iJRASET
International Journal For Research in Applied Science and Engineering Technology



# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

**Volume:** 13 **Issue:** IV **Month of publication:** April 2025

**DOI:** https://doi.org/10.22214/ijraset.2025.68879

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
*ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538*
*Volume 13 Issue IV Apr 2025- Available at www.ijraset.com*

# Design and Development of an IR Sensor-Based Automated Guided Vehicle for Efficient Material Handling

Prof. H. K. Shete[1], Anup Revansiddha Konapure[2], Aniket Ananda Jadhav[3], Aditya Anil Varude[4], Pushkar Rajendrakumar Raut[5], Parag Hemant Burande[6]
[1]*Professor*[1], [2, 3, 4, 5, 6]*Student, Mechanical Engineering Department, Dr. Daulatrao Aher College of Engineering, Karad,India*

***Abstract: This research presents the design and development of an IR sensor-based Automated Guided Vehicle (AGV) prototype for efficient and autonomous material handling. The AGV is designed to navigate through multiple stations using IR sensors, eliminating the need for manual intervention in the pickup, assembly, and delivery of components. At each station, the AGV collaborates with robotic arms to pick a shaft and pulley, perform assembly, and transport the final package to the designated endpoint. The system uses a set of IR sensors for path following, station detection, and object verification, combined with an Arduino Mega controller and a relay-driven motor* system. The solution offers a low-cost, reliable, and scalable automation system suitable for small-scale industrial applications.***

***Keywords: Automated Guided Vehicle, IR Sensors, Arduino Mega, Robotic Arm, Path Following, Industrial Automation.***

## I. INTRODUCTION

Automation in industries is becoming increasingly important to boost efficiency, minimize human error, and streamline repetitive tasks. One critical area of focus is automated material handling, which often involves transporting components between different process stations. This research introduces a compact Automated Guided Vehicle (AGV) designed using IR sensors for navigation and interaction, offering a cost-effective and reliable solution for small-scale automation setups. The AGV operates in sync with robotic arms to perform material pickup, assembly, and delivery with minimal human assistance.

## II. PROBLEM IDENTIFICATION

Manual methods of material handling such as human labor or forklifts are often inefficient, time-consuming, and error-prone. They require continuous supervision and are not easily adaptable to process changes. These limitations increase operational costs and reduce overall workflow efficiency. A sensor-based AGV can address these challenges by providing a flexible, autonomous, and safe alternative for transporting and processing materials.

## III. OBJECTIVE

The objective of this project is to develop a fully autonomous AGV prototype that can:

*1)* Follow a defined path using IR sensors
*2)* Detect stations and perform logical stops
*3)* Interact with robotic arms for component pickup and assembly
*4)* Confirm object handling operations with IR feedback sensors
*5)* Operate without human intervention once initialized

## IV. SCOPE OF THE PROJECT

*1)* Manufacturing and Warehousing
*2)* Material Handling: Automates transportation of components (shaft and pulley) between workstations
*3)* Assembly Integration: Supports robotic arms in real-time component handling and packing
*4)* Compact Storage Environments: IR-guided path following enables precise movement in tight layouts
*5)* Logistics and Distribution
*6)* Package Delivery: Final assembled box is transported to the endpoint without manual handling
*7)* Operational Efficiency: Reduces labor costs and improves throughput by automating repetitive tasks

©IJRASET: All Rights are Reserved 

## V. METHODOLOGY

### A. *System Design and Planning*

The AGV's structure and control layout are conceptualized to ensure smooth motion, path accuracy, and stable operation.

### B. *Component Selection*

Key components including DC motors, IR sensors, relay, and Arduino Mega are selected based on performance requirements.

### C. *Mechanical Fabrication*

The AGV chassis is built to support multiple workstations and accommodate onboard electronics and battery systems.

### D. *Sensor Integration and Control*

IR sensors are configured for:
Path following (2 sensors)
Station detection (1 sensor)
Object detection (2 sensors for shaft and pulley pickup, 1 for box detection)
A relay module controls motor switching through Arduino logic.

### E. *Programming and Logic Flow*

The Arduino Mega is programmed to interpret IR sensor signals, control motors through relay switching, and sequence actions at each station.

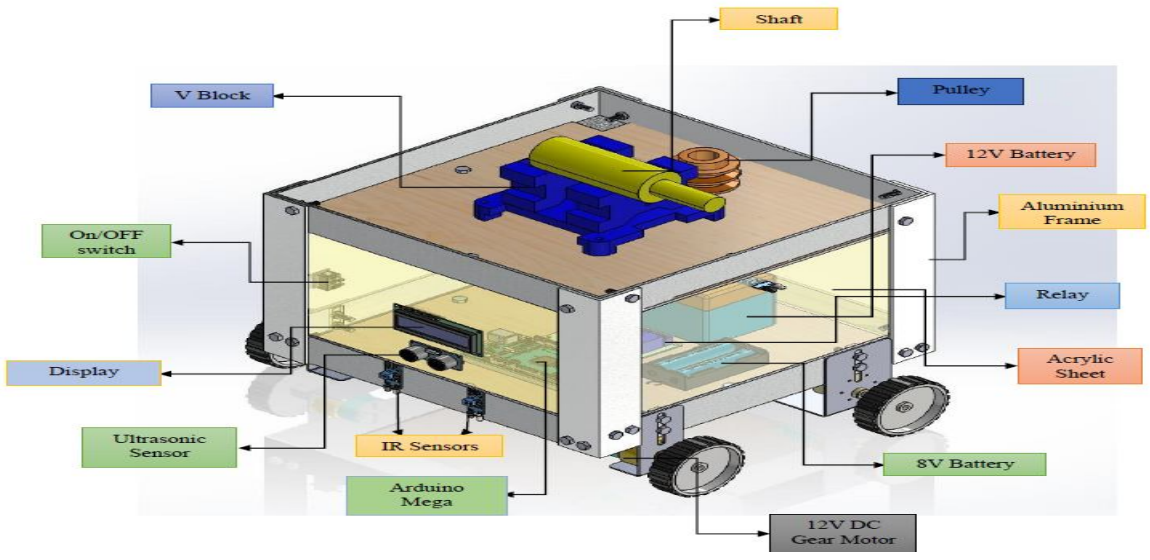
### F. *Testing and Optimization*

The AGV is tested on a predefined path with all three stations. Logic is refined to improve stop accuracy, sensor reliability, and coordination with robotic arms.

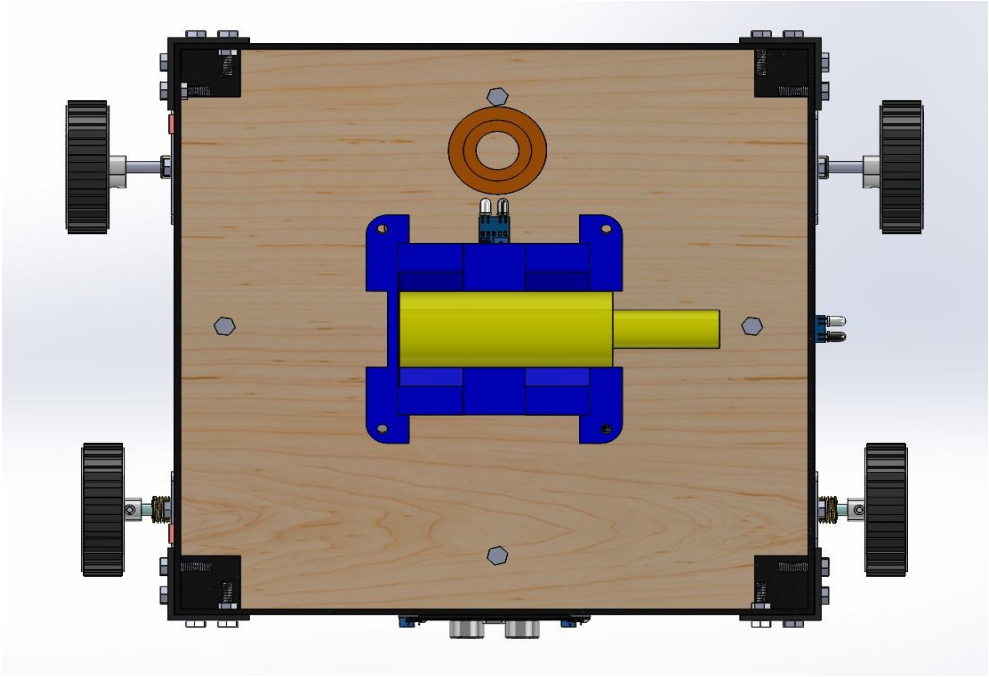
## VI. WORKING OF AGV SYSTEM

The AGV starts at its initial position and begins path-following using two IR sensors. It approaches Station 1, where an IR sensor detects the location, prompting the AGV to stop. A robotic arm picks up a shaft, and a separate IR sensor confirms the pickup.
Next, the AGV moves forward to Station 2, where it stops again using an IR sensor. A robotic arm picks up pulley from AGV, which is also confirmed via IR detection. The AGV then travels to Station 3, the assembly and packaging station.
At this station, the robotic arms assemble the shaft and pulley into a box and place it on the AGV. Another IR sensor confirms that the box has been placed. Once verified, the AGV moves to the final drop-off point, completing the cycle.

### A. *Design*



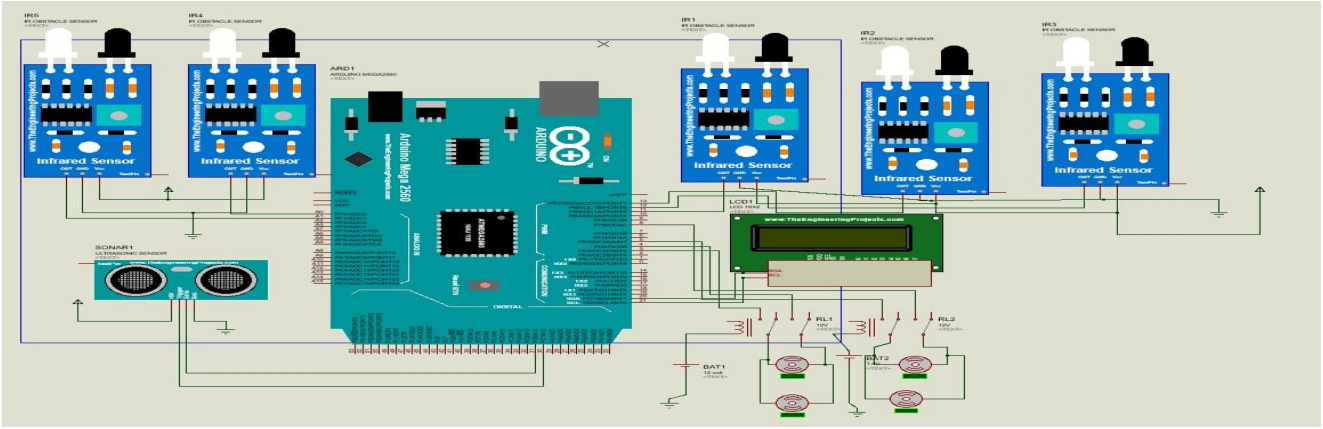
*B. Top View*



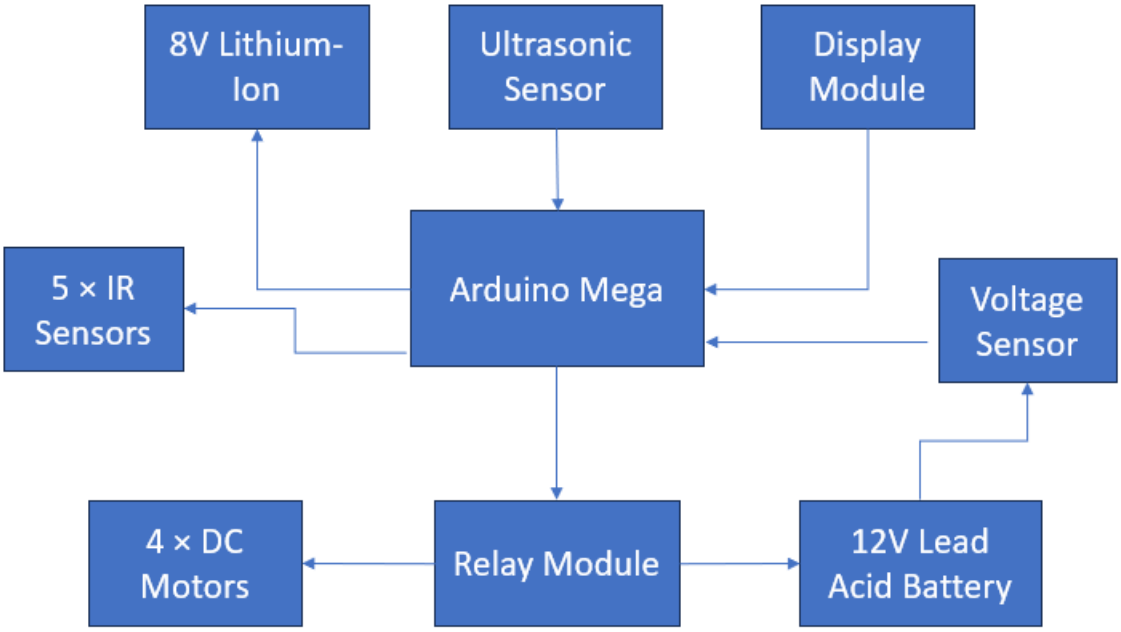
## VII. COMPONENTS USED

| Component | Specifications / Role |
|---|---|
| Arduino Mega | Microcontroller for logic control and I/O handling |
| 4 × DC Motors | Drive system for movement and turning |
| 1 × Relay Module | Controls direction and on/off switching of motors |
| 5 × IR Sensors | 2 for object detection (shaft & pulley), 1 for station detection, 2 for line following |
| 1 × Voltage Sensor | Monitors battery voltage level |
| 1 × Display Module | Displays system status (optional) |
| 12V Battery | Powers the motors |
| 8V Lithium-Ion Battery | Powers the Arduino and sensors |
| 1 × Ultrasonic Sensor | Used for distance measurement and obstacle detection |
| 2 × On /Off Switch | One for Arduino Mega and other for DC Motors |

## VIII. CIRCUIT DIAGRAM



## IX. BLOCK DIAGRAM




## X. CONCLUSION

The developed AGV prototype offers a practical and efficient approach to material handling and assembly using a sensor-driven autonomous platform. With the integration of IR sensors and robotic arms, the system effectively reduces human involvement, improves accuracy, and increases workflow speed. Its modular design allows easy scaling and customization for various industrial setups. This IR-based solution is especially suited for small-to-medium automation tasks where low cost, simplicity, and flexibility are key.

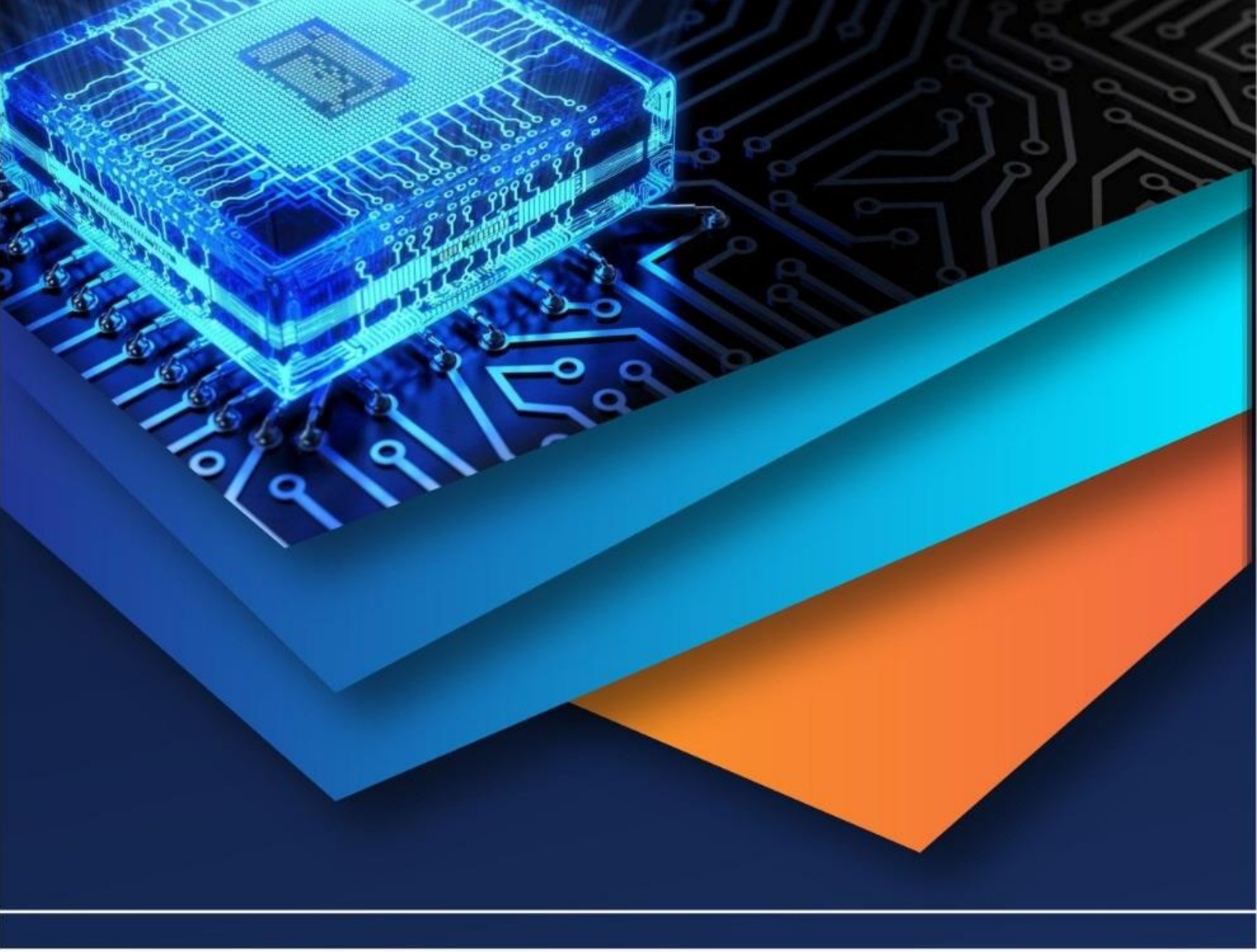
## XI. ACKNOWLEDGMENT

We sincerely thank Prof. H. K. Shete, our guide and mentor, for his constant support, valuable suggestions, and encouragement throughout the project. His guidance played a key role in successfully completing this research work. We also extend our gratitude to the faculty members of the Mechanical Engineering Department for their support and resources. Lastly, we are thankful to our peers and families for their motivation and encouragement during the entire development process.

## REFERENCES

[1] N. Viswanadham, “Automation in Material Handling Systems,” Journal of Manufacturing Systems, Vol. 25, No. 2, 2020.
[2] R. Gupta and A. Singh, “Design and Implementation of Line Following AGV Using IR Sensors,” International Journal of Robotics and Automation, 2021.
[3] S. Kumar et al., “Smart Material Handling Using Arduino Based Autonomous Robot,” International Research Journal of Engineering and Technology, Vol. 6, No. 4, 2022.
[4] D. Patel, “Development of a Cost-Effective AGV for Industrial Applications,” International Journal of Engineering Research, 2023.
[5] A. Sharma, “Path Following Robot for Assembly Line Using Sensor-Based Control,” IEEE Conference on Industrial Automation and Robotics, 2024.

©IJRASET: All Rights are Reserved 



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089 (24*7 Support on Whatsapp)