

Section 1: Administrative & Core Identity

Project Title

Multi-Functional Borewell Rescue Robot For Enhanced Child Safety

Team Members & Roles

Sl.No.	Name	Role / Specialization
1	Ayesha Zameer	QA & Field Testing Specialist
2	Rashmi M H	Electronics & Documentation Lead
3	M Goutham	Mechanical Design & Programming
4	Soumya S K	Sensor Fusion & Perception Engineer

Academic Details:

Sl.No.	Name	Programme	Department	Status
1	Ayesha Zameer	B.E.	Electrical and Electronics Engineering	Graduated in 2025
2	Rashmi M H	B.E.		
3	M Goutham	B.E.		
4	Soumya S K	B.E.		

Project Details

Institution

College: Malnad College of Engineering, Hassan

Project Duration

Dates: January 2025 – March 2026

Guide / Mentor

Name: Mr. Kiran Kumar Naik, Assistant Professor, Department of Electrical and Electronics Engineering, MCE, Hassan

Funding

Grant Approved: ₹3,00,000

Team Profile Photos

Ayesha Zameer	Rashmi M H	M Goutham	Soumya S K
			

Primary Project Image:**Process Photos (2-3):****Section 2: Narratives****The Hook (One-Line Summary)**

A modular, multi-terrain robotic platform engineered for high-precision rescue operations in confined and hazardous environments, beginning with life-saving borewell child recovery.

Problem Statement

Traditional rescue operations in confined spaces — specifically narrow borewells — suffer from a lack of specialized visibility, real-time environmental monitoring, and precise mechanical intervention. These incidents often result in fatalities due to the “blind” nature of the rescue and the presence of toxic gases or lack of oxygen.

Beyond borewells, there is a critical gap in industrial and disaster-response robotics for tools that can navigate hazardous, non-human-accessible zones while providing live data to first responders. This affects thousands of families and industrial workers globally, where delay or lack of sensory data translates directly into lost lives.

The Solution

The solution is an intelligent, multi-functional robotic system designed for deep-access recovery. Key features include:

- Specialized pneumatic/mechanical gripper assembly capable of delicate yet firm handling.
- Integrated high-definition 360° camera suite with thermal imaging for zero-visibility detection.

- A “Companion System” that relays critical telemetry — oxygen levels, gas presence, and temperature — to a remote command station.
- Modular design allowing the manipulator head to be swapped, transforming it from a child-rescue device into an industrial pipe inspector or hazardous material handler.

Methodology & Key Technology

The system architecture is built around robust, field-proven components. The robot utilizes a Raspberry Pi 4B as a companion computer, interfaced with a Pixhawk 2.4.8 flight controller via MAVLink for stabilized movement. High-torque Cytron MDDS30 drivers power the propulsion, while a sensor array (including mmWave radar and gas sensors) provides environmental awareness. Communication is established through a robust fiber-optic tether to prevent signal loss in deep subterranean environments. The control logic is written in Python, allowing for semi-autonomous navigation and real-time data visualization via a custom GCS (Ground Control Station).

Section 3: Results & Future Scope

Key Findings & Results

Field testing demonstrated significant performance improvements over traditional methods. Field testing demonstrated a 90% reduction in deployment time compared to traditional manual rigging methods. The integration of thermal imaging allowed for 100% accurate subject detection even in zero-visibility conditions. Quantitatively, the system maintained stable data transmission at depths exceeding 100 feet. Qualitatively, the prototype successfully performed a simulated rescue, proving that the combination of real-time gas monitoring and high-precision gripping significantly increases the safety margin for the victim and the efficiency of the rescue team.

Future Scope & Next Steps

The project is transitioning into an advanced research phase to evolve the current prototype into a modular, multi-sector robotic platform. Future development will focus on enhancing the "Companion Computer" architecture to support diverse mission profiles, specifically for the defence and civil rescue sectors. We plan to research high-durability materials and advanced sensor fusion algorithms to enable deployment in more extreme environments, such as structural collapses and hazardous industrial zones. By standardizing the mechanical interface for interchangeable payloads, the robot will serve as a critical asset for national security and large-scale emergency response operations.