e-Yantra Robotics Competition (eYRC 2019-20)

Theme: Supply Bot (SB)

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(Certificate)

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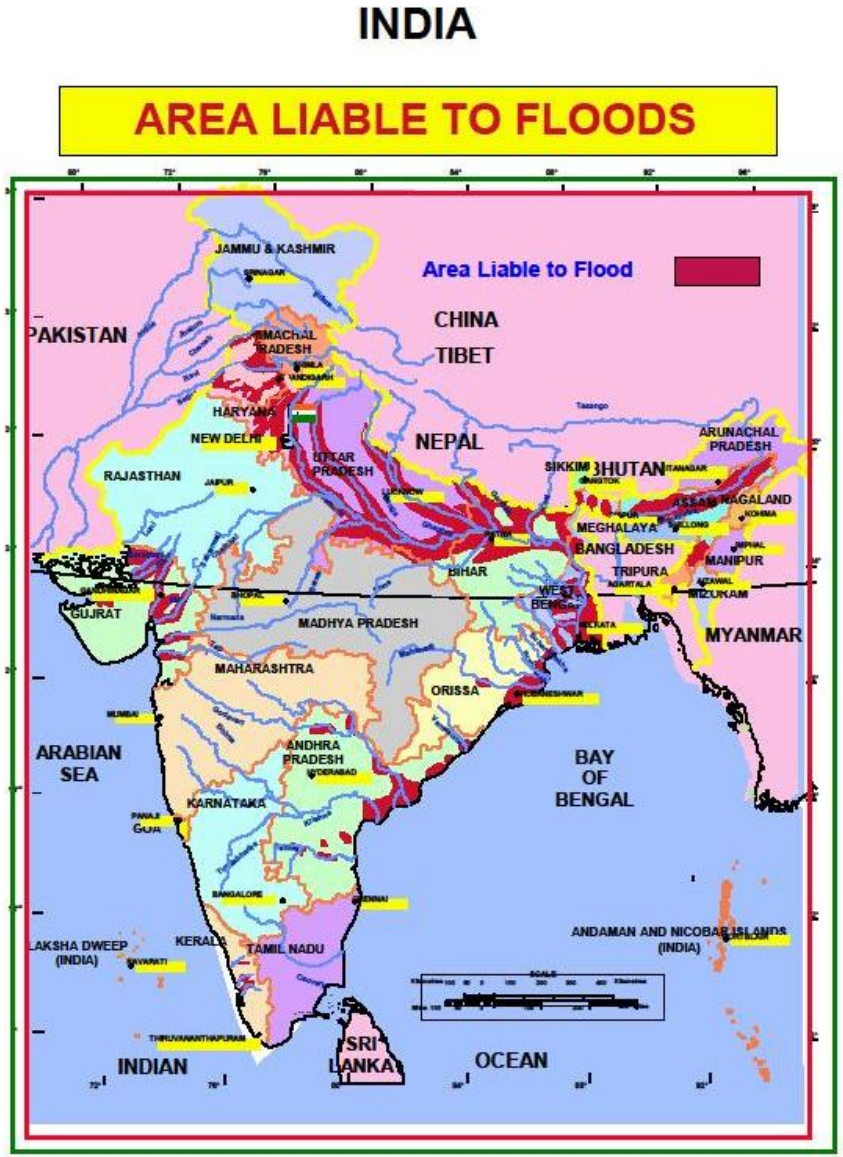
Introduction & Motivation

- India’s more than 12% of its total geographical area of 329 million hectares—approximately **40 million hectares—are flood-prone**, frequently disrupting lives, livelihoods, infrastructure, and public utilities.
- Each year, floods impact approximately 7.5 million hectares of land (about 2.3% of the total area), leading to the **loss of around 1,600 lives**, with **significant flood events occurring more than once every five years**, highlighting the country's persistent and widespread flooding issues.
- Most rescue operations focus on evacuating residents and livestock to safety while distributing essential supplies such as food and medical aid to stranded individuals in affected areas, highlighting the **need for a robust flood disaster management system**.



Reference: National Disaster Management Authority. Floods | NDMA, Govt. of India
https://ndma.gov.in/Natural-Hazards/Floods

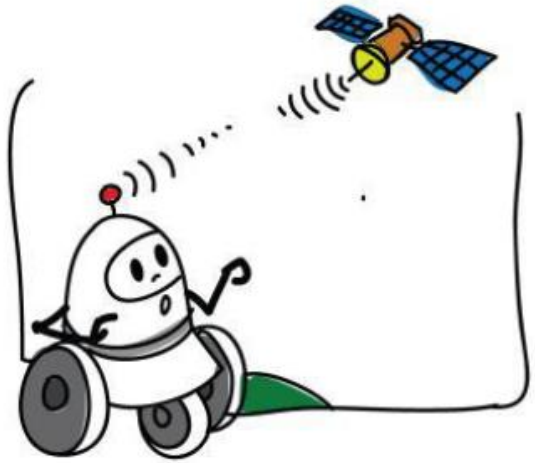
Project Overview

Aim: We aimed to create an autonomous robot, Supply Bot, to efficiently deliver emergency aid in flood-impacted areas. This system can prioritize requests for medical aid, food, and essential supplies.

Objectives:

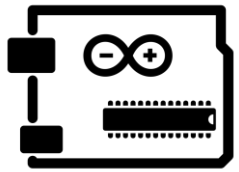
1) Develop an autonomous robot capable of identifying and delivering relief packages.
2) Enable real-time aid requests via satellite-like communication.
3) Prioritize critical areas and supplies in flood-disaster scenarios.

Key Features: Autonomous Navigation, Image Processing for Aid Recognition, and Efficient Target Delivery.

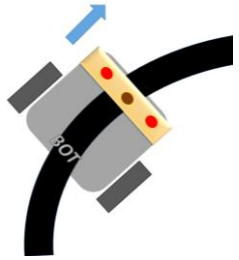


Components

Hardware



Microcontroller: Arduino for robot control.



Sensors: Line-following sensors for navigation and ultrasonic sensors for obstacle detection.

Motors and Actuators: For mobility and dispatching aid packages.

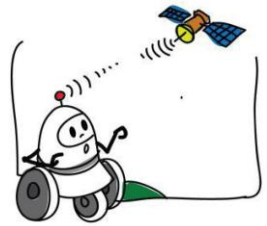
Software

Programming Languages: Python for image processing; Embedded C for robot control.

Frameworks: OpenCV for image recognition and aid tracking.

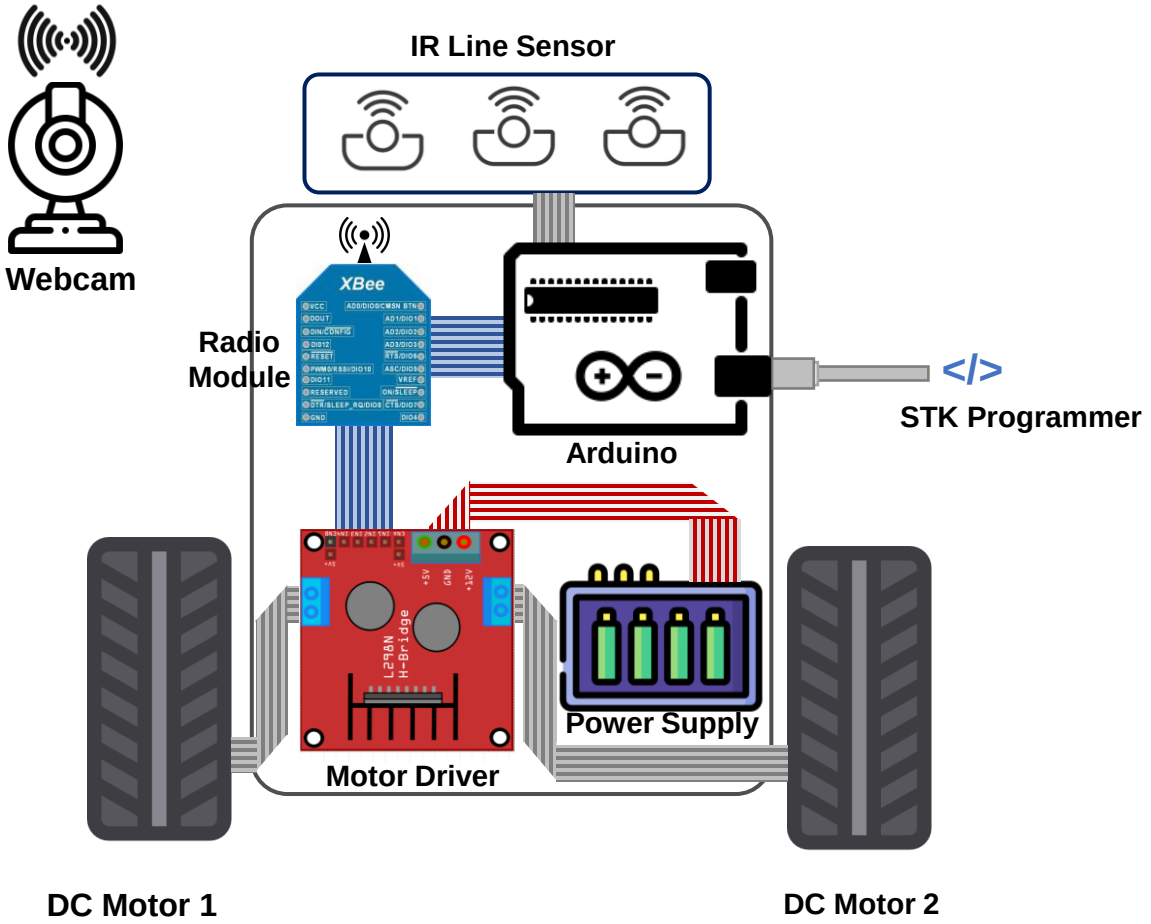
Image Processing

Interpretating satellite signals (camera) to locate 'help beacons' placed across the arena.

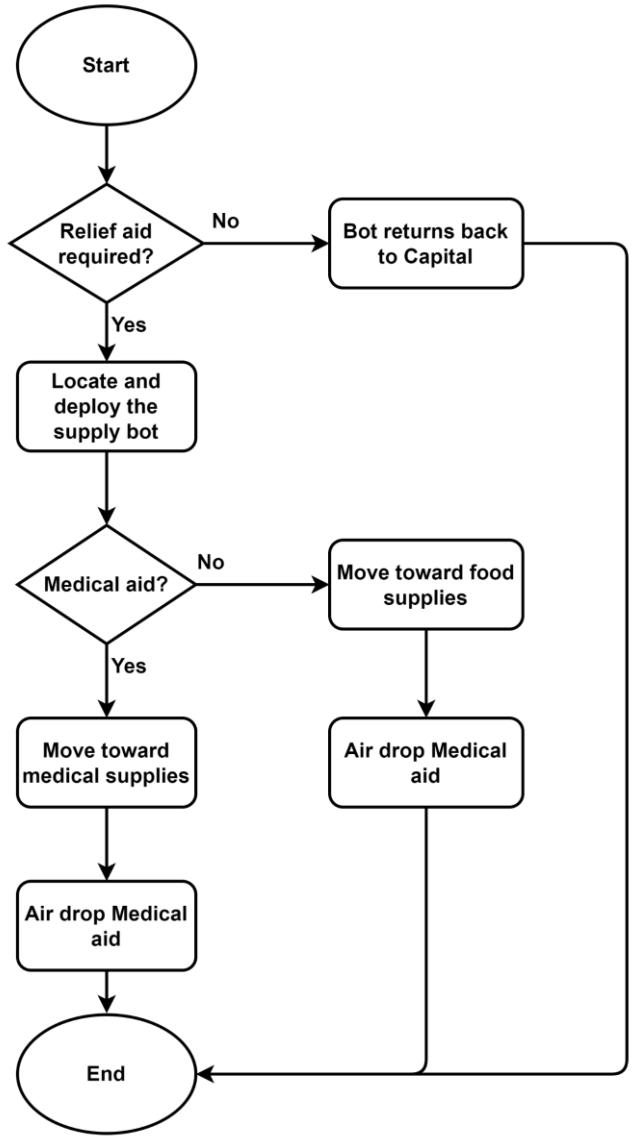


Color-coded beacons based on aid type (red for medical aid, green for food) is identified and navigated to the location.

System Design



Algorithm:



Arena Setup and Navigation

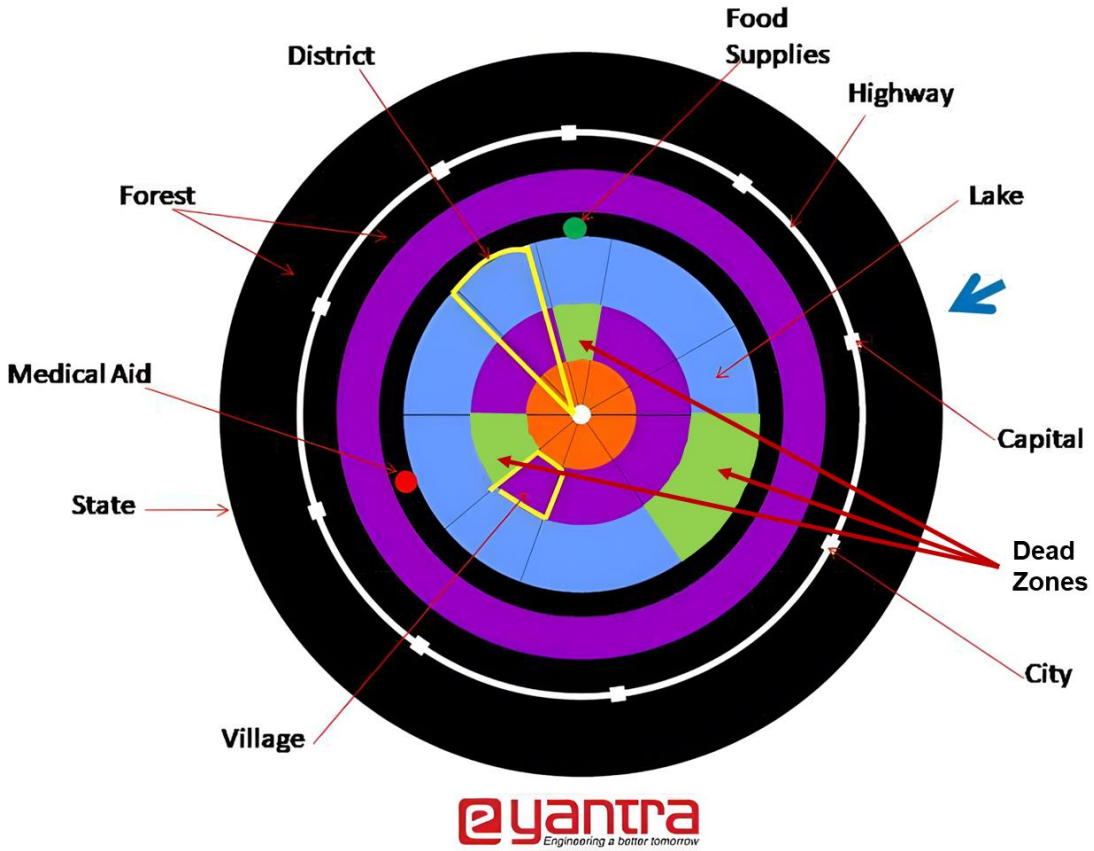


Fig: Elements of the Arena

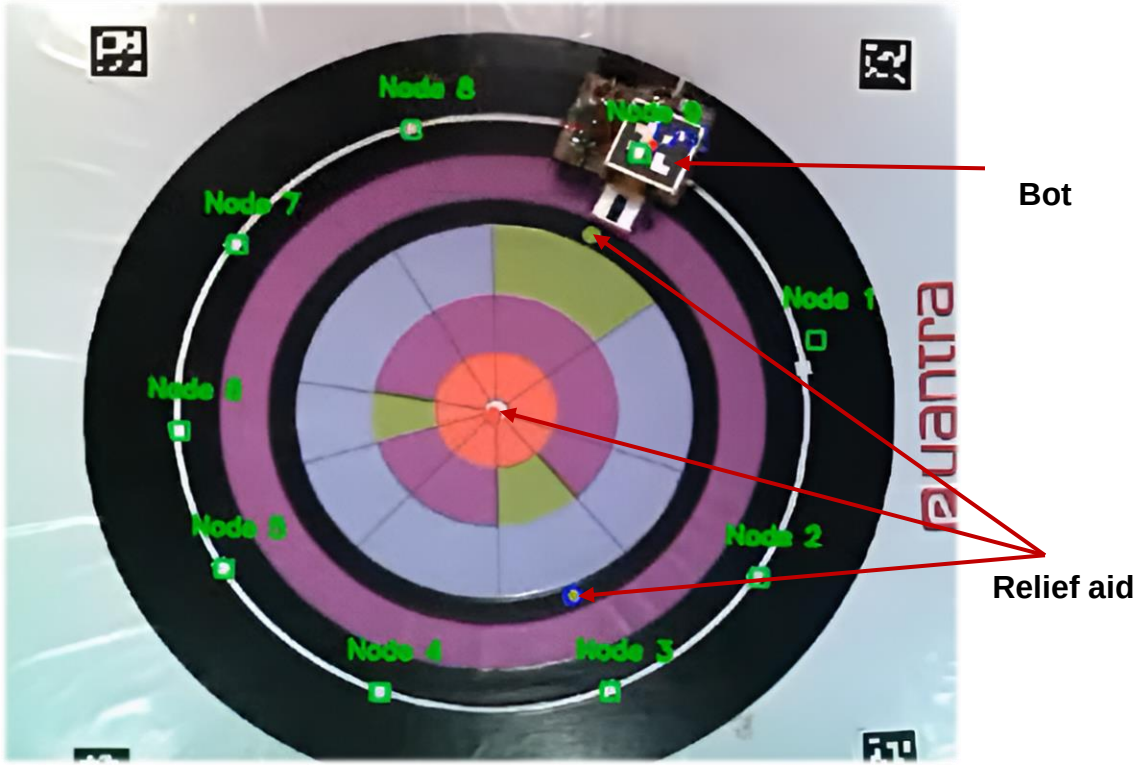


Fig: Arena

- The arena simulates a flood-affected state, divided into districts, cities, and villages. Each district represents a flood zone requiring aid.
- Supply Bot follows a predefined path (white line) through districts, delivering aid to designated cities.
- Dead zones represent unserviceable areas where aid should not be dispatched, ensuring resource optimization.

Robot in Action

Operational Workflow

Step 1: Bot starts at the state capital (starting point).

Step 2: Detect aid beacons via overhead camera and navigate to the location.

Step 3: Prioritizes critical aid types and delivers to impacted zones.

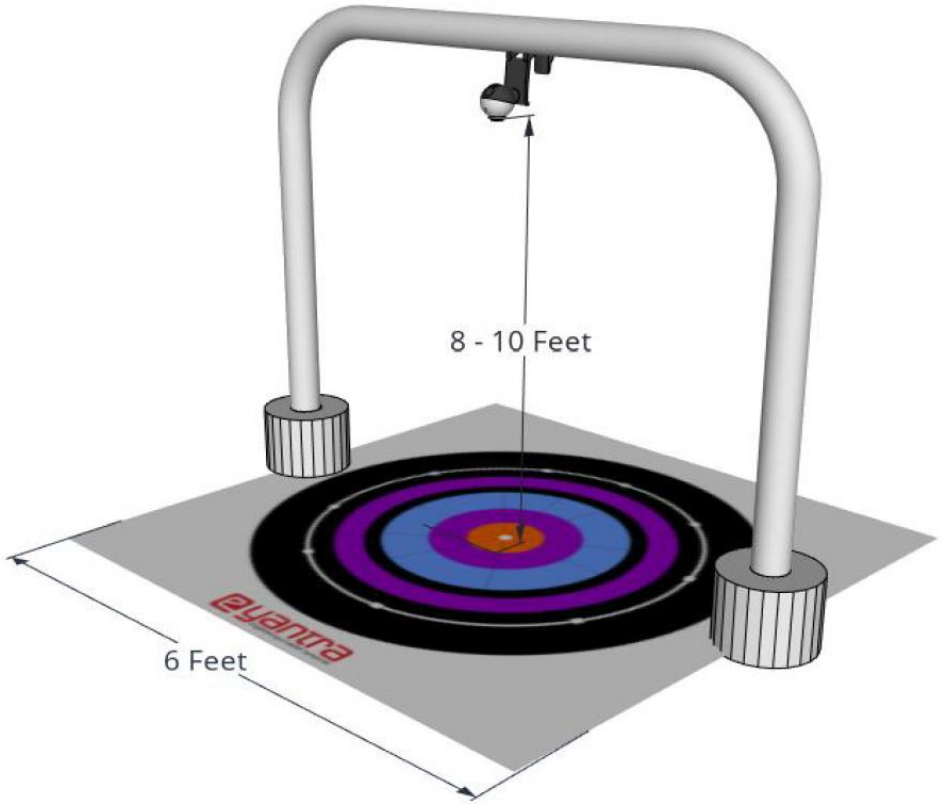


Fig: Setup

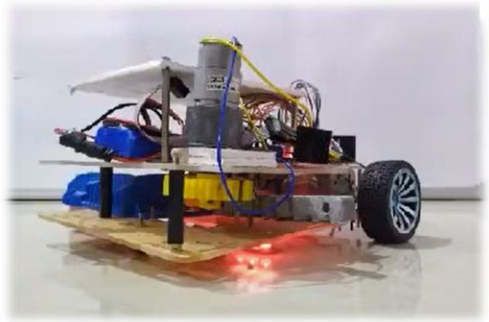


Fig: Supply Bot

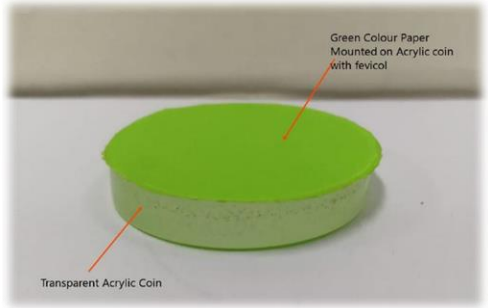


Fig: Relief-Aid

NOTE:

- Medical aid beacons (red) are prioritized over food (green) when both requests are detected in a single district.
- The bot addresses the state capital first if it's impacted, reflecting real-world disaster response priorities.

Challenges and Solutions

Technical Challenges:

- *Image Recognition:* Difficulties in consistent detection under varying light and environmental conditions.
- *Navigation Precision:* Maintaining accuracy while avoiding obstacles and dead zones.
- *Coin Dispatch Mechanism:* Ensuring precise and reliable aid delivery to designated areas.

Solutions Implemented:

- Calibrated image recognition algorithms to enhance accuracy in beacon identification.
- Adjusted line-following sensors for smoother navigation and obstacle handling.
- Designed a mechanical structure to release aid reliably without disrupting the bot’s trajectory.

Conclusion

Conclusion:

- The Supply Bot project demonstrates the potential of autonomous robotics in disaster relief, focusing on efficient, real-time aid delivery in flood-affected regions.
- By integrating image-processing capabilities, the project shows promise for scalable, impactful disaster response solutions.

Future Improvements:

- Incorporate machine learning for advanced decision-making based on environmental data.
- Enhance battery efficiency and range to cover broader and more challenging terrains.

Thank you