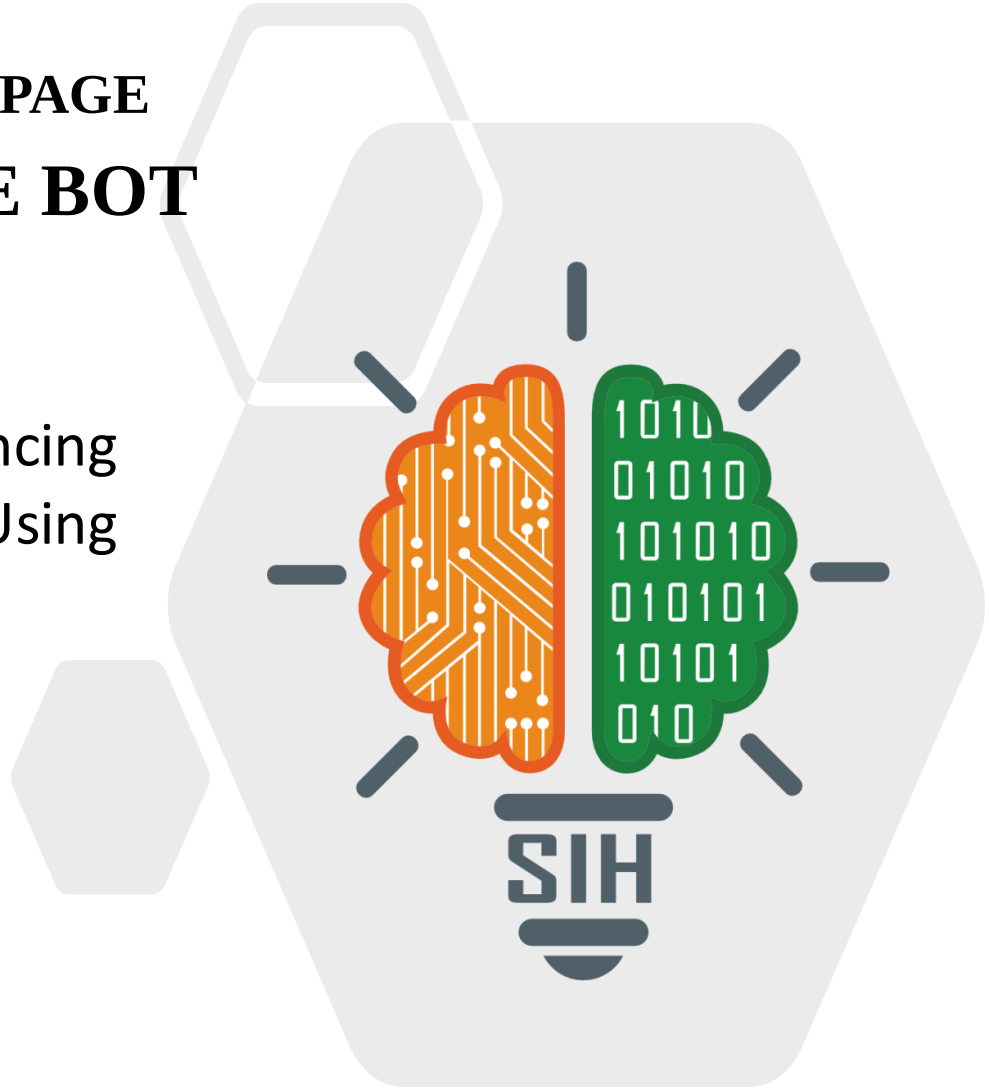
SMART INDIA HACKATHON 2024

TITLE PAGE

SNAKE BOT

- **Problem Statement ID:** SIH1566
- **Problem Statement Title:** Enhancing body detection in CSSR Operations Using Advanced Technology
- **Theme:** Disaster Management
- **PS Category:** Hardware
- **Team ID:** 22150
- **Team Name:** S.L.I.T.H.E.R



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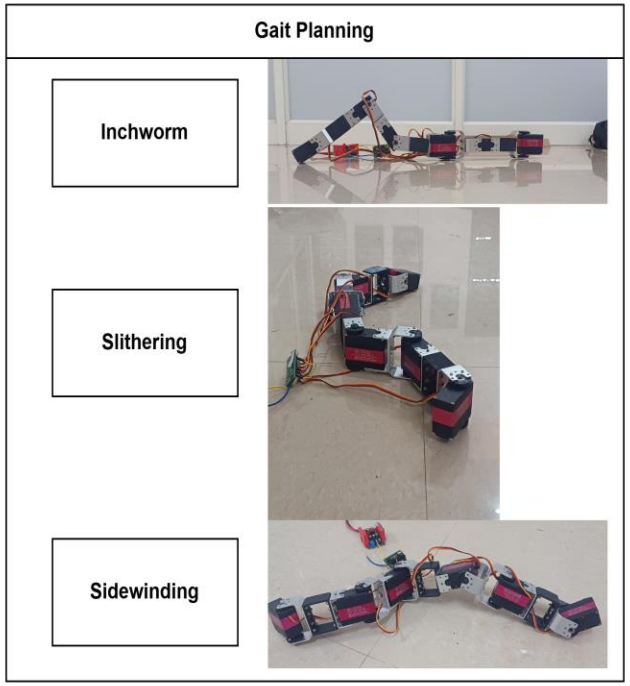
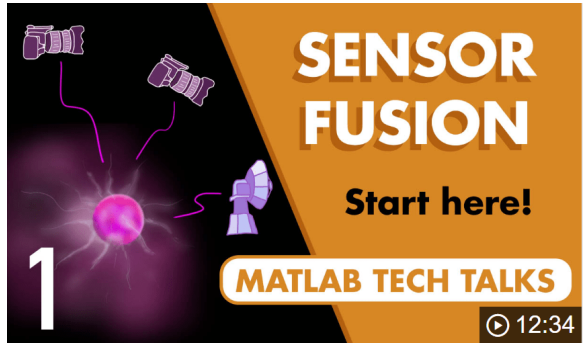
SNAKE BOT

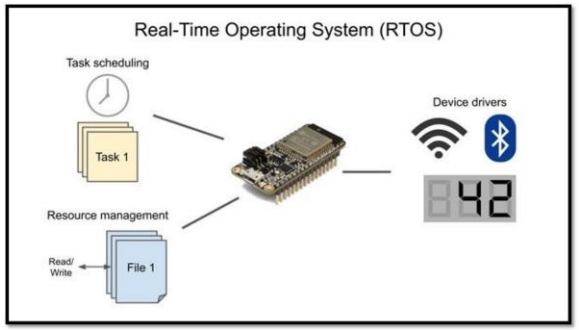
Our Solution:

We propose the deployment of a reconfigurable robot snake equipped with multiple locomotion capabilities (slithering, inchworm, sidewinding, rolling) to navigate through collapsed structures.

Salient Features:







Traditional Search Methods

- A big steel plunger is used to bang on concrete, and then listen for survivors with high powered microphones.
- Smell and sound travel through concrete much better than light does and hence dogs and microphones are also used

Limitations:

- The effectiveness of this method depends on the distance travelled by sound through concrete.
- Background noise interference.
- May not be able to detect survivors who are unconscious.

How is it different?

- Avoids the problem of **middle layer autonomy** by automatically choosing the required gait pattern mode.
- The proposed bot has a variety of future scope. It has a lot of potential to be converted into an **amphibious snake bot** utilizing similar gait pattern.
- Utilizes the concept of **sensor fusion.** By combining the outputs from all these sensors, the bot can create a more holistic view of its surroundings.

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METHODOLOGY

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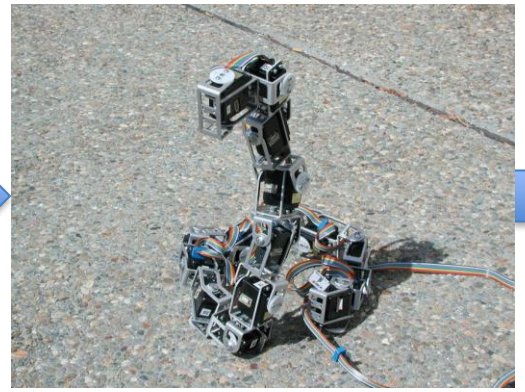
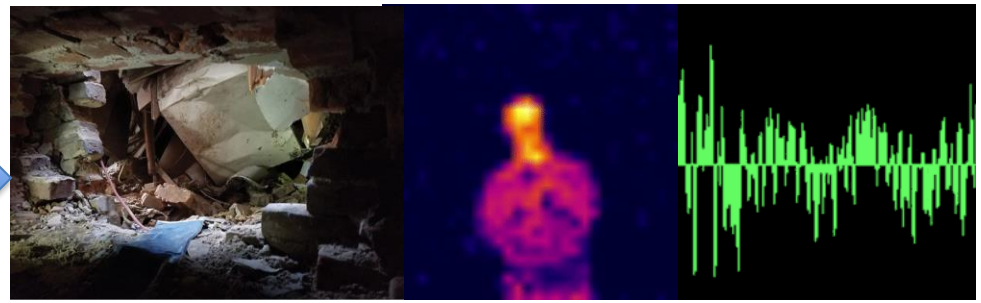
The building collapses

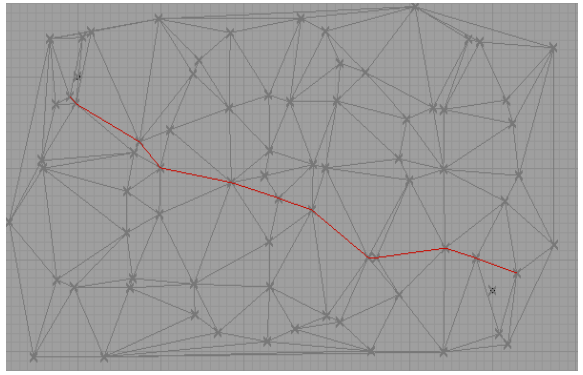


Deploying the snake robot into the collapsed structure



Employing a camera, thermal sensor and microphone to gather data and using IMU and ultrasonic sensor to navigate.

Combining the data using sensor fusion and using YOLOv8 to detect bodies.



Finally, using SLAM to generate a map of the internal structure and sending the precise location of the victims to the operator.

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TECHNICAL APPROACH

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Hardware Stack

Component Name (Link)	Specifications	Use
Thermal Camera	MLX90640 IR Array Thermal Imaging Camera, 32×24 Pixels, 110° FOV	Thermal scanning and imaging
Gas Sensor	SeeedStudio Grove Gas Sensor(MQ2)	Detecting flammable gases
Microphone	Analog Sound sensor microphone module	Audio feedback
IMU	MPU9250 9-Axis Gyro Accelerator Magnetometer	SLAM
Ultrasonic Sensor	HC-SR04-Ultrasonic	SLAM
Servo Motor	OT5320M 7.4V 20kg.cm 180°	Actuation
Servo Controller	Pololu mini maestro 18-channel servo controller	Servo control

Technological Stack

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IMPACT AND BENEFITS

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Key Market Opportunities | **Industrial Application** | **Defense** | **Disaster Management** | **Medical Application**

Regional Market

North America leads the snake robot market due to tech advancements, healthcare adoption, and government funding. **Europe** follows the next while **South America** and **MEA** contribute at a slower pace.

Industry Developments Market

The snake robot market is set to grow from **USD 1.34 billion** in 2023 to **USD 12.2 billion** by 2032. Key developments include the launch of **Soft Robotics' Mamba** and the **European SnakeBot** project.

Key Market Trend

Their flexibility makes them ideal for procedures like **laparoscopy.** Opportunities lie in search and rescue, inspection, and hazardous material handling. Recent trends involve AI integration for autonomy and soft robotics for enhanced flexibility

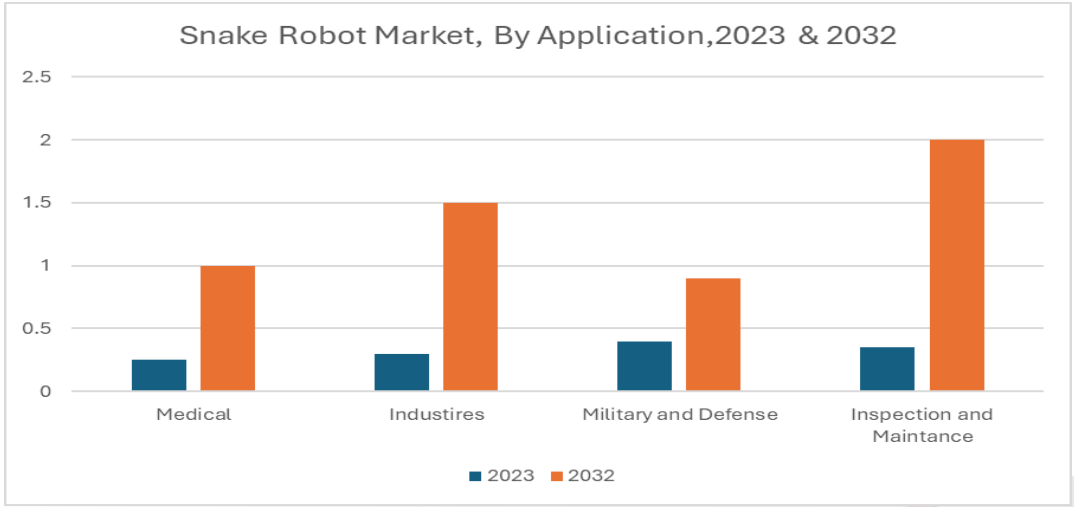
INVESTING COMPANIES

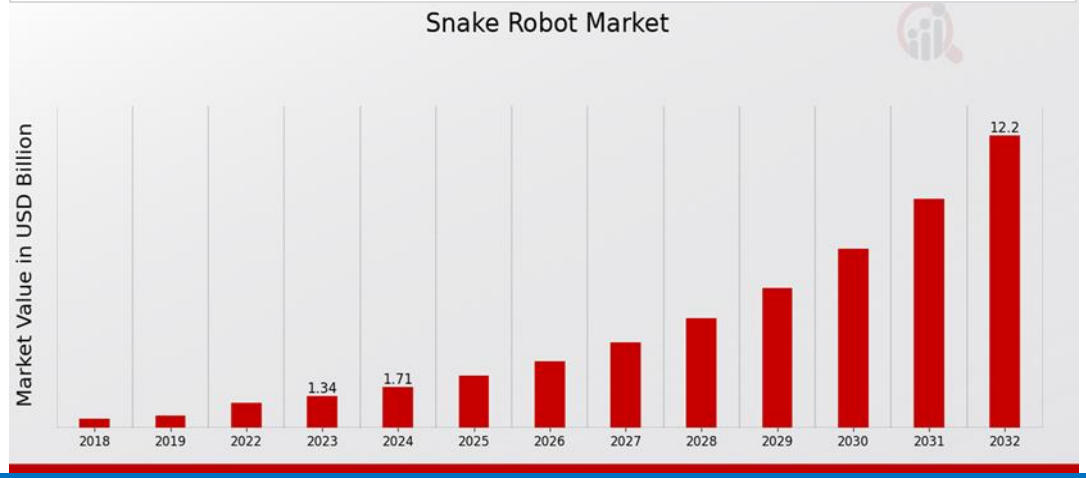
Kawasaki Robotics

iRobot

Medrobotics

OCRobotics
A GE Aviation company





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FEASIBILITY AND VIABILITY

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S — STRENGTHS

- Navigates Confined Spaces
- Handles various terrains and obstacles
- Efficient in Complex Environments
- Remote Operation

W — WEAKNESSES

- Complex Mechanism
- Restricted Payload
- Limited Speed

O — OPPORTUNITIES

- Automating the process
- Making it amphibious
- Battery Operated

T — THREATS

- Technological Failures
- Mechanical Durability
- Building collapsing on the robot

Effective Solutions to Address Key Challenges

Decentralized Design: Instead of having a single electronic system controlling all the modules, each component functions independently. This enables the robot to continue navigating even if one node fails, rather than depending on a central control unit.

Robust Materials: Using advanced, durable materials like carbon fiber, flexible polymers, and lightweight metal alloys can enhance the robot's ability to withstand harsh environments and physical stress.

Handiling Complexities: RTOS (Real-Time Operating System) is designed for time-critical applications. This enables RTOS the power of multitasking,precise control over the robot's movements .

RESEARCH AND REFERENCES

- *AmphiBot I*: an amphibious snake-like robot
- CSSR Equipment
- Statistics
- Tutorial