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Smart Borewell Rescue System through Wireless Monitoring using Artificial Intelligence

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Abstract: *Modern urbanization and expansion of cities has boomed since a decade, water shortage and inefficient supply of water from conventional water reservoir and supply system has led to increase in number of domestic bore well installation. And cost of installation and maintenance is easy and affordable hencemore and more people are opting for their personal bore well, rather depending of City Corporation for water supply. This has drastically increased the accident in the site of bore well especially small kids are vulnerable and many incidents has occurred where small kids get struck in open bre well and some being sunk into the depth. The objective of the project is to construct and design a bore wellrescue robot, which can lift and rescue the kids who fall into well.*

Keywords: bore well

I. INTRODUCTION

A bore well is a narrow shaft dug vertically into the ground. There is no efficient and fast way to rescue the victims of bore well accident. It may be constructed for various purposes, such as the extraction of water for daily human usages, or in other cases, other liquids (such as petroleum) or gases (such as natural gas). It is a well-known fact that India has been facing a severe ground water crisis over the past few years.

Conventional methods needs to dig out a parallel hole through which the victims can be rescued, but this is long procedure and victim may not survive till the rescue operation completes, also the procedure poses huge risk of potential collapse of hole and victim may get injured. It should also be noted that the pressure varies as we go deep down to the core of the earth, and structure ofthe soil also plays a crucial role in the rescue operation. Situations where robotshave to perform rescue operations above 600 feet from sea level may also arise. After factoring in all these parameters, an optimal design for a bore well rescue robot was prototyped and tested. Report says current rescue system is only 30% effective in bringing out victims alive. So there is wide scope for the developmentof new robot which can saves lives of the victims.

Problem statement:

Many bore well accident happen every day. Small kids are main victim of these accidents. Current system uses parallel digging of earth to remove kids who fell into well, which is slow and tedious There is requirement for a fast and efficient way to rescue kids who fall into bore well. Most of the bore well accidents happenin rural areas.

Lesser diameter Bore wells are used for domestic purposes in the cities. So it seems bigger diameter holes are a problem. In the villages, the bore wells are dugfor two reasons. Those are domestic and agriculture purposes.

Objective:

- To design and develop borewell rescue robot which can have vertical motion
- Develop website integrated in edmedded environment to control robot
- Sense environment like temperature humidity , light levels
- Interate robotic gripper controlled by servo motor 5:live streaming capabilities on website usng esp32 cam

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Motivation:

Most of the bore well accidents happen in rural areas. Lesser diameter Bore wellsare used for domestic purposes in the cities. So it seems bigger diameter holes area problem. In the villages, the bore wells are dug for two reasons. Those are domestic and agriculture purposes

II. PROPOSED METHODOLOGY

The robot is attached to a surface hub via rope; the robot is dropped a little into the bore well, while the surface hub is fixed on top of the bore well. The robot isthen controlled using computer / mobile, the motors are then activated which allows robot to slowly crawl into the depth. The process is monitored using on board live streaming camera. The operator the searches for victim while being dropped into depth.

Once the operator finds the victim, the robot is slowed down, then the robot has to maneuver to find good place to grab the victim. The robotic arm gripper is moved and the victim is grabbed, then the robot motors are activated which then pulls the victim out to surface. The whole procedure should take approximately 20 minutes which is lot more efficient than the conventional procedure which takes many hours

Existing System:

In the existing system, conventional methods are employed for rescuing victimstrapped in borewells. These methods often involve parallel digging of the earth to create a passage for rescuers to reach the victim. However, this process is slow, labor-intensive, and poses risks of collapse, particularly in unstable soil conditions. Additionally, the effectiveness of the existing system is limited, withonly around 30% success rate in bringing out victims alive.

Difference between Existing System and Proposed System:

- Efficiency: The existing system relies on manual labor and parallel digging, resulting in slow and labor-intensive rescue operations. In contrast, the proposed system utilizes a robotic approach, enabling faster response times and more
- efficient rescue procedures
- Risk: Conventional methods pose risks of collapse and injury to both victims and rescuers due to manual digging in unstable soil conditions. The proposed system minimizes such risks by employing a remotely operated robot,reducing the need for human intervention in hazardous environments.
- Success Rate: The effectiveness of the existing system is limited, with a relatively low success rate in bringing out victims alive. The proposed systemaims to improve success rates by employing advanced technology, such as live streaming cameras and robotic grippers, to facilitate timely and effective rescue operations.

III. APPLICATION

The Borewell Rescue Robot is a cutting-edge solution designed for swift and efficient rescue operations in borewells. This robotic system is equipped with advanced features, including a live-streaming camera and a robotic arm with a gripper, allowing remote operators to navigate and retrieve victims from borewells with precision.

Advantages:

Rapid Response:

The Borewell Rescue Robot ensures a swift response to emergencysituations, significantly reducing the time it takes to reach and assess theincident site.

Remote Operation Capability:

The robot's remote controllability enables operators to manage the entirerescue operation from a safe distance, ensuring the safety of both the victimsand rescue personnel.

Real-Time Visualization

The live-streaming camera provides real-time visuals of the borewell interior, allowing operators to make informed decisions and adapt to changingconditions during the rescue mission.

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Limitations:

Communication Reliability:

The effectiveness of the robot depends on a reliable and continuous communication link between the operator and the robot. Any disruptions in communication may impact the operation.

Maneuverability Challenges:

The robot may face challenges in navigating through extremely tight or irregular spaces within the borewell, limiting its ability to reach certain areas.

Battery Constraints:

The robot's operation is constrained by its battery life, and prolonged rescueoperations may require periodic recharging or a backup power source.

BLOCK DIAGRAM:

- **ESP32 cam** is used to live stream video as shown in below block diagram.
- **Power supply** : power supply to the entire system is given by 7.4v li-ion batterywhich is also rechargable
- **ESP8266(node mcu)** : since esp32 cam has less output pins ,node mcu will act as extended processor to connect sensor which sends data to blynk
- **MOTOR DRIVER** : since we cannot directly connect motors to node mcu a motor driver(ln239d) is used which takes sign al from esp32 and controls themotor
- **DC MOTOR** : Dc motors are used to climb up or drop down the robot via guidrope
- **LDR SENSOR**: Ldr sensor is used measure the light intensity inside the borewell
- **TEMPERATURE SENSOR** :Temperature sensor is used to measure thetemperature levels inside the bore well
- **PRESSURE SENSOR** : Pressure sensors measures the pressure and send it tothe microcontroller
- **ROBOTIC ARM (Gripper)** :Robotic arm gripper is used to hold and grab thekid while rescuing
- **HIGHPOWER LED** : High power led is used to light up the area inside borewell
- **CAMERA :** Camera is used to take live video stream and scan be viewed onphone or laptop

IV. METHODOLOGY / TECHNOLOGY USED

The robot is attached to a surface hub via rope; the robot is dropped a little into the bore well, while the surface hub is fixed on top of the bore well. The robot isthen controlled using computer / mobile, the motors are then activated which allows robot to slowly crawl into the depth. The process is monitored using on board live streaming camera. The operator the searches for victim while being dropped into depth.

Once the operator finds the victim, the robot is slowed down, then the robot has to maneuver to find good place to grab the victim. The robotic arm gripper is moved and the victim is grabbed, then the robot motors are activated which then pulls the victim out to surface. The whole procedure should take approximately 20 minutes which is lot more efficient than the conventional procedure which takes many hours

Functional Requirements:

- Remote Control Interface: The system should have a user-friendly interfacefor remote control of the robot.
- Robot Movement: The robot should be capable of vertical motion, controlleddescent, and maneuverability inside the borewell.
- Sensors to measure environmental factors like temperature ,pressure ,light
- Robotic Gripper: A robotic arm with a gripper should be integrated into thesystem for grabbing and holding the victim securely.
- Live Streaming: The system should support live streaming of video feed from the borewell to facilitate real-time monitoring by operators.

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Non-functional Requirements:

- Reliability: The system should be reliable and operate effectively under various environmental conditions, including different soil types and depths.
- Safety: Safety is paramount, and the system should prioritize the safety ofboth victims and rescue personnel during operations.
- Scalability: The system should be scalable to accommodate different borewell dimensions and rescue scenarios.
- Battery Life: The system should have sufficient battery life to support prolonged rescue operations without interruption
- Ease of Maintenance: The system should be easy to maintain and service toensure continuous operation and longevity.

By incorporating these functional and non-functional requirements, the proposed system aims to address the limitations of the existing system and provide an efficient, reliable, and safe solution for borewell rescue operations.

Data Flow:

User Input:

- Inputs from the user through a computer or mobile device tocontrol the robot and initiate the rescue operation.

ESP8266(NODE MCU) Control:

- The ESP32 microcontroller processes user inputs and controls theentire system.
- Manages the interfacing of sensors and motors.
- Orchestrates the overall flow of data and commands.

Sensors:

- LDR Sensor: Measures light intensity inside the bore well.
- Temperature Sensor (DHT11): Monitors temperature levels insidethe bore well.
- Pressure Sensor: Measures pressure and sends data to themicrocontroller.

Motors and Motor Driver

- DC Motors: Control the movement of the robot for climbing up or dropping down the bore well.
- Motor Driver (L293D): Acts as an interface between ESP32 and DC motors.

Robotic Arm (Gripper):

- Robotic arm gripper: Used to hold and grab the victim during the rescue operation.

Camera:(ESP32 CAMERA)

- High-resolution camera: Takes live video stream for real-time monitoring of the bore well interior.

Power Supply:

- 7.4V Li-ion Battery: Powers the entire system, ensuring mobility and functionality.

Live Streaming:

- Live-streaming data: Sent from the camera to the user interface for real-time visualization.

Modules and Descriptions:

1. User Interface Module:

- Responsible for receiving user inputs for controlling the robot.
- Initiates the rescue operation.

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Control Module (ESP8266):

- Manages the overall control of the system.
- Interacts with sensors, motors, and the robotic arm.
- Processes data and commands from the user interface. 3.Sensor Module:
- Manages the data from sensors, including LDR, temperature, and pressure.
- Sends sensor data to the control module for decision-making.

Motor and Motor Driver Module:

- Controls the DC motors for the movement of the robot. -
- Interfaces with the motor driver (L293D) to translate commands from the control module.

Robotic Arm Module:

- Controls the robotic arm gripper for grabbing and holding the victim.
- Interfaces with the control module to execute commands.

Camera Module:

- Manages the live-streaming camera data.
- Sends real-time video feed to the user interface for monitoring.

Power Supply Module:

- Manages the power supply to ensure the continuous operation of the system.

V. SOFTWARE REQUIREMENT

- C++
- Arduino ide

VI. HARDWARE REQUIREMENT

- Esp32 cam development board Node mcu esp8266
- Ldr sensor Motor driver Motor
- Robot arm gripper
- Temperature humidity sensor

VII. LITERATURE SURVEY

1: Implementation of Robotics for Child Rescue from Bore Hole using Internet of Things
T. Keerthika; M Dhaarini; Dafny Azeliya Felix Arokiadoss; J Danica; S Iswarya
Abstract: The most vital component of life is water. Bore wells are dug to meet the growing demand for water. Several children have become stuck after slipping into abandoned bore wells that have been left open to the elements. The present rescue systems are inefficient and inaccurate since they rely on manual assistance, which is prone to human mistake. The main aim of our project is to save the child from the bore well how much ever deep the child is. So here this research study has proposed an advanced robotic system for rescuing the child from a bore well. The robot uses a surveillance camera to monitor the movements of the child which can be viewed through the Internet of Things application. Hand gripper is used to rescue the child which is controlled using microcontrollers. This system uses an ultrasonic sensor, gas sensor, temperature sensor and pulse sensor. The facial feeling of the kid is perceived through camera and Voice playback is used to communicate to the child continuously to keep it alive. An Internet of Things application is created to monitor the sensor recordings and control the robotic hand gripper simultaneously in the same panel using microcontrollers. The proposed system will easily rescue the child without any major injury.

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2:Innovative Child Rescue System from Borewell using Arduino Bhavana Thota; Karthik Reddy Challabotla; Teja Vuppala; A. Lavanya

Abstract: Across the globe, the demand for water is high, especially in developing nations like India. Humans are digging bore wells in water-scarce locations, primarily in rural areas, as a result, the demand for underground water raised. Many innocent infants and animals are falling into these pits which are left uncovered. They are prone to death due to no proper and efficient rescue equipment. In recent cases, it is seen that the conventional approach is inefficient in terms of time and labor requirements. This means that it takes long time and effort to complete a task using this method, which can result in delay, higher costs, and may lead to the death of the victim. The proposed child rescue system features an arm clipper designed to safely extract the child from the borewell. A wireless webcam is mounted onto the arm clipper, which provides real-time monitoring of the infant's position as the rescue operation progresses. To accurately measure the temperature deep inside the borewell, a temperature sensor is also attached to the arm dipper. A gas sensor is used to detect the presence of harmful gases. What sets this research apart from existing methods is the provision of a flexible base for the child, which prevents them from sinking deeper into the borewell. The base is delivered to the victim in the form of a stick and, once it reaches the victim, it opens up into an L-shape, providing a stable platform for the child. The entire system is controlled by a microcontroller, which receives commands through switches. The use of this innovative base and microcontroller-based control system improves the safety and efficiency of borewell rescue operations, ultimately helping to save lives.

3: Design And Development Of Robot For Rescue Operations For BoreWell Victims

B. Akash; K. Kanisha; Saumya Ranjan; M. Jayakumar

Abstract: In the past years, the reported rates of children falling inside the bore-well have increased considerably. Where in most cases rescue operations take place by digging the pits parallel to an existing one consuming both time and manpower, others leave the children in forfeiting their lives. The current method used has very little chance of rescuing the child out of the bore-well safely, which is why this robotic system promises to target the current situation. The project implies a design of two arm grippers using gear mechanism mounted on the lead screw for to-and-fro motion with cushion-like material placed inwards to grip the child and pull him out of the bore-well safely. The robot interfaces with the Raspberry Pi. Live streaming helps in assessing the position of the child and sensor values give the real-time data of the distance from the child, temperature, and humidity. The control and monitoring of the entire system are done through the Webpage.

4:“Pangolin”-Animatronic Based Robotic Hand System for Human Rescue in Deep Mine Hole and Bore Well Accidents

Sen K Varghese; Tom Joseph; Sandra Ann Varughese; Lakshmi Anil

Abstract: To avoid the scarcity of water which is a tough situation, borewells are dug all over the world. But the careless management and improper completion of such wells lead to a situation where such wells become an artefact of death rather than life. The number of reported cases of a child falling in borewells is increasing day by day. Even with the advancement in science and technology, a proper and risk-free rescue method for such a scenario is not yet made. Existing robots are also not efficient enough to do a successful rescue. This is the reason why we came up with this paper. Pangolin, also called anteater is a mammal whose method of catching its prey used in our paper. A pangolin extends its tongue to burrow and catches the prey once it is stuck onto the tongue.

Similarly, we also have a mechanical based extension system for the extending of the robot. Like pangolin sticky tongue, using animatronic hand we can ensure the safety of the victim by holding safely and tightly. In addition to this hand, support from the bottom also is there so that the total pulling force is evenly spread to the child's body. After successful gripping of the child, he/she is pulled up using a mechanical chain system. The child's condition is monitored throughout using various sensors. A high-resolution camera is also used for perfect gripping of the animatronics-based hands.

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