Project Title: Borewell Rescue Robotic Device

Team ID: IPR-057

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# 1. Introduction

In rural regions, accidental falls into open borewells often result in critical rescue scenarios, especially involving children. Conventional rescue operations are time-intensive, risky, and frequently unsuccessful. This project aims to develop a compact, real-time, robotic rescue system using Raspberry Pi Pico or ESP32, integrated with video streaming, sensors, and a robotic arm to enhance rescue outcomes.

# 2. Problem Statement

To design and implement a robotic device capable of descending into narrow borewells, offering real-time visual feedback, environmental monitoring, and mechanical assistance to aid in the rescue of trapped individuals.

# 3. Proposed Solution

* Real-Time Monitoring: Onboard camera module for live feed.
* Obstacle Detection: Ultrasonic sensors to avoid collisions.
* Compact & Modular Design: Adaptable to different borewell diameters.
* Communication Module: Two-way communication with the victim.
* Autonomous Movement: Motorized navigation with manual override.
* Robotic Arm: Mechanism for providing essentials or lifting the victim.

# 4. Innovation and Uniqueness

* Modular construction for easy customization.
* Integration of Blynk 2.0 for IoT-based control.
* Real-time data transfer and remote accessibility.
* Cost-effective components ensuring affordability.
* Data logging and AI-ready architecture for future enhancements.

# 5. Technical Approach

## Hardware Components:

* ESP32-CAM
* OV2640 Camera Module
* Ultrasonic Sensors
* L298N Motor Driver & DC Motors
* Servo Motor-based Robotic Arm
* Battery Pack (Li-ion)
* Chassis Frame with Wheels

## Software Tools:

* Arduino IDE (C/C++)
* Blynk 2.0 Mobile Platform
* Firebase for Cloud Logging
* MQTT for communication

# 6. System Architecture

* Input: Ultrasonic Sensors, Camera Feed
* Processing: ESP32 handles sensor and camera data
* Output: Video Stream, Arm and Movement Commands
* Communication: Blynk App Dashboard via Wi-Fi
* Power: Portable Li-ion battery supply

# 7. Sample Code for ESP32-CAM with Blynk and Ultrasonic Sensor

#include <WiFi.h>  
#include <BlynkSimpleEsp32.h>  
#include <NewPing.h>  
  
char auth[] = "YourAuthToken";  
char ssid[] = "YourWiFiSSID";  
char pass[] = "YourWiFiPassword";  
  
#define TRIG\_PIN 5  
#define ECHO\_PIN 18  
#define MAX\_DISTANCE 200  
  
NewPing sonar(TRIG\_PIN, ECHO\_PIN, MAX\_DISTANCE);  
  
BlynkTimer timer;  
  
void sendSensor() {  
 int distance = sonar.ping\_cm();  
 Blynk.virtualWrite(V0, distance);  
}  
  
void setup() {  
 Serial.begin(115200);  
 Blynk.begin(auth, ssid, pass);  
 timer.setInterval(1000L, sendSensor);  
}  
  
void loop() {  
 Blynk.run();  
 timer.run();  
}

# 8. Project Timeline

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| Phase | Timeline | Activities | Output |
| I | Week 1-2 | Research, Component Listing, Procurement | Conceptual Design |
| II | Week 3-4 | Hardware Assembly, Sensor Integration | Physical Prototype |
| III | Week 5-6 | Software Development, Mobile App (Blynk) Integration | Working Model |
| IV | Week 7-8 | Testing, Debugging, Optimization | Final Prototype |
| V | Week 9 | Report Writing, Review, Presentation | Project Completion |

# 9. Conclusion

This Borewell Rescue Robotic Device addresses a critical societal need using innovative, scalable, and cost-efficient technology. By leveraging real-time monitoring, sensor integration, and remote operability, it significantly enhances the safety and success of borewell rescue missions.

# References

1. Tejaswini S. Mane et al., "Robotic Device for Borewell Rescue Operation", IJCRT, 2024.
2. R. Murphy et al., "Mobile Robots in Mine Rescue and Recovery", IEEE Robotics Automation Magazine, 2009.
3. G. Kavianand et al., "Smart Child Rescue System from Borewell", ICETETS, 2016.