SIH: Borewell Rescue Robot

Description:

A robotics device for borewell rescue operations can be a crucial tool for the National Disaster Response Force (NDRF) when rescuing individuals trapped in borewells. These devices come equipped with cameras, sensors, and various tools to locate and safely extract those stuck in such situations. In recent years, India has witnessed unfortunate incidents where people, including children and adults, have fallen into open borewells, leading to tragic consequences. The rescue operations in these scenarios are intricate and demanding, necessitating specialized equipment and skills. NDRF is frequently called upon to assist in these rescue efforts.

Links to the research papers:

1. https://jespublication.com/upload/2023-V14I3064.pdf

Summary:

The system uses AI-based technology to detect and alert caregivers when a child is near a borehole. The second stage is rescue, which involves using a portable equipment module to extract the child from the borehole. The third stage is post-rescue care, which involves providing oxygen and medical attention to the child.

Technologies we need:

1. AI-based technology for detecting the presence of a child near a borehole.
2. Sensors to detect the child's facial expressions, measure the oxygen percentage in the hole, and detect the presence of poisonous gases.
3. An ultrasonic sensor to measure how far away the child is from the sensor.
4. A robotic arm controlled by a motor driver to extract the child from the borehole.
5. A temperature sensor to measure the child's temperature.
6. An analog-to-digital converter to convert the sensed analog values of temperature, pressure, and gas sensors to digital values.

7. Gas sensors to detect the presence of poisonous gases such as hydrocarbons, methane, and volatile organic compounds in a borehole.
8. A gripper to hold the child tightly and take them out safely.
9. A USB camera to capture video footage of the borehole.
10. Zigbee technology to transmit control signals from the PC to the robot.

Hardware Requirements:

1. Raspberry Pi, a single-board computer used to control electronic components for physical computing and explore the Internet of Things (IoT) using GPIO pins.
2. ESP-32 CAM, a low-cost Wi-Fi module with a built-in camera that can be used as a surveillance camera.
3. Ultrasonic sensor, an electronic device that measures the distance of a target object by emitting ultrasonic sound waves and converts the reflected sound into an electrical signal.
4. Gas sensors to detect the presence of poisonous gases such as hydrocarbons, methane, and volatile organic compounds in a borehole.
5. Analog-to-digital converter to convert the sensed analog values of temperature, pressure, and gas sensors to digital values.
6. Motor driver to control the robotic arm.
7. USB camera to capture video footage of the borehole.
8. Zigbee technology to transmit control signals from the PC to the robot.

Software Requirements:

1. Python IDLE, an integrated development environment (IDE) for Python used to write programs and upload them into the Raspberry Pi.
2. ThingViewFree, a mobile application used to visualize ThingSpeak channels and access the values of temperature and distance of objects.

3. VNC Viewer, a cross-platform screen-sharing system used to remotely control another computer and access the desktop of a remote computer from a secondary device. This type of mobile application is used to control the proposed system.

ML models:

1. VGG NET algorithms, a deep learning model used to detect facial emotions of children trapped in borewells and recognize a child's voice.
2. Real-time EEG-based emotion recognition system, a model proposed by Liu et al. to identify an individual's emotional states through the analysis of brain waves.

Problem Understanding and Novel Innovation:

The problem at hand revolves around the urgent need for effective borewell rescue operations in India, where individuals, including children and adults, often fall into open borewells, leading to tragic outcomes. The National Disaster Response Force (NDRF) is frequently tasked with these challenging rescue operations, which demand specialized equipment and expertise.

Key Points of the Problem Statement:

1. **High Incidence of Borewell Incidents**: India has witnessed numerous incidents where people have fallen into open borewells, posing a significant danger to their lives.
2. **Complex and Challenging Rescue Operations**: Rescuing individuals trapped in borewells is a complex and perilous undertaking due to factors like depth, soil composition, and potential instability.
3. **NDRF's Role**: The NDRF plays a crucial role in responding to these emergencies and needs tools and equipment to enhance their capabilities.
4. **Need for Specialized Equipment**: Borewell rescue operations require specialized equipment, including robotics devices, to locate and safely extract trapped individuals.

5. **Real-Time Data and Remote Operation**: Robotics devices equipped with cameras, sensors, and remote control capabilities can provide real-time data on the situation inside the borewell, ensuring safer and more effective operations.
6. **Transportation and Deployment**: Devices need to be lightweight and compact for easy transportation to rescue sites, considering the urgency of the situations.
7. **Objective**: The primary objective is to save lives and minimize damage during these emergency borewell incidents.

Addressing this problem requires the development and deployment of advanced robotics devices tailored to borewell rescue operations, coupled with comprehensive training and coordination among relevant authorities and organizations. The solution should focus on improving the speed, safety, and success rate of these challenging rescue missions to prevent tragic outcomes.

Impact on Society:

1. **Lives Saved**: Implementing robotics devices for borewell rescue operations can directly save lives by enabling quicker and safer extractions of trapped individuals. This would significantly reduce the tragic outcomes seen in such incidents.
2. **Minimized Trauma**: Successful rescue operations contribute to reducing trauma and emotional distress experienced by both the trapped individuals and their families, improving the overall well-being of affected communities.
3. **Enhanced Preparedness**: The presence of such technology and expertise can serve as a preventive measure, deterring people from approaching borewells unsafely, thereby reducing the occurrence of accidents.
4. **Public Awareness**: The deployment of advanced technology in rescue operations can raise awareness about borewell safety and the importance of securing open borewells, leading to a safer environment for children and adults alike.

Scalability:

1. **Nationwide Implementation**: The deployment of robotics devices for borewell rescue can be scaled up nationwide in India, given the country's high incidence of

borewell accidents. Similar technology can be adapted for use in other countries facing similar challenges.

2. **Training and Standardization**: To ensure scalability, standardized training programs can be developed to equip NDRF and other rescue teams with the skills required to operate these devices effectively.
3. **Research and Development**: Continuous research and development efforts can lead to improvements in device design and capabilities, making them even more effective and versatile in various rescue scenarios.

Probable Business Model:

1. **Device Manufacturing**: Companies can specialize in manufacturing and selling robotics devices tailored for borewell rescue operations. They can offer different models with varying levels of sophistication to cater to the needs of different rescue teams.
2. **Service Contracts**: Offer service contracts to government agencies, rescue organizations, and local communities to provide maintenance, training, and support for these devices.
3. **Consulting and Training**: Establish consulting and training services to educate rescue teams on the effective use of these devices and borewell rescue best practices.
4. **Public-Private Partnerships**: Collaborate with government agencies to deploy these devices as part of public safety initiatives. Such partnerships can involve equipment provision, training, and maintenance contracts.
5. **Community Awareness Programs**: Develop community-focused initiatives to raise awareness about borewell safety and offer services for securing open borewells.
6. **Research and Development Grants**: Seek grants and funding for research and development to continuously improve the technology and expand the range of applications.
7. **International Expansion**: Consider exporting the technology and expertise to other countries facing similar challenges, potentially creating opportunities for global partnerships.

A well-executed business model should prioritize the primary goal of saving lives and preventing borewell accidents while ensuring the sustainability and scalability of the technology and services provided.