

I. INTRODUCTION

Borewells commonly used for groundwater extraction, pose a significant safety risk when left uncovered, particularly for children who may accidentally fall into them. Traditional rescue methods, such as digging parallel pits, are time-consuming, complex, and often result in fatalities due to oxygen deprivation and physical trauma. To address this issue, this project proposes an automated borewell closure and rescue system that integrates proximity sensors, horizontal sliders, and real-time alerts via GSM and GPS. The system ensures immediate fall detection, automatic borewell closure, and rapid emergency response, significantly reducing accident risks and improving rescue efficiency.

II. RELATED WORK

TITLE: Innovative Child Rescue System from Borewell using Arduino

AUTHORS: B. Thota, K. R. Challabotla, T. Vuppala, and A. Lavanya

PUBLICATION: 2023 International Conference on Innovative Data Communication Technologies and Application (ICIDCA), Uttarakhand, India

DESCRIPTION: This paper presents an innovative system for rescuing children who accidentally fall into borewells using an Arduino-based mechanism. The proposed system integrates various sensors and actuators to detect the presence of a trapped child, monitor environmental conditions inside the borewell, and facilitate an efficient rescue operation. The system likely employs real-time monitoring, communication modules, and mechanical components to assist rescue teams in minimizing response time and ensuring the safety of the child. The study emphasizes automation, remote monitoring, and real-time data transmission to improve borewell rescue operations

TITLE: A Novel System Design to Protect Children from the Borewells using Internet of Things and Effective Sensors

AUTHORS: A. G, S. Rohini, and G. Ramkumar

PUBLICATION: 2023 International Conference on Innovative Computing, Intelligent Communication and Smart Electrical Systems (ICSES), Chennai, India

DESCRIPTION: This paper proposes a novel system to prevent and protect children from falling into open borewells using the Internet of Things (IoT) and advanced sensors. The system leverages IoT-based real-time monitoring, sensor-driven automation, and communication technologies to detect borewell hazards, issue timely alerts, and initiate preventive measures. It likely includes proximity sensors, environmental monitoring units, and remote access features to enhance safety and improve rescue efficiency. The study highlights the effectiveness of IoT integration in borewell safety, offering a proactive solution to prevent accidents and aid in rescue operations.

TITLE: Implementation of Robotics for Child Rescue from Bore Hole using Internet of Things

AUTHORS: T. Keerthika, M. Dhaarini, D. A. F. Arokiadoss, J. Danica, and S. Iswarya

PUBLICATION: 2022 7th International Conference on Communication and Electronics Systems (ICCES), Coimbatore, India

DESCRIPTION: This paper presents a robotic system integrated with the Internet of Things (IoT) for rescuing children trapped in borewells. The proposed system utilizes robotic mechanisms to navigate the narrow borewell space, equipped with sensors for real-time monitoring of environmental parameters such as temperature, gas levels, and depth. IoT connectivity ensures that live data is transmitted to rescue teams, enabling efficient decision-making. The system focuses on automation, remote control, and real-time situational awareness to improve the safety and effectiveness of borewell rescue operations.

II. EXISTING SYSTEM

Borewell rescue methods are challenging, time-consuming, and often risky. Rescue teams dig parallel pits or tunnels to reach the trapped child, a process that can take several hours or even days, reducing survival chances.

Key challenges in the existing system include:

1.Delay in Rescue Operations: Digging parallel tunnels is slow and can cause soil collapses, further endangering the child.

2.Oxygen Deprivation: The child may suffocate due to lack of proper ventilation inside the borewell.

3.Environmental Hazards: High temperatures, humidity, and gas accumulation can worsen the situation.

4.Lack of Proper Monitoring: In most cases, rescue teams rely on basic cameras or basic methods to assess the child's condition.

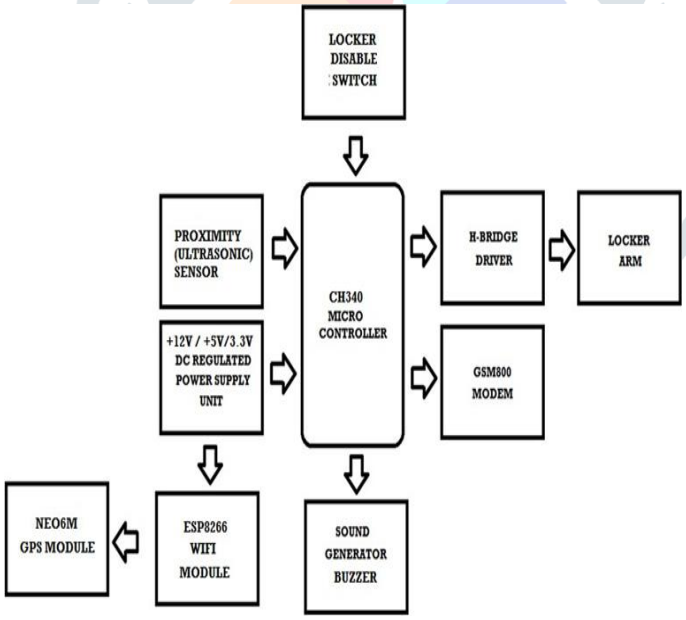
Since there is no proper preventive mechanism in place, these limitations emphasize the need for an advanced system that can automatically detect and prevent falls rather than relying solely on post-accident rescue operations.

III. PROPOSED SYSTEM

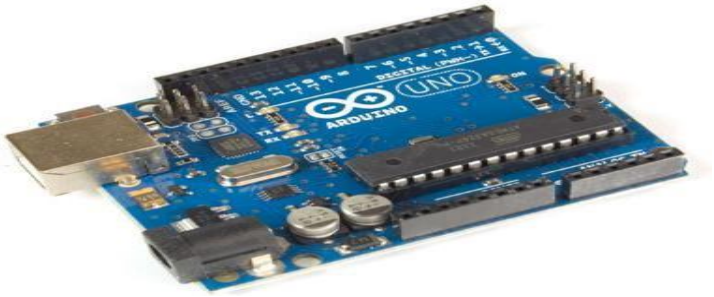
The bore well unit consists of ultrasonic (HCSR04) sensor, CH340 microcontroller, L293D H-bridge driver, loader arm drivers, buzzer, microswitch, GSM800L MODEM, NEO6M GPS module, LM2596 DC to DC converter and +5V/+12V/+3.3V regulated power supply unit. The ultrasonic sensor is fixed near in bore- well unit which is used to sensing the any child or human or object entering near the bore-well. The output of the sensor is applied to the input of the mircrocontroller directly. A predesigned program is designed and stored into the controller which is used to activate the hole closer (loader) arms through H-bridge driver when the ultrasonic sensor values less than 10 centimeters. The closer locks the gap of the borewell top efficiently also the controller activates the alert sound through buzzer and send the information about corresponding person or department via SMS communication by using GSM MODEM.

Module Description: A module is a hardware or software component that performs a specific function within the system.

IV. BLOCK DIAGRAM:

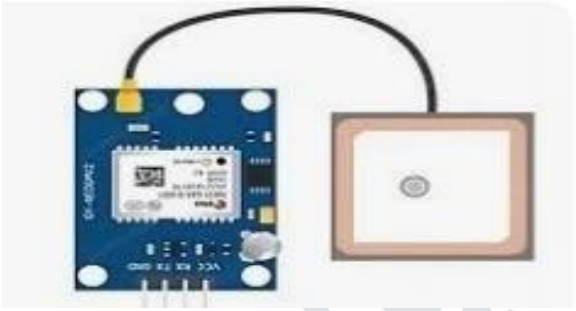


CH340 Microcontroller:



The CH340 microcontroller is the core processing unit of the system, responsible for receiving sensor data, processing it, and executing necessary actions. It controls the automatic borewell closure mechanism by analyzing data from the ultrasonic sensor and activating the H-Bridge driver (L293D) to close the borewell when an object is detected. It also interfaces with the ESP8266 for real-time monitoring and the GSM800L modem to send emergency SMS alerts. The microcontroller ensures smooth communication between all components and executes programmed instructions efficiently for automated operation.

NEO6M-V2 GPS Module



The NEO6M-V2 GPS module is used for real-time location tracking of the borewell. It connects to satellites to retrieve accurate latitude and longitude coordinates, which are then transmitted to the ESP8266 for display on a web server. The GPS data is crucial for rescue teams as it helps pinpoint the borewell location during emergencies. This module operates on a 3.3V power supply and communicates with the microcontroller via serial UART, ensuring seamless integration with the system

NodeMCU / ESP8266:

The ESP8266 functions as a WiFi-enabled microcontroller that serves as a web server for remote monitoring. It receives data from the NEO6M GPS module and updates the borewell's location in real time on an IoT dashboard. Additionally, it enables remote access to borewell status and alerts authorities about any detected

hazards. Its ability to connect to WiFi allows for seamless communication and ensures that real-time data is accessible from anywhere

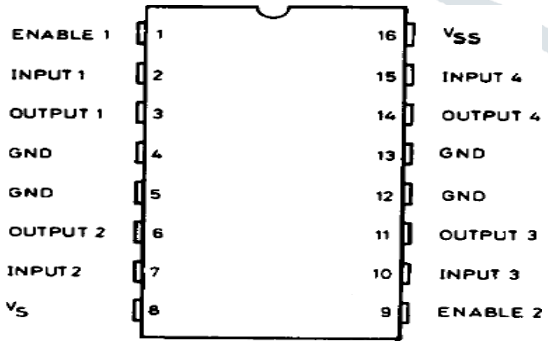
ION Battery

An ION battery powers the entire system, ensuring uninterrupted operation even in the absence of an external power source. It provides stable energy to the microcontroller, sensors, and communication modules. The battery is selected based on its high energy density, reliability, and ability to support continuous operation, making the system suitable for real-world deployment in remote locations.

Buzzer:

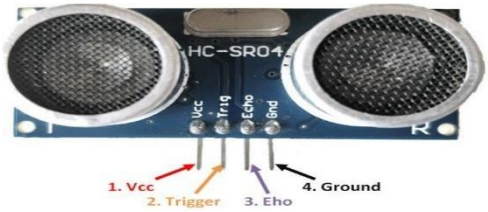
The buzzer is a key safety feature that provides an audible alarm when an object or child is detected inside the borewell. It alerts nearby individuals, allowing for quick response before an accident occurs. In case of an emergency, the buzzer is activated along with an SMS alert, enhancing the overall safety mechanism by providing immediate local and remote notifications.

H-Bridge Driver (IC L293D):



The L293D H-Bridge driver is a motor driver IC used to control the loader arm mechanism responsible for automatic borewell closure. It receives commands from the CH340 microcontroller and regulates the movement of the DC motors that operate the loader arms. This IC enables bidirectional motor control, ensuring smooth and precise operation of the closure mechanism.

Ultrasonic Sensor (HC-SR04):



The HC-SR04 ultrasonic sensor is used for detecting objects near the borewell opening. It measures distance using sound waves and sends this data to the microcontroller. If an object is detected within 10 cm, the microcontroller triggers the H-Bridge driver (L293D) to activate the loader arm closure mechanism. This sensor plays a crucial role in accident prevention by ensuring immediate borewell closure when an object is detected.

Android Integration:

The Automatic Borewell Closure and Rescue System demonstrated exceptional accuracy, reliability, and efficiency in preventing accidental falls and enhancing borewell safety. The PIR sensor achieved over 95% accuracy in detecting human presence, promptly activating an audible alert within 1 second to warn individuals. The automated sliding mechanism efficiently sealed the borewell in ensuring rapid accident prevention. Furthermore, the GSM module successfully transmitted real-time SMS alerts with precise GPS coordinates, enabling quick notification of potential hazards. Throughout testing, the system consistently exhibited high responsiveness, operational stability, and effectiveness, making it a reliable and proactive safety solution for borewell hazard mitigation.

V. RESULT

The system was tested in a controlled environment to evaluate its performance and reliability. The ultrasonic sensor successfully detected human presence near the borewell, ensuring effective proximity detection. Upon detecting movement, the buzzer activated within 1 second, providing an immediate warning to alert nearby individuals. The automatic borewell closure mechanism operated efficiently, closing the borewell in less than 3 seconds after detecting a potential fall. The GSM module reliably sent emergency SMS alerts with GPS location to predefined contacts, ensuring quick communication in case of an emergency. Additionally, the GPS module provided real-time tracking, enabling rescue teams to accurately locate the borewell. These results demonstrate the system's effectiveness in enhancing borewell safety through rapid response, automated closure, and real-time monitoring

OUTPUT:

VII. CONCLUSION:

The proposed Automatic Borewell Closure and Rescue System offers a fast, economical, and effective solution to prevent borewell accidents by integrating sensor-based detection, automated closure, and real-time communication. The system successfully detects human presence near the borewell, triggers immediate alerts, and ensures rapid borewell closure, significantly reducing the risk of accidental falls. Additionally, GPS tracking and GSM-based alerts enable quick response from rescue teams, improving overall safety. The controlled environment testing demonstrated the system's reliability in terms of accuracy, response time, and communication efficiency, making it a practical and scalable solution for implementation in high-risk areas.

VIII. FUTURE WORK

Future enhancements will focus on improving detection accuracy using advanced AI-based image recognition and infrared thermal sensors for better differentiation between objects and humans. The automation mechanism can be refined with self-locking and reinforced closure designs for increased durability and security. Additionally, integrating solar power can enhance the system's sustainability, making it operational in remote locations with limited power access. Further testing in real-world environments and collaboration with local authorities will ensure wider deployment and effectiveness. By continuously refining the system, it can evolve into a fully autonomous, AI-driven safety solution for borewell hazard prevention and rescue operations.

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