# TITLE:HAZARDSCOUT:MULTI PURPOSE EMERGENCY RESPONSE ROBOT

DOMAIN:IOT

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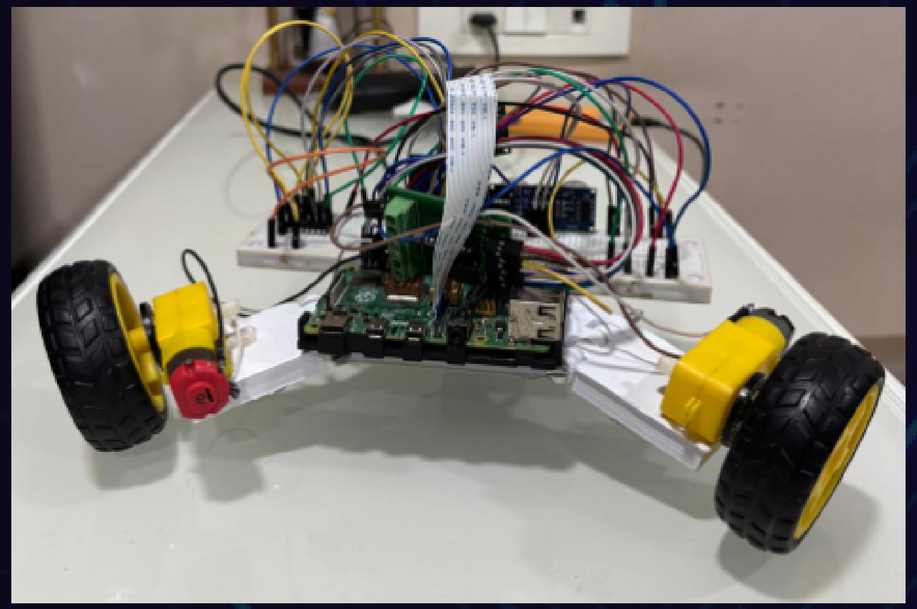

# ABSTRACT

Inspecting pipelines and telecom cables is slow, risky, and costly with manual methods. Our robot makes this process safer and faster. It can climb pipes vertically, move horizontally, and overcome obstacles. Equipped with gas, temperature, and humidity sensors, a camera, and location tracking, it detects issues in real time and sends SMS alerts for quick action. This improves safety, reduces costs, and speeds up maintenance.

# PROBLEM STATEMENT

Current inspection and maintenance methods for critical infrastructure, such as pipelines and telecommunication cables, are often slow, labor-intensive, and carry significant risks for human operators. Tight spaces, obstacles like pipe joints, stairs, and the complexity of underground or overhead systems hinder efficient inspections. Additionally, existing systems struggle to effectively detect hazards such as gas leaks, fire risks, corrosion, or structural damage in real-time, leading to delayed response times and potential safety hazards. Manual inspections of pipelines, oil, gas, water systems, and telecommunication infrastructure are prone to errors, increasing operational costs and risking human safety during emergency situations like fires or leaks.

# LITERATURE SURVEY

| Sr No | Author(s) and Year of Publication | Title of the Paper | Key Methodology Followed | Findings | Gaps/Limitations | Future Work |
|---|---|---|---|---|---|---|
| 1 | J. Smith et al., 2023 | Flexible Pipe Navigation in Robotics | Articulated joints for flexible navigation in pipelines | Capable of navigating through complex and narrow pipelines | Lacks autonomous decision-making ability | Add AI-driven navigation for better autonomy |
| 2 | N. Patel et al., 2023 | Autonomous Firefighting Robots with Sensor Fusion | Data fusion from smoke, gas, and temperature sensors | Improved accuracy in detecting fire and gas leaks | Response time is still relatively high | Develop faster response algorithms |
| 3 | Y. Tanaka et al., 2023 | Firefighting Robots with Water Jet Propulsion | Water jet propulsion and thermal imaging for fire suppression | Capable of extinguishing fires in challenging environments | Limited water supply for prolonged fire suppression | Integrate more efficient water storage or refuelling systems |
| 4 | X. Zhang et al., 2022 | Magnetic-Wheeled Climbing Robots for Non-Destructive | Magnetic adhesion combined with adaptive mechanisms | Effective in detecting gas leaks in hazardous vertical environment | Limited to metallic surfaces | Expand to non-metallic surface climbing techniques |

# LITERATURE SURVEY

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|---|---|---|---|---|---|---|
| 5 | M. Lee et al., 2022 | Advanced Fire Detection and Suppression Robots | Use of thermal and infrared imaging with automated fire | Autonomous detection and suppression of fire in industrial settings | Limited to flat, open spaces | Limited to flat, open spaces |
| 6 | F. Wilson et al., 2022 | Robots for Petrochemical Industry Inspections | Magnetic wall-climbing with real-time gas monitoring | Effective for inspecting industrial pipelines and tanks | Only applicable to specific environments (petrochemical) | Adapt design for broader industrial applications |
| 7 | D. Li et al., 2022 | Wireless Sensor Networks for Industrial Safety | Integration of wireless sensor networks for continuous monitoring | Autonomous detection and alarming of gas leaks | High maintenance cost of sensor systems | Develop cost-effective WSNs for widespread use |
| 8 | A. Brown et al., 2021 | Real-Time Data Transmission in Hazardous Environments | High-resolution cameras and sensors for real-time data | Reduces human exposure to hazardous environments | Data transmission sometimes fails in low connectivity areas | Improve connectivity in remote industrial areas |

# LITERATURE SURVEY

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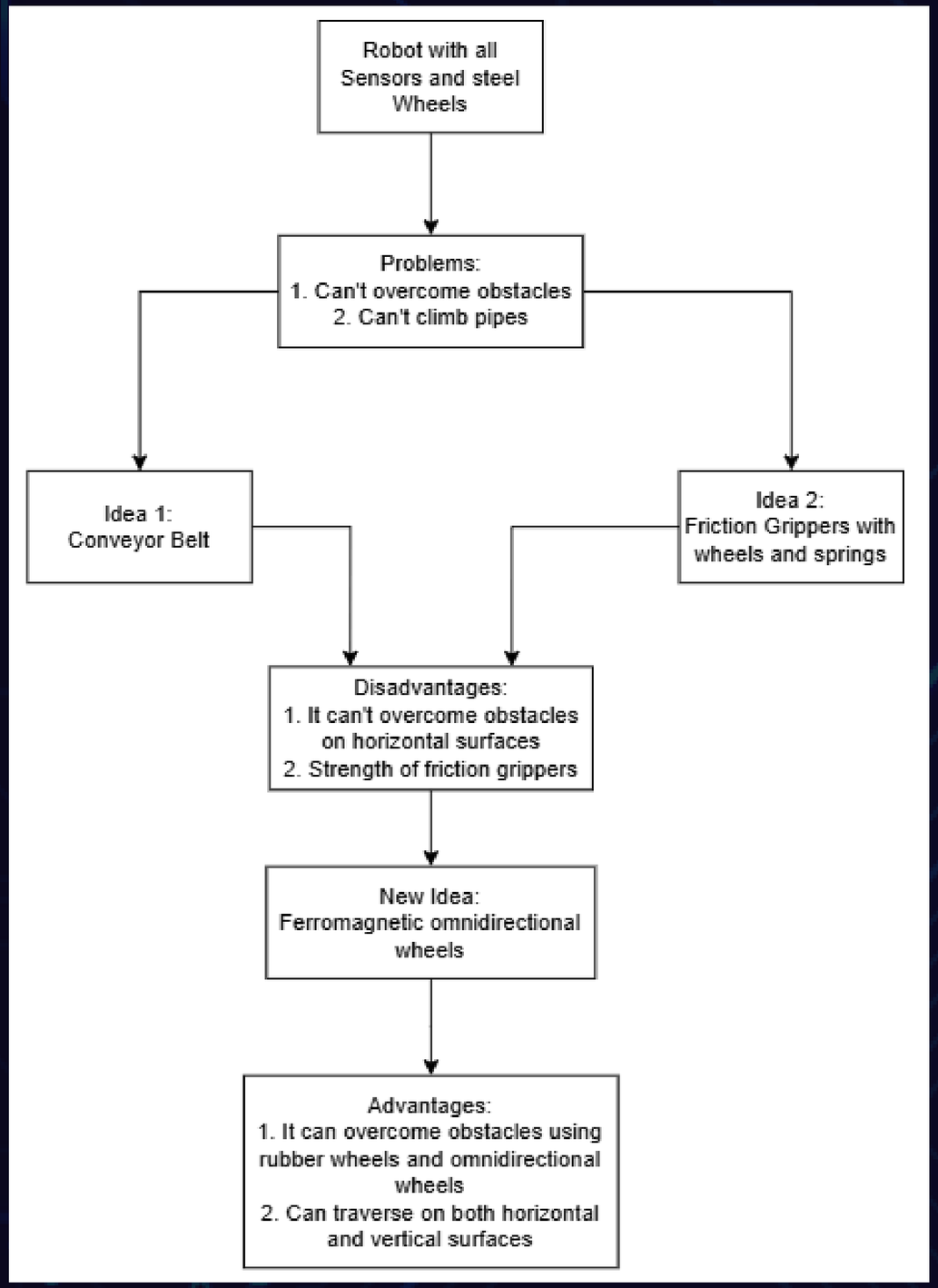
| 9 | R. Diaz et al., 2021 | Snake Robots for Confined Space Navigation | Serpentine movement for navigating confined spaces | Useful in post-disaster environments and confined industrial areas | Limited control in unpredictable environments | Enhance robustness to environmental changes |
| 10 | A. Kumar et al., 2021 | Gas Leak Detection Using Multi-Sensor Robotic Systems | Multi-sensor integration for real-time leak detection | Accurate detection of gas concentration | High energy consumption of sensors | Improve energy efficiency of sensor networks |




# PREVIOUS IDEAS

The diagram depicts the evolution of solutions for a robot to climb pipes and navigate obstacles. Initially, the robot with sensors and steel wheels struggled with climbing and obstacles. The first idea, conveyor belts, failed on vertical surfaces. The second idea, friction grippers, faced strength issues. Finally, ferromagnetic omnidirectional wheels were chosen, offering effective traversal on both horizontal and vertical surfaces while overcoming obstacles.

# PROPOSED SOLUTION

Our robot is designed for gas leakage detection and environmental monitoring in industrial and residential settings. Controlled via a mobile app, the robot utilizes motors, ultrasonic sensors, and magnets for stable movement on pipes, with omnidirectional wheels and obstacle detection for enhanced navigation. It features gas, chemical, temperature, and humidity sensors to capture real-time environmental data, while a camera module and flashlight assist in image capture and low-light conditions.

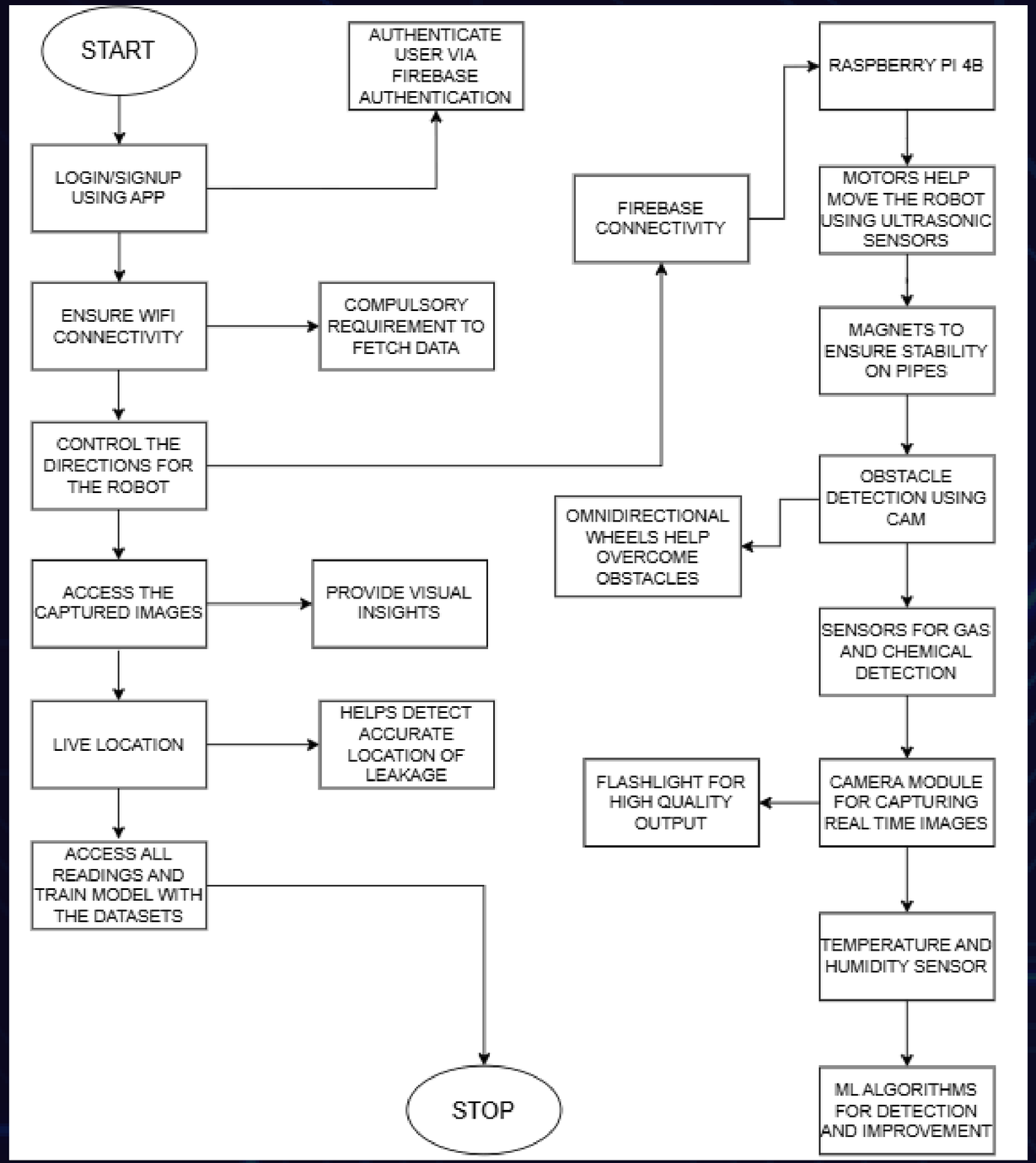
# SYSTEM REQUIREMENTS

**System Requirements - Software**

- Raspbian OS
- Thonny python IDE
- Machine Learning
- Flutter App
- Figma - UI/UX

**System Requirements - Hardware**

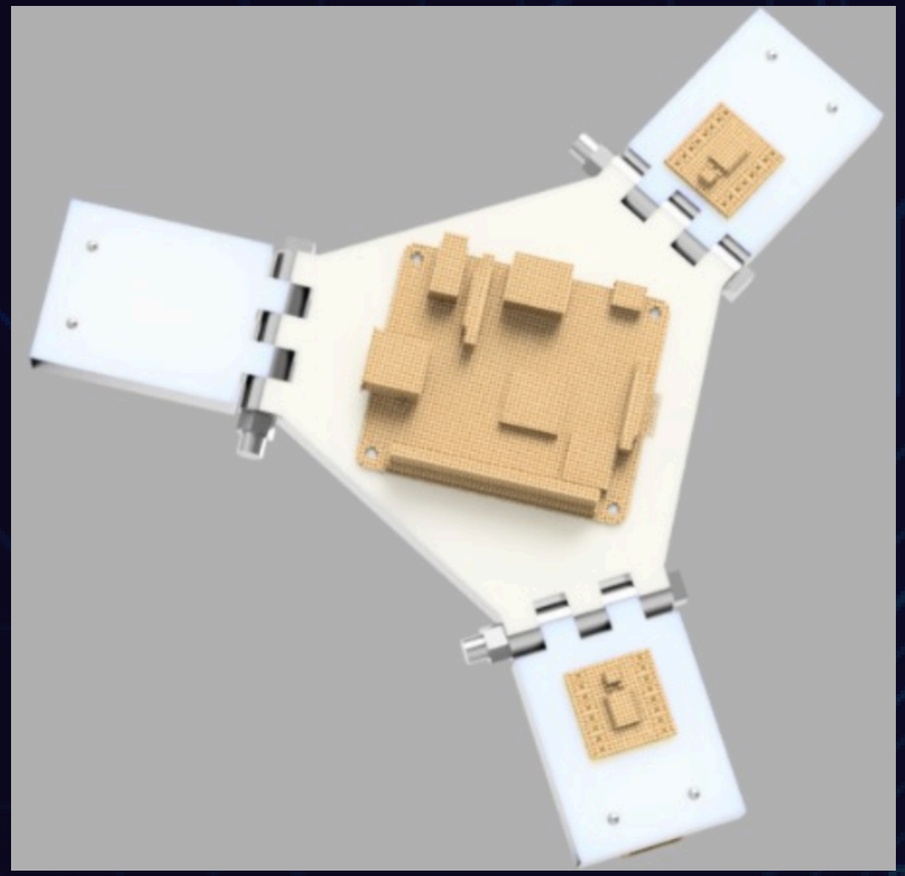
- Raspberry Pi
- MQ-6 (Gas Sensor)
- Temperature and Humidity Sensors
- 2 regular wheels and 1 castor wheel
- 2 DC Motor
- 1 Pi Camera
- 2 Ultrasonic Sensors
- 1 Breadboard
- Cables and Connectors
- Ventilating Fan
- Flashlight for Enhanced output
- Ultrasonic sersar
- 1293 Motor Driver

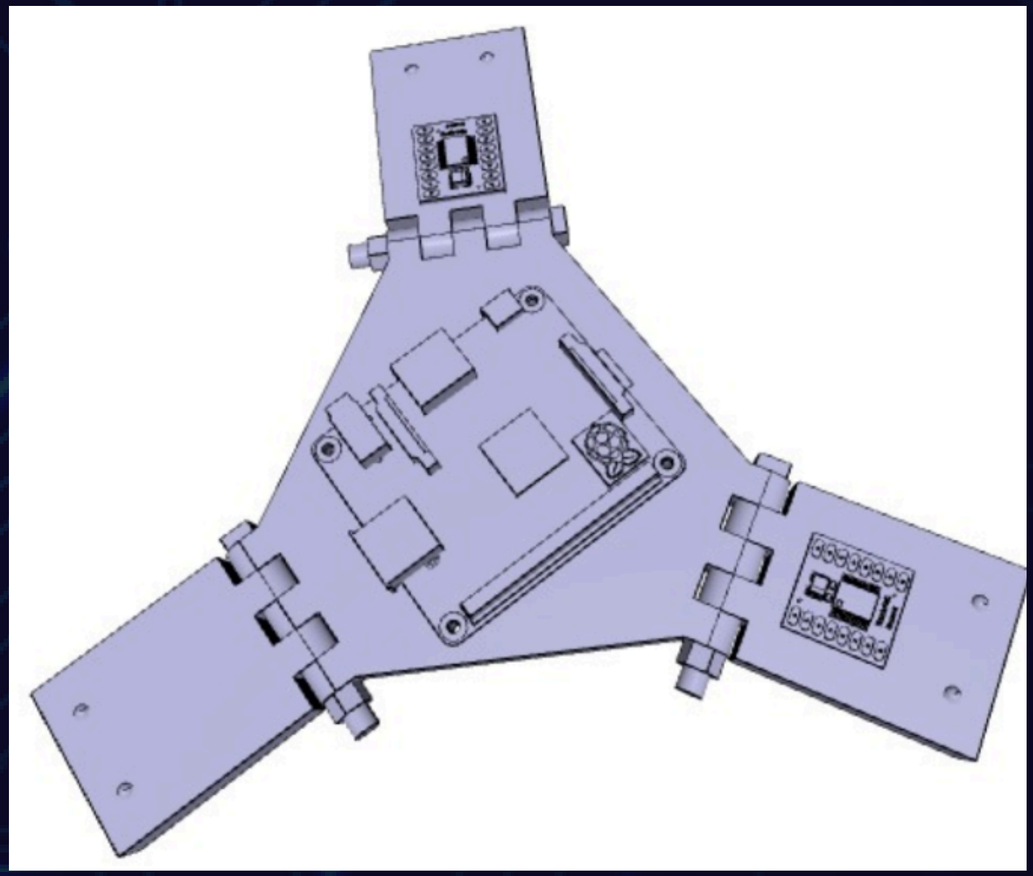



# ARCHITECTURE DIAGRAM

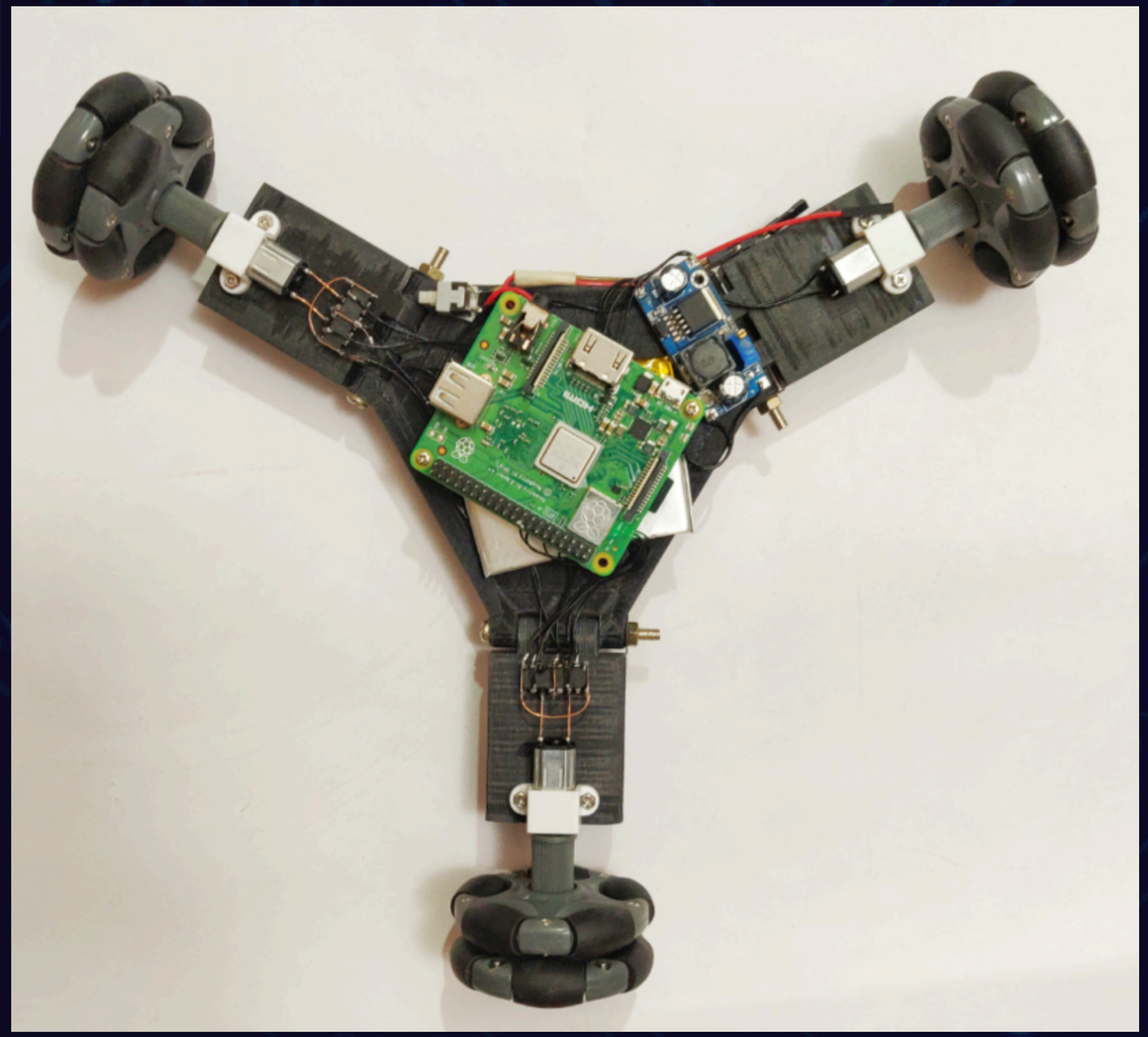
The diagram illustrates the operation of a robotic system designed for pipe inspection and gas leakage detection. It begins with user authentication via an app using Firebase, followed by ensuring WiFi connectivity to control the robot. The robot employs various features such as omnidirectional wheels for obstacle navigation, magnets for stability, and advanced sensors for detecting gas leaks and capturing real-time data. The collected data is analyzed using machine learning to provide accurate insights and live visuals, enhancing detection capabilities and delivering precise outcomes to users.

# CAD DESIGN

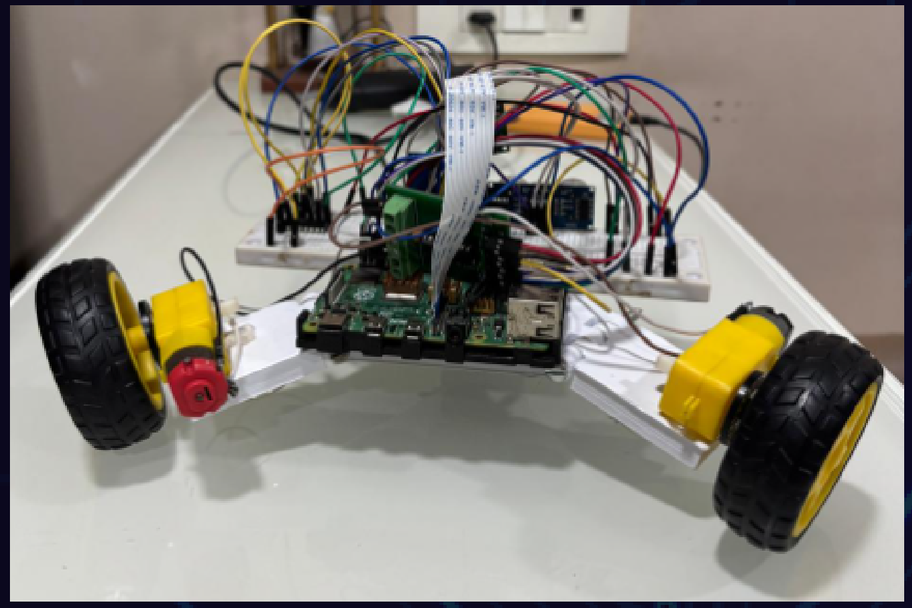


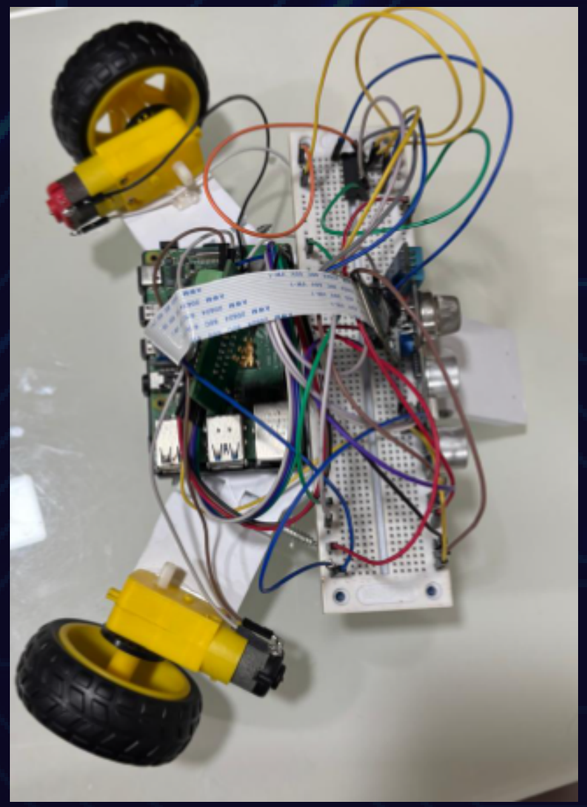


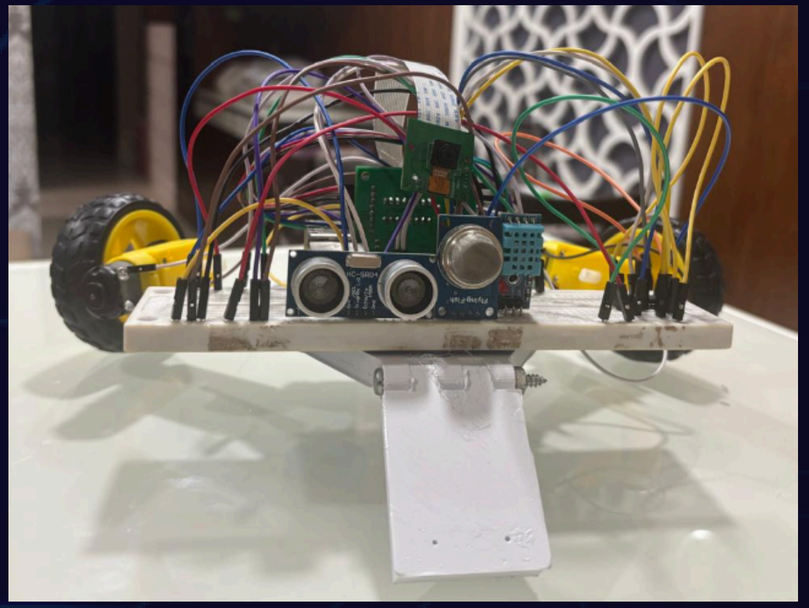
# PROPOSED DESIGN



# CURRENT PROGRESS







# CURRENT PROGRESS

# SURVEY

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# THANK YOU