PROTOTYPING AND TESTING

WAREHOUSE AUTOMATION

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INTRODUCTION

Our goal is to streamline the warehouse automation system, enhancing its efficiency, reliability, and adaptability to ensure seamless operations.

We aim to employ easy-to-replicate methods for improved scalability.

We wish to employ available and affordable sensors as well as easy to understand algorithms for better usability.

MOTIVATION

The warehouse automation system being used in industries is quite complex that involves many sensors as well as autonomy algorithms.

This inhibits the scope of improvement for the system due to computational power constraints as well as component constraints.

Our goal is to streamline the warehouse automation system, enhancing its efficiency, reliability, and adaptability to ensure seamless operations.

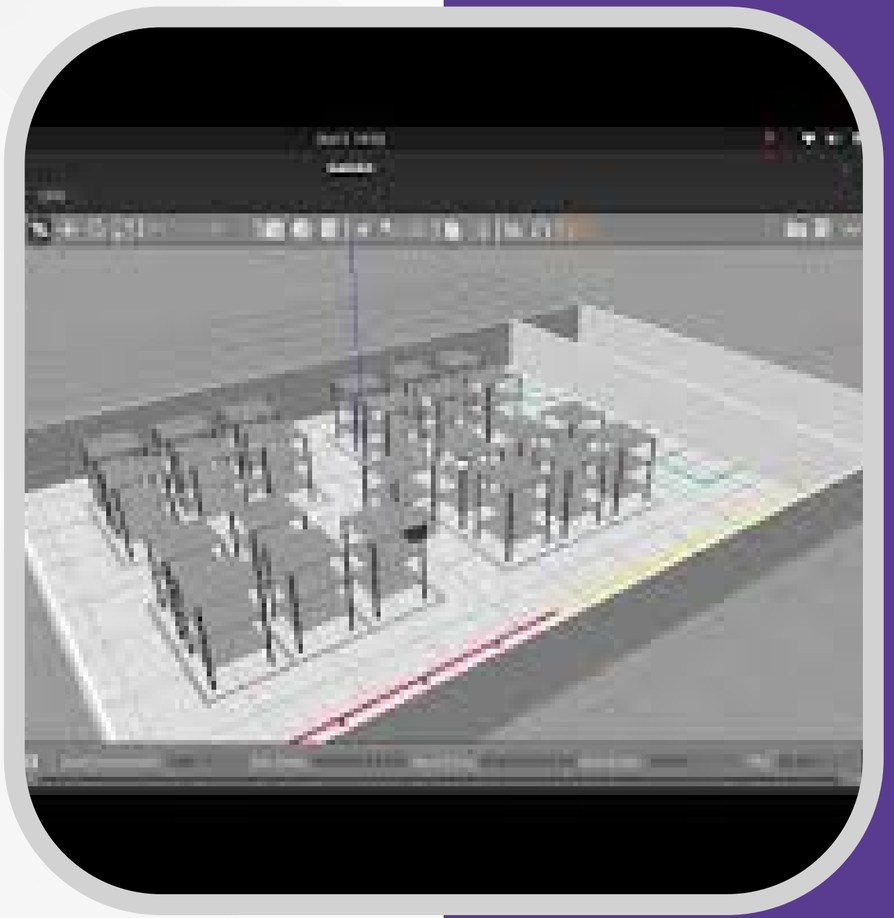
LITERATURE SURVEY

Use of IR sensors: Patel & Patel, 2017
These sensors detect contrast between the line and the floor, allowing robots to correct their orientation and stay on track.

Use of PID Control: Kumar & Verma, 2018
Real-time correction of deviations ensures smoother movement along curves and junctions.

Use of fixed path systems: Gupta & Khurana, 2015
These systems are easy to install and reliable for long-term usability.

OBJECTIVES

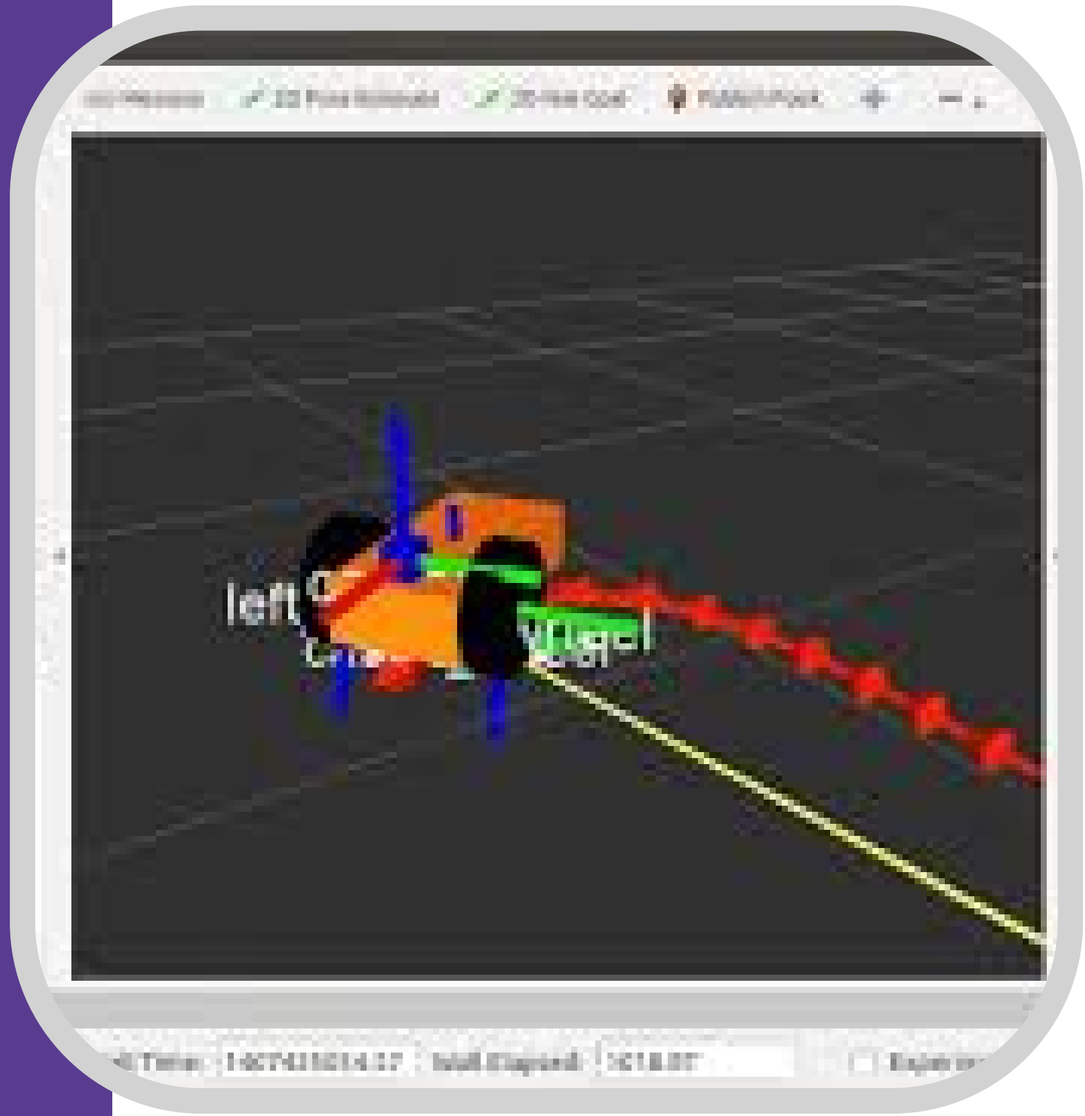


- Implementation of an IR sensor based bot in a custom warehouse with self implemented tracks using ROS2.
- Implementation of a custom path control algorithm based on proportional-integral-derivative control.
- Simulation and analysis of the system in Gazebo to check for potential hazards.

METHODOLOGY

- Core Framework: ROS2
  Simulation: Gazebo, Rviz
  Embedded Board: ESP32-WROOM
  Sensors Used: Infrared

- The bot will work on the principal of simplified and robust controls using fixed or dynamic path algorithms for better control and predictability.



DELIVERABLES

Hardware Components – Assembled and functional robot

Software Development – Working code for line following using PID control

System Integration – Robot following the warehouse path accurately

Testing & Optimization – Ensuring accuracy, efficiency, and reliability

Hardware Implementation

Line-following robot with IR sensors and a fixed path system

Chassis & Motor Assembly – 2-wheel drive with a caster wheel

IR Sensor Array – Line detection and path-following capability

Microcontroller Unit – Arduino/ESP32 for control logic

Motor Driver – L298N for motor control

Battery & Power System – Ensuring uninterrupted operation

Software Development

PID Algorithm Implementation – Smooth and precise line tracking

Motor Speed Control – Dynamic adjustments based on sensor feedback

Warehouse Navigation Logic – Fixed-path movement with obstacle handling

Testing & Calibration – Fine-tuning PID gains for optimal performance

System Integration

Path Setup in Warehouse – Fixed black line for predefined navigation

Multi-Bot Coordination (Optional) – Syncing multiple robots for efficiency

User Control Panel – Start/stop and monitoring (if applicable)

Potential IoT/WMS Integration – For enhanced warehouse automation

Testing & Performance Evaluation

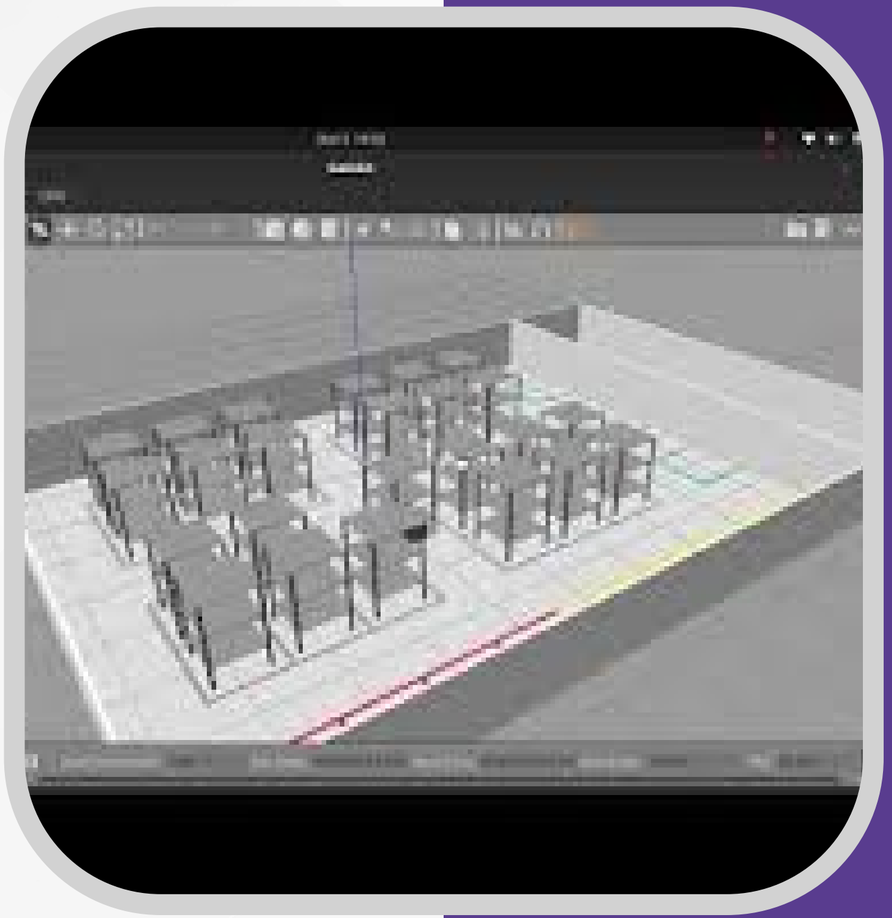
Error Reduction Analysis – Minimizing deviation from the path

Speed & Efficiency Testing – Optimizing movement speed for faster transport

Load Testing – Evaluating payload capacity and stability

Reliability & Safety Assessment – Ensuring consistent operation in real conditions

FUTURE UPGRADES



- Implementation and synchronization of multiple bots for simultaneous operations
- Development of a web-server for operation of the warehouse system over-the-cloud.
- Improvement of the warehouse layout for easier maneuverability of heat zones.

THANK YOU

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