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“Jnana Sangama” Belagavi-590018, Karnataka

JSS MAHAVIDYAPEETHA

JSS Academy of Technical Education, Bengaluru

Department of Robotics & Automation

Presentation on

TITLE: SURVEILLANCE ROBOT

PROJECT GUIDE

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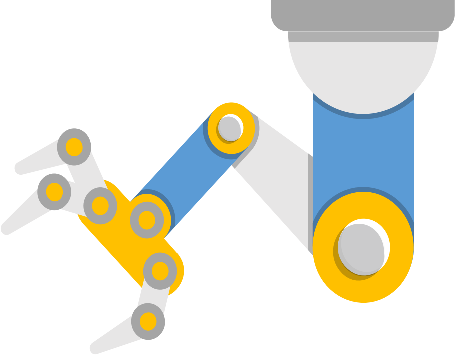
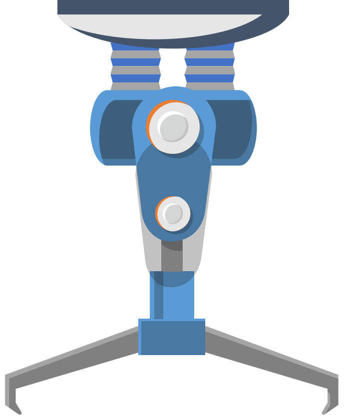


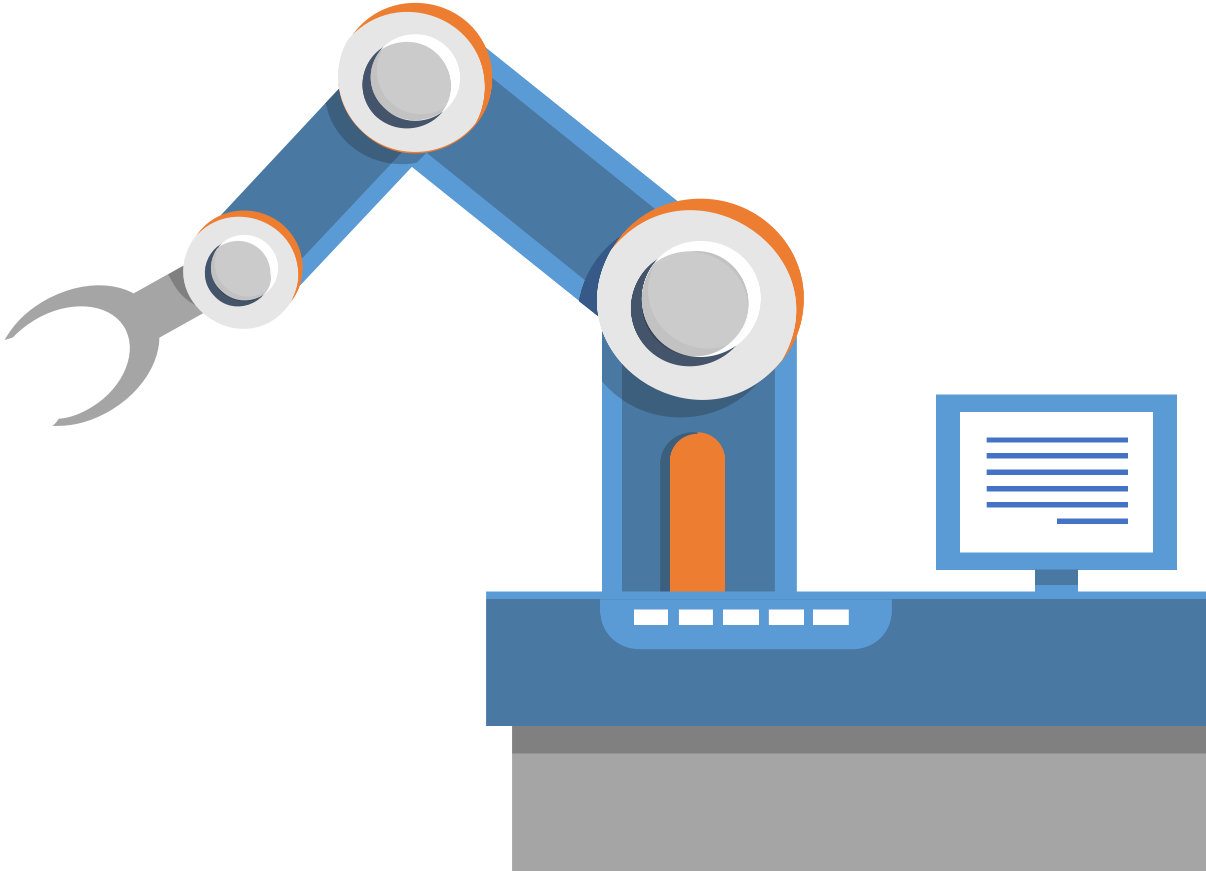
OBJECTIVES AND GOALS



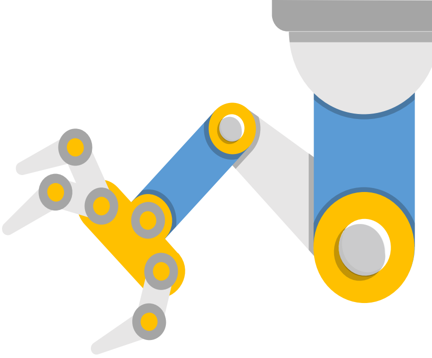
The Spider Bot project leverages ESP32 to create an autonomous surveillance system for border security

Key characteristics include:

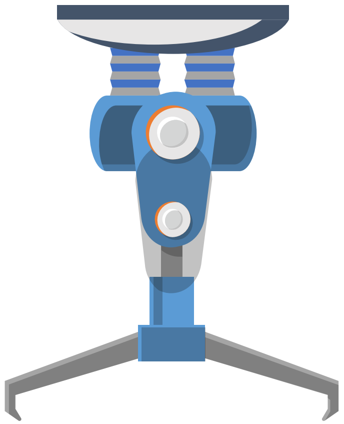
- ❖ 1. To create an autonomous system for border security.
- ❖ 2. To detect and notify landmines and unauthorized movements.
- ❖ 3. To classify and respond to known and unknown individuals at the border.



PROBLEM STATEMENT



The current military surveillance methods have several challenges, including limited coverage, human error, and high risk to personnel.



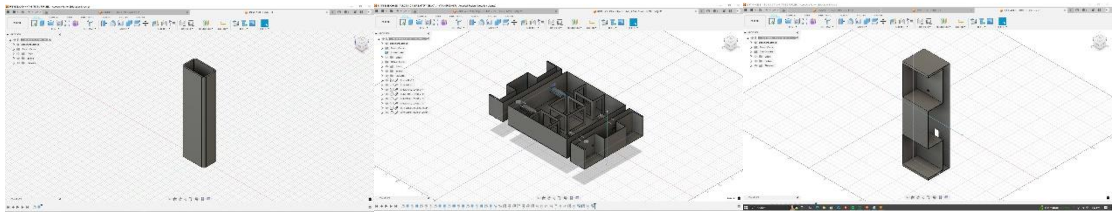
There is a need for an autonomous system that can enhance coverage and reduce these risks.

TITLE	AUTHOR	YEAR	SUMMARY
Survey on Contemporary Remote Surveillance Systems for Public Safety	Tomi D. Räty	2010	This paper reviews the evolution of contemporary surveillance systems, highlighting three generations of technology. Recent advancements focus on using diverse sensors and enhancing intelligence and situational awareness. Challenges include real-time distributed architecture, video surveillance issues, wireless networks, and energy efficiency. The paper concludes with a summary and insights into the future of surveillance systems for public safety.
A Literature Review on New Robotics: Automation from Love to War	Lambèr Royakkers & Rinie van Est	2015	This article examines the societal impact of robotics in Europe and the US, focusing on five key areas: home, healthcare, traffic, police, and the military. While robots are accepted for industrial tasks, questions arise about their role in sensitive areas like child and elderly care, military actions, and intimate relationships. The review explores emerging robot technologies and the ethical and regulatory challenges they pose. It provides a thoughtful analysis of the societal implications without speculating on future developments.

Review of sensors used in robotics for humanitarian demining application	Johana Florez; Carlos Parra	2016	This document evaluates sensor technologies for landmine detection on robotic platforms, starting with the global context of landmines. It assesses the physics parameters of relevant sensors, their advantages and disadvantages for demining, and design considerations for robotic systems. Finally, the document explores new sensor requirements for detecting improvised explosive devices (IEDs) and suggests a reduced set of sensors for this task.
Cooperative robotic networks for underwater surveillance: an overview	Gabriele Ferri, Andrea Munafò, Alessandra Tesei, Paolo Braca, Florian Meyer, Konstantinos Pelekanakis, Roberto Petroccia, João Alves, Christopher Strode, Kevin LePage	2017	This paper reviews the evolution of contemporary surveillance systems, highlighting three generations of technology. Recent advancements focus on using diverse sensors and enhancing intelligence and situational awareness. Challenges include real-time distributed architecture, video surveillance issues, wireless networks, and energy efficiency.
Progress in robotics for combating infectious diseases	Anzhu Gao, Robin R. Murphy, Weidong Chen, Giulio Dagnino , Peer Fischer , Maximiliano G. Gutierrez , Dennis Kundrat	2021	Robots could play a crucial role in managing future pandemics by taking on tasks in disease prevention, monitoring, clinical care, lab automation, logistics, and maintaining socioeconomic activities. They are ideal for dangerous or unsuitable environments for humans. The development of reliable, safe, and rapidly deployable robots is essential for their effectiveness. Open challenges include creating application-oriented robots that can address real-world needs.

A comprehensive review on landmine detection using deep learning techniques in 5G environment: open issues and challenges	Ahmed Barnawi, Ishan Budhiraja, Krishan Kumar, Neeraj Kumar, Bander Alzahrani, Amal Almansour & Adeeb Noor	2022	This paper addresses the challenge of detecting landmines, particularly anti-tank mines and unexploded devices, which pose significant risks in war-torn regions. Current detection methods suffer from issues related to cost, efficiency, and accuracy. The paper explores how deep learning, unmanned aerial vehicles (UAVs), and sensing technologies could improve detection and removal
A Broad View on Robot Self-Defense: Rapid Scoping Review and Cultural Comparison	Martin Cooney ,Masahiro Shiomi ,Eduardo Kochenborger Duarte and Alexey Vinel	2023	This study explores the acceptability of robot self-defense (RSD), focusing on public perceptions and ethical, legal, and practical issues. It examines the growing use of force-capable robots in law enforcement and military contexts, and the public's mixed feelings towards them. A survey revealed general acceptance of RSD, with cultural differences.
Review on smart landmine and landmine detection	Hans Kumar, Abhas Kanungo, Kartik Chaudhary, Jatin Tomar, Priyanshu, Harshit Yadav	2024	This paper presents a smart landmine detection rover-robot designed to enhance safety for army soldiers by using a transmitter and receiver system. The robot utilizes two sensors—magnetic and metal—to differentiate between friendly and enemy landmines. The system includes a simple transmitter-receiver circuit, Arduino UNO, and a remote-control robot.

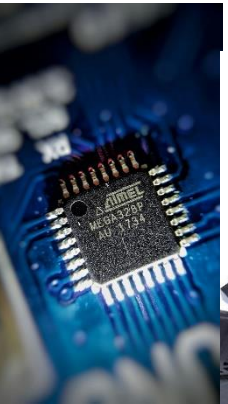
METHODOLOGY

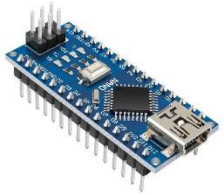


1. Mechanical Focus: Prioritize structural integrity for surveillance mechanisms.

3. Iterative Refinement: Adjust based on real-world testing.

2. Robust Electronics: Ensure microcontrollers handle real-time processing.









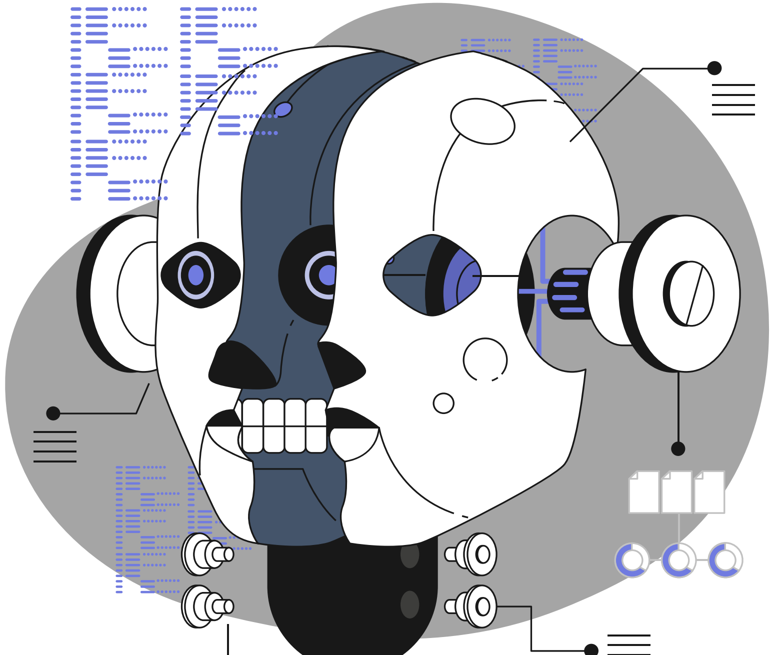


METHODOLOGY

1. Hardware Setup: ESP32, servo motors, sensors, camera, and laser gun are assembled and configured.

2. Software Development: Face recognition using OpenCV, communication via Telegram, and motion control through ESP32.

3. Testing: Border-like conditions are simulated to validate detection, identification, and response mechanisms.



COMPONENTS LIST

MAJOR COMPONENETS

HC-12

Key Features of HC-12 Module:

1.Frequency Range: It operates in the **433 MHz ISM band**, commonly used for low-power, short-range communication.

2.Transmission Distance: Can transmit up to **1 km** in open space (with proper antenna and low power settings), but the range may be reduced by obstacles or interference.

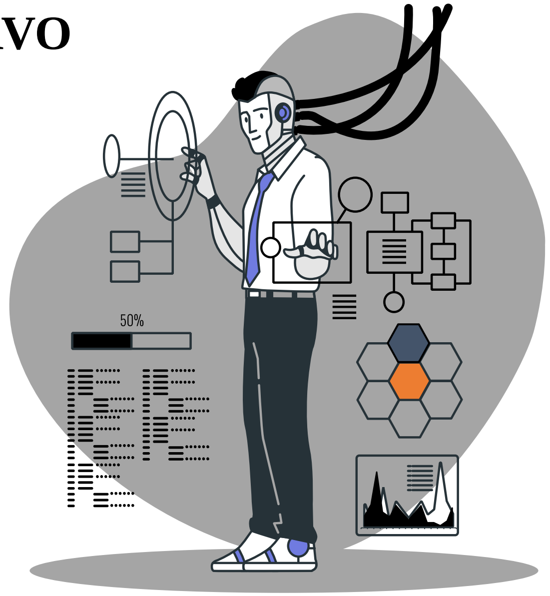
3.Serial Communication: Uses a standard **UART (TX/RX)** interface for communication with microcontrollers like Arduino, Raspberry Pi, etc.

4.Low Power Consumption: Ideal for battery-powered applications, offering different power modes to adjust range and consumption.

5.Data Rate: The module supports data rates up to **1,000 bps** in the default mode, with slower rates for longer-range communication.

SG90 SERVO

Model: SG90
Weight: 9 grams
Operating Voltage: 4.8V (typical)
Stall Torque: 1.8 kgf-cm (4.8V)
Operating Speed: 0.1 sec/60 degrees (4.8V)
Dead Band Width: 10 microseconds
Rotation: 180 degrees (90 degrees in each direction)
Additional Specifications
Operating Voltage Range: 3.0V to 7.2V
Stall Torque (6.6V): 1.6 kgf-cm
Operating Speed (6.6V): 0.09 sec/60 degrees
Dimensions: 22.2 x 11.8 x 31 mm (approx.)



ESP-32

Key Features of ESP32:

1.Dual-Core Processor: The ESP32 features a **dual-core Tensilica LX6** processor, with clock speeds up to **240 MHz**, providing significant computational power for a wide range of applications.

2.Wi-Fi and Bluetooth:

1. **Wi-Fi**: Supports IEEE 802.11 b/g/n standards for reliable Wi-Fi communication.
2. **Bluetooth**: Includes **Bluetooth 4.2 (Classic)** and **Bluetooth Low Energy (BLE)**, making it suitable for various wireless applications, such as smart home devices, wearables, and Bluetooth-controlled projects.

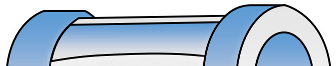
3.Memory:

1. It typically comes with **520 KB of SRAM** and supports external flash memory, ranging from **4MB to 16MB**, allowing for large firmware and data storage.

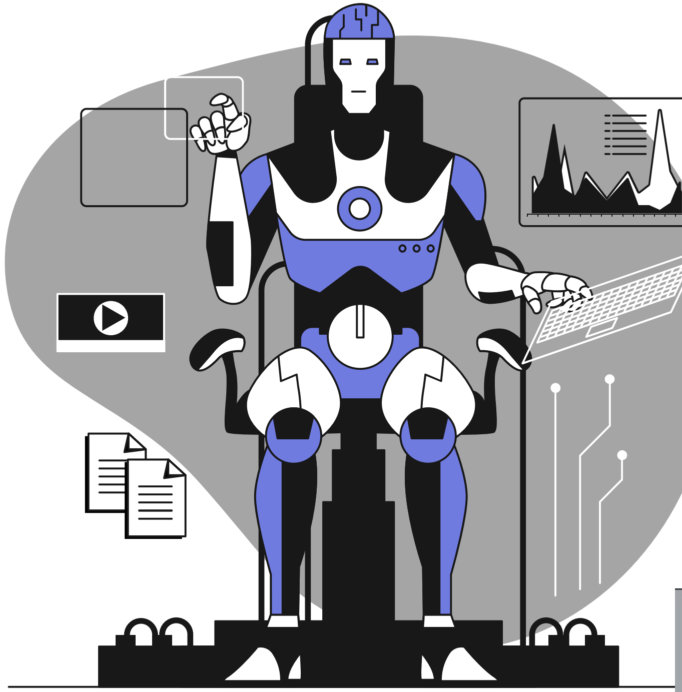
4.Low Power Consumption: Designed for battery-powered applications, it has various power-saving modes, including deep sleep mode, which helps extend battery life in IoT devices.

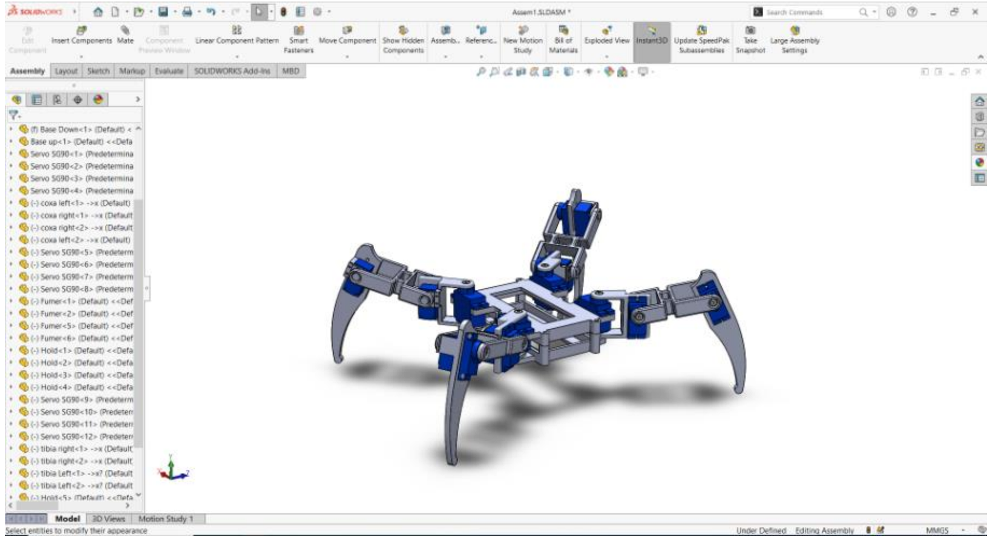
5.Rich I/O:

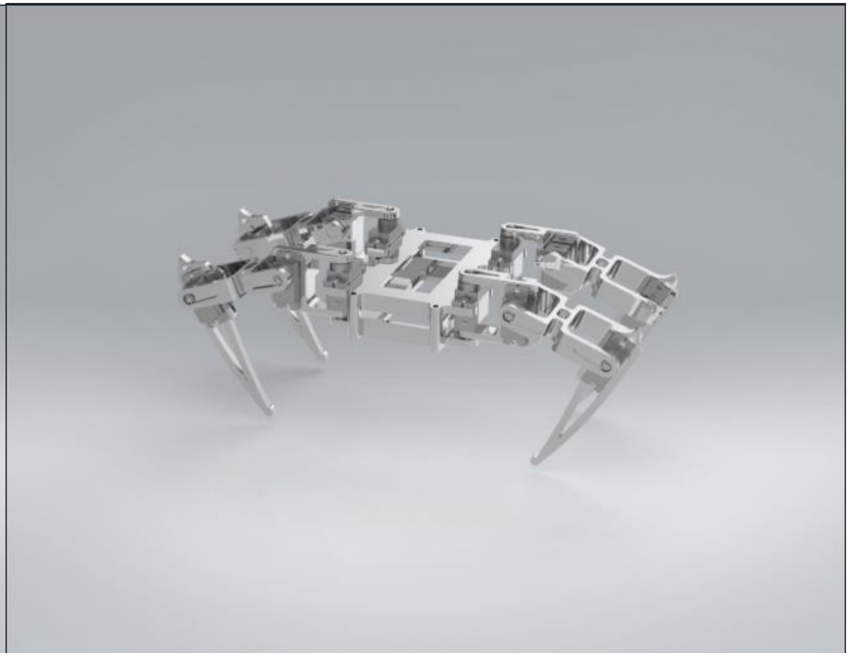
1. **GPIO Pins**: The ESP32 comes with **34 GPIO pins** (varies by board version), which can be used for input and output tasks.
2. Supports digital I/O, **PWM**, **I2C**, **SPI**, **UART**, **ADC**, **DAC**, and more, enabling it to interface with a variety of sensors, actuators, and peripherals.



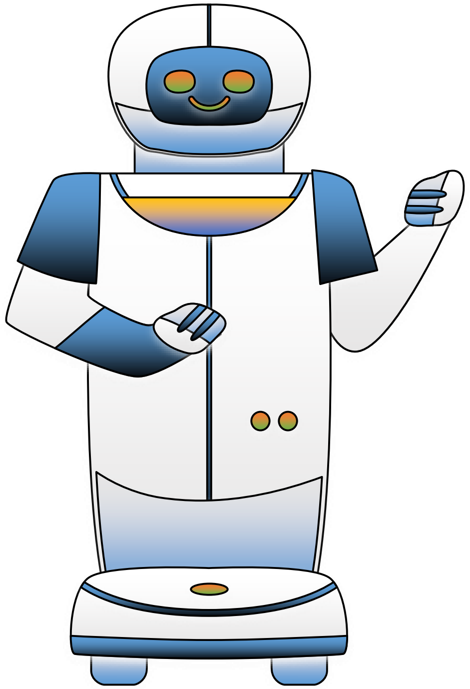
DESIGN

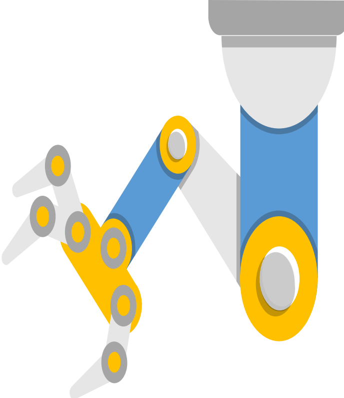






FABRICATION AND MANUFACTURING



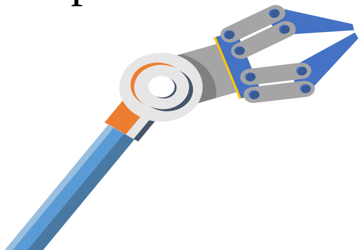


Comparison Table

Aspect	CNC Machining	3D Printing (ABS)	Water Jet Cutting
Precision	Very High (±0.01 mm)	Moderate (±0.1-0.2 mm)	High (±0.1 mm)
Material Waste	High	Low	Moderate
Material Options	Broad (metals, plastics)	Limited (thermoplastics)	Very Broad
Complex Geometries	Limited	Excellent	Limited to 2D cuts
Cost Efficiency	High for large volumes	High for prototyping	High for thick materials
Strength of Parts	Excellent	Moderate	Excellent
Environmental Impact	Moderate	Low	Low

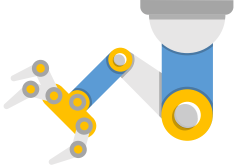
DECORATIVE ROBOT PANELS:
Use 3D printing (ABS) for lightweight, customizable panels.
If made from metal sheets, use water jet cutting.

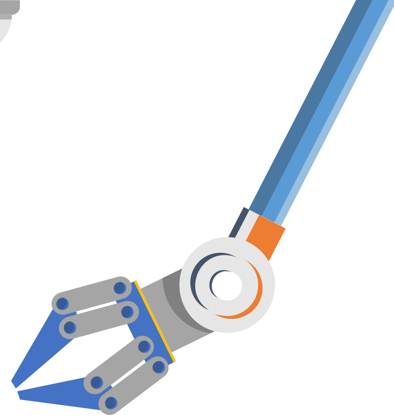
ROBOT ARM:
Use CNC machining for strength and precision.
Alternatively, use water jet cutting if it's a flat plate and strength is critical.



PROTOTYPE GEAR SYSTEM:
Start with 3D printing (ABS) for a prototype.
Use CNC machining for final production with tight tolerances.

GOAL / PROBABLE RESULT





The primary goal of a **surveillance robot** is to enhance security and monitoring capabilities in environments where human presence may be challenging, dangerous, or impractical. These robots are designed to autonomously patrol areas, collect data, and provide real-time feedback to operators, helping ensure safety and improve situational awareness.

Enhanced Security and Monitoring:

Constant monitoring of public or private spaces to detect intruders, suspicious activities, or security breaches.

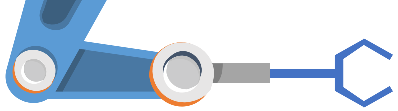
Automatic tracking of movements and behaviours in sensitive areas like borders, government buildings, or private property.

Real-Time Data Collection:

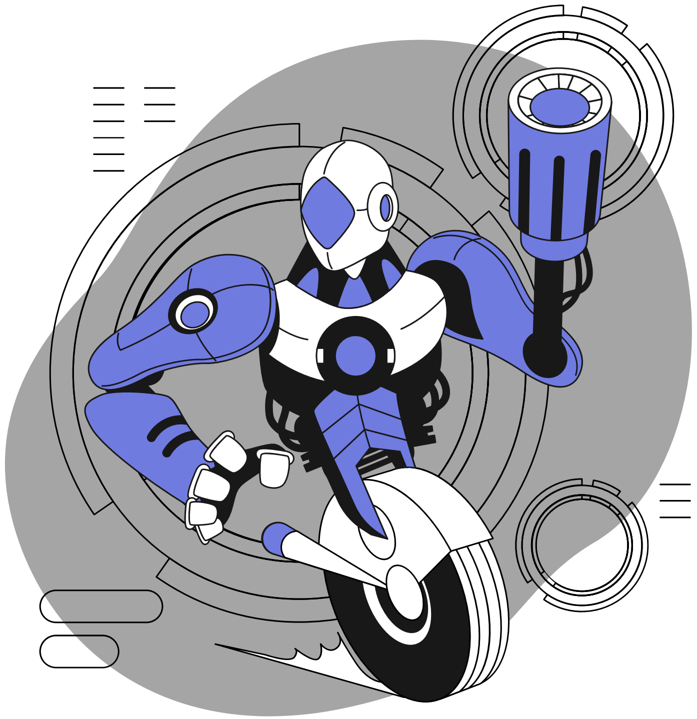
Gathering real-time video, audio, and environmental data (e.g., temperature, air quality, motion) for analysis.

Ability to transmit live data back to control centres, enabling quicker responses to incidents.

Risk Reduction:

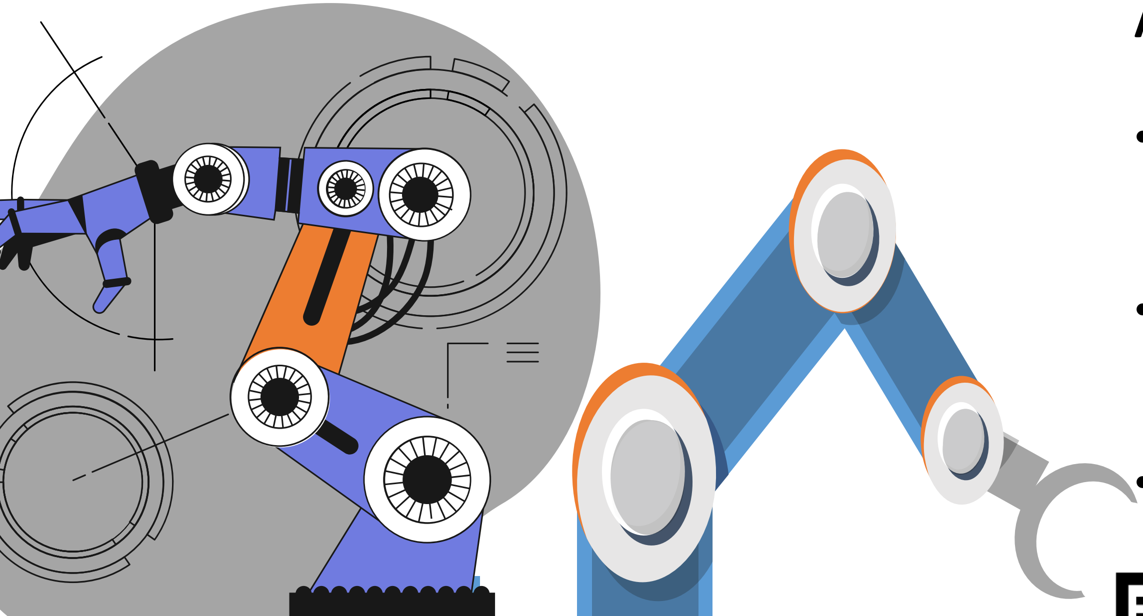


FUTURE WORK



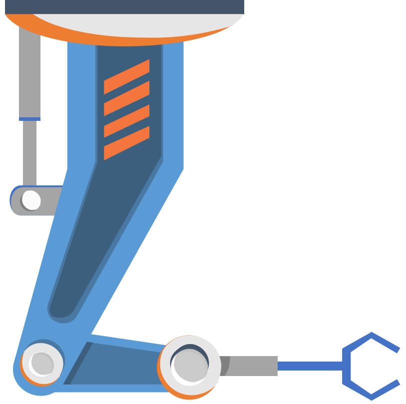
Enhanced AI and Machine Learning

- Autonomous Decision-Making: Robots will analyze situations and make independent decisions based on real-time data.
- Behavior Prediction: Machine learning algorithms will predict suspicious behavior, enhancing security.
- Facial and Object Recognition: Improved AI algorithms for better detection and identification of faces, objects, and threats.



Advanced Sensor Technology

- Multispectral and Thermal Imaging: Enhanced sensors for detecting humans, animals, or heat sources in low-visibility conditions.
- Acoustic Sensors: Detect unusual sounds like gunshots, breaking glass, or screams.
- Environmental Sensors: Monitor air quality, temperature, and chemical hazards.



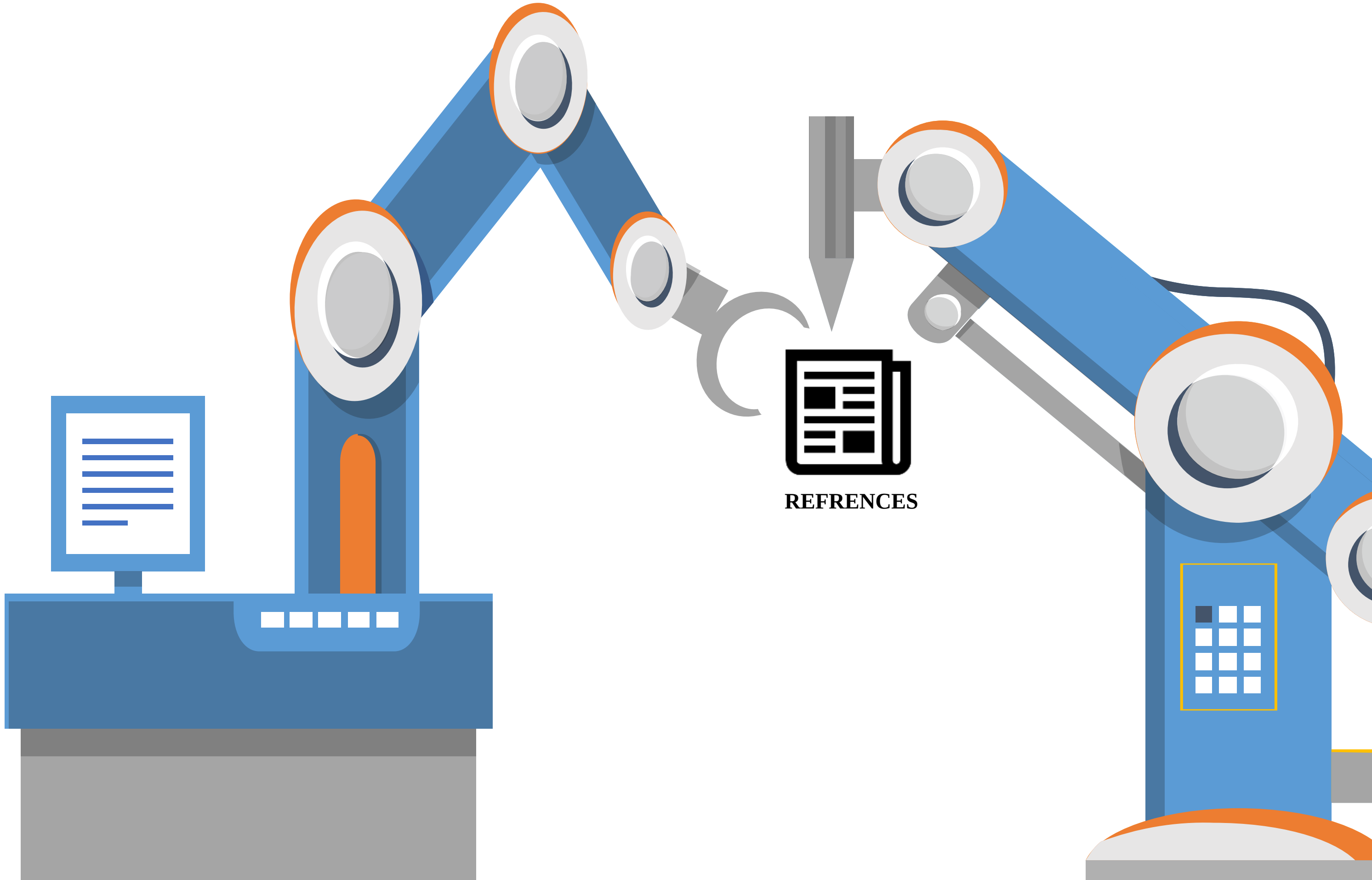
FUTURE WORK

Swarm Robotics

- Coordinated Surveillance: Groups of robots working together to cover large areas.
- Distributed Intelligence: Sharing data among robots for collective decision-making.
- Dynamic Adaptation: Swarms can reconfigure themselves to adapt to changing environments or threats.

Human-Robot Interaction

- Voice Commands: Natural language processing for easier control and monitoring.
- AR/VR Interfaces: Operators can monitor and control robots remotely through augmented or virtual reality systems.
- Collaborative Robots (Cobots): Robots that work alongside human teams.



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THANK YOU