Design And Implementation of Child Rescue System from Borewell Using Zigbee

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Abstract—**In recent years, many cases have been reported of children getting trapped in bore wells which take life of the children and are a nightmare for parents. There is a definite need for developing a security and rescue system for children to rescue from bore well. The current rescue systems are time taking, and are not at all accurate as involve manual help where there are many chances of human error. The bore well cases have taken many lives of innocent children while playing in that area. The process is very complicated and may be if someone is stuck a notification is also not received. In this paper, a new child rescue system is proposed, in which use of sensors and microcontrollers for rescue improves the efficiency of the system. Using surveillance camera, the child can be rescued by a hand gripper with utmost safety. This helps in the rescue of child from borewells and also gives real time data of sensors and communicates to the system through Zigbee.**

Index Terms—**Arduino UNO, ultrasonic sensor, DHT sensor, Gas sensor, NodeMcu, Buzzer, Zigbee Module.**

I. INTRODUCTION

India relies heavily on agriculture, and farmers often depend on groundwater accessed through bore wells. With rising population and urbanization, more bore wells are dug but often left uncovered after use. These open wells pose a serious danger, especially to children who may accidentally fall in. Rescue operations are risky and time-consuming, especially in rocky areas, reducing the chances of saving lives.

The goal is to reduce the risks associated with open bore wells and ensure help can arrive quickly and effectively during emergencies, giving parents peace of mind and protecting children from avoidable tragedies.

II.LITERATURE SURVEY:

2.1 Title: Design and Implementation of a Child Rescue System Using Zigbee Technology

This paper introduces a rescue system designed to save children who accidentally fall into borewells. The system uses Zigbee wireless technology to communicate with sensors that detect the child's presence and monitor their vital signs. It also includes GPS for tracking the exact location in real time. Thanks to Zigbee's low power usage and long-range coverage, the system works well in rural areas where such accidents are more common.

2.2 Title: Wireless Sensor Networks for Child Rescue: A Zigbee-Based Approach

This research looks at how wireless sensor networks, especially those using Zigbee, can help in emergencies when a child falls into a borewell. The system uses several Zigbee-connected devices placed around the borewell to send real-time data. This quick sharing of information helps rescuers respond faster, improving the chances of saving the child.

2.3 Title: Zigbee-Based Child Tracking System for Borewell Safety

This study focuses on preventing accidents by tracking children using Zigbee-based wearable devices. If a child comes near a dangerous area like a borewell, the system immediately alerts parents or caregivers. The use of Zigbee ensures the alerts work over a long distance without using much power.

2.4 Title: A Novel Approach to Borewell Accident Prevention Using Zigbee Networks

This research introduces a new idea to put an end for

borewell accidents before they happen. Zigbee-based sensors are placed around borewells to detect any unusual movement or danger. If a risk is detected, the system sends alerts immediately. This early warning can help prevent accidents altogether.

III. PROPOSED METHODOLOGY

1. The control station includes another Arduino with a Zigbee receiver, which displays real-time data from the borewell on an LCD screen. The data collected is transmitted to the receiver module via Zigbee.
2. Temperature sensor (LM35): Monitors temperature inside the borewell to prevent heat-related risks.
3. Gas Sensor (MQ2 or MQ135): Detects hazardous gases (such as LPG, methane, or CO2) that could harm the child.
4. Humidity Sensor (DHT11): Monitors humidity levels to assess environmental conditions. .
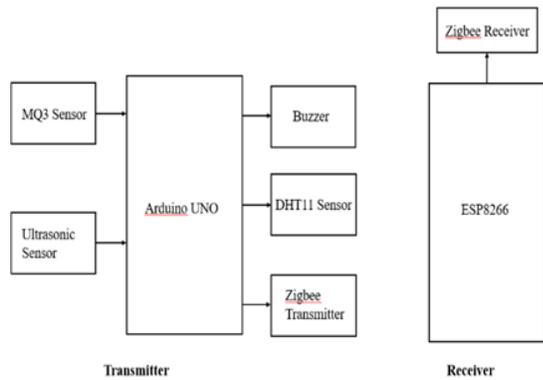
IV.SCHEMATIC EXPLANATION

Arduino UNO:
Acts as the brain of the system. It reads data from the sensors and sends information via the Zigbee module.
DHT11 Sensor (Temperature and Humidity Sensor):
VCC connected to 5V on Arduino.
DATA connected to Digital Pin 2 on Arduino.
GND connected to GND on Arduino.
Purpose: Measures temperature and humidity.
Ultrasonic Sensor (Distance Measurement):
VCC connected to 5V.
GND connected to GND.
TRIG connected to Digital Pin 9.
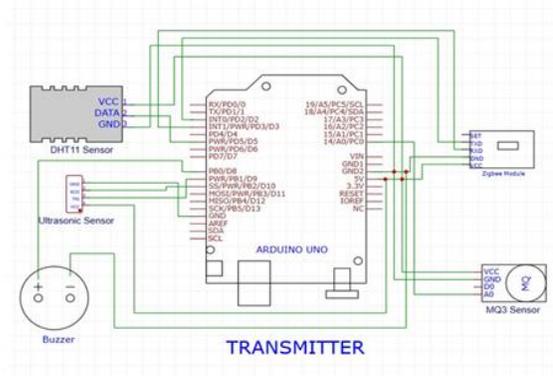
ECHO connected to Digital Pin 8
Purpose: Measures distance to an object (maybe for obstacle detection or level monitoring).
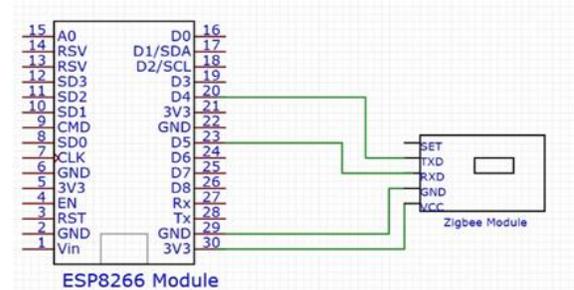MQ3 Sensor (Alcohol Detection Sensor):
VCC connected to 5V.
GND connected to GND.
D0 (Digital Output) connected to a Digital Pin (not clearly marked in the image, but generally a digital input pin).
A0 (Analog Output) can be read by an analog pin for finer measurements (like A0 on Arduino).
Purpose: Detects alcohol levels in the air.

Zigbee Module (Wireless Communication):
VCC connected to 5V.
GND connected to GND.
TXD (Transmitter) connected to Digital Pin 3.
RXD (Receiver) connected to Digital Pin 4.
Purpose: Sends collected data wirelessly to a receiver module (another Arduino with Zigbee probably).
Sensors collect environmental data (temperature, humidity, distance, alcohol).
Arduino reads this sensor data.
Arduino sends the data through the Zigbee Module wirelessly to another receiver (likely another Arduino or computer).
ESP8266 Module (a Wi-Fi enabled microcontroller):
It receives data wirelessly via the Zigbee module.

It can later process or send the data to a web server, mobile app, or store it locally.

Communicates wirelessly with the Zigbee module on the transmitter side (Arduino UNO).

It receives the data that was sent by the Arduino transmitter.

Connections between ESP8266 and Zigbee:

VCC (Zigbee) → 3V3 (ESP8266):

Powering the Zigbee module with 3.3V.

GND (Zigbee) → GND (ESP8266):

Ground connection.

TXD (Zigbee) → D6 (ESP8266 Pin 24):

Data from Zigbee's TX is received by ESP8266 on D6 (receive pin).

RXD (Zigbee) → D5 (ESP8266 Pin 23):

Data from ESP8266 is sent to Zigbee through D5 (transmit pin).

SET is also connected, possibly to control modes of the Zigbee (but in simple communication, it might be ignored or pulled HIGH/LOW).

Working Principle:

The Zigbee module attached to the ESP8266 receives the wireless data sent by the Arduino transmitter.

The ESP8266 reads this incoming data through its pins (D5 and D6).

Then, the ESP8266 can process, display, or upload the data (for example, to a cloud server, database, or app).
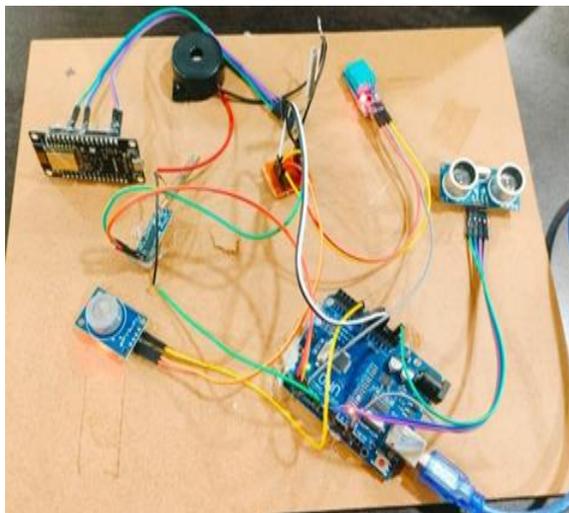
V. RESULT

Figure: DESIGN AND IMPLEMENTATION OF CHILD RESCUE SYSTEM FROM BOREWELL USING ZIGBEE HARDWARE KIT
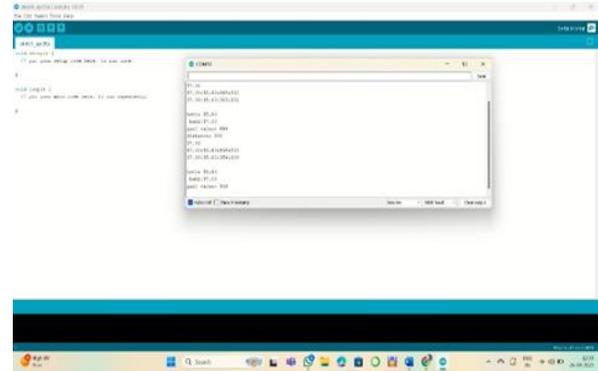

Figure: Execution of Design and implementation of child rescue system from borewell using Zigbee

The above images show the Arduino IDE with a serial monitor displaying real-time sensor data such as temperature, humidity, and distance, where sensors help monitor borewell conditions. The system aims to detect a child's presence and environmental parameters, transmitting and receiving data wirelessly via Zigbee for immediate rescue response.

VI. APPLICATIONS

1. Supports rescue teams during tunnel incidents by providing data and visibility.
2. Detects trapped miners and environmental dangers in underground mining scenarios.
3. Ideal for rescuing workers from deep construction-related pits and shafts.
4. Useful in industrial contexts to locate and assist trapped maintenance personnel.
5. Can support operations in confined defense or tactical underground scenarios.
6. Detects vital signs and hazardous conditions in enclosed environments like tanks or tunnels.

VII. ADVANTAGES

1. Uses affordable components, making it suitable for large-scale deployment in low-resource areas.
2. Zigbee enables remote communication without physical cables, improving safety and flexibility.
3. Lightweight and compact, allowing for easy transportation and quick deployment at rescue sites.
4. Sensors provide continuous data to monitor borewell conditions and the victim's status in real-time.

5. Minimal setup time ensures the system can be used immediately in urgent rescue situations.
6. Sends live readings to the monitoring unit, aiding timely and informed decisions by rescuers.
7. Operates on minimal power, making it suitable for battery-operated or remote-area rescues.
8. Enhances signal strength and reliability, especially in complex environment
9. Ideal for navigating narrow shafts without obstruction or damage
10. Components can be easily replaced or upgraded, improving system longevity and flexibility.
11. Simple controls and clear outputs make it operable even by personnel with limited technical skills.
12. Sends critical information before sending rescuers into dangerous environments.

VIII.CONCLUSION

The implementation of our child rescue system has been successfully completed and rigorously tested, yielding positive outcomes. Tragically, a significant number of lives are lost each year due to children and animals accidentally falling into borewells. In response to this pressing issue, we have designed an innovative framework aimed at safely and efficiently rescuing children trapped in borewells. Our system incorporates real-time monitoring capabilities, allowing for a comprehensive view of the borewell environment through the use of remote cameras. This continuous surveillance provides crucial visual feedback to rescue teams, enabling them to assess the situation accurately and make informed decisions. Additionally, the system is equipped with temperature and gas sensors, which help maintain a safe environment for the trapped individual. These sensors continuously monitor conditions within the borewell, ensuring that any hazardous changes are detected early. The integration of these safety features not only enhances the effectiveness of the rescue operation but also protects the child from potential dangers such as toxic gases or extreme temperatures. The rescue mechanism includes a specialized gripper, designed to securely grasp and lift the child from the borewell. This ensures that the rescue process is not only swift but also gentle, minimizing the risk of injury during extraction.

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