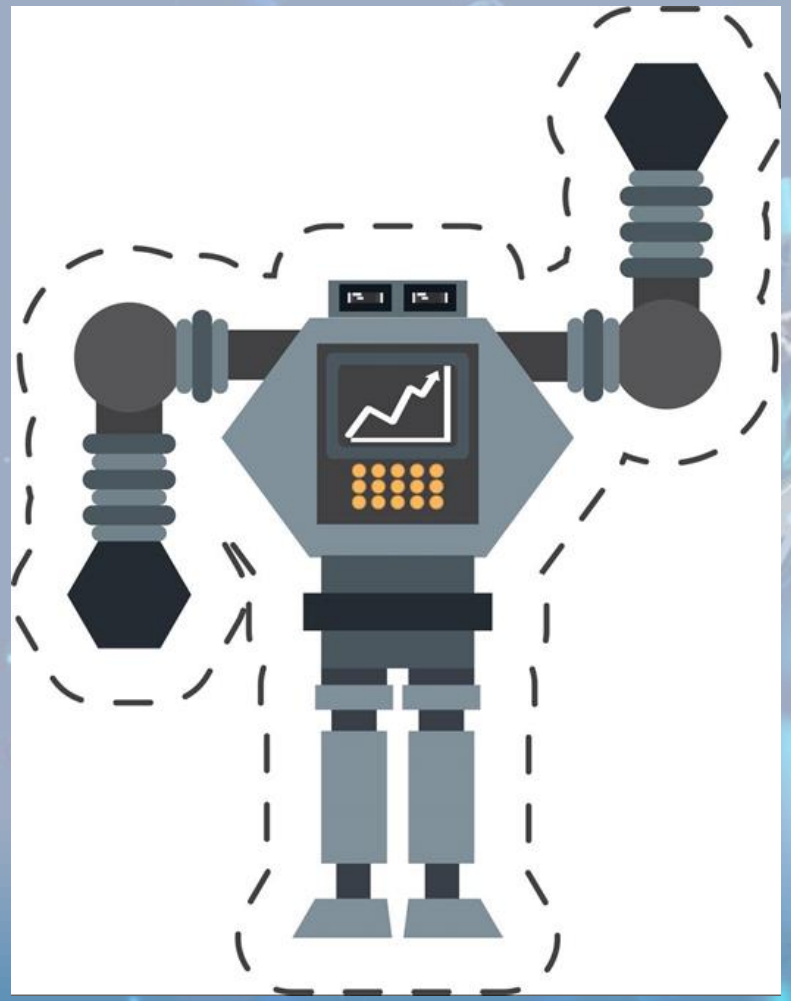

Autonomous Navigation System for Factory Floor Robots (AGVs)

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Project Overview

- This project aims to build an Autonomous Navigation System for Automated Guided Vehicles (AGVs) operating on factory floors.
- It uses Ultrasonic, Infrared (IR), and PIR sensors to detect obstacles and human presence in real-time.
- The project falls under the domains of Industrial IoT, Embedded Systems, and Smart Robotics, contributing to the broader vision of Industry 4.0 and intelligent automation.
- Embedded systems via Raspberry Pi Pico W ensure on-device sensing and decisions, while cloud-based Machine Learning allows for long-term optimization, such as identifying bottlenecks and improving navigation based on historical data.
- This hybrid approach balances low-latency local response with smart global improvements.

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Project Statement-VIII

Autonomous Navigation System for Factory Floor Robots (AGVs)

Sensors: Ultrasonic (1), IR (1), PIR (1)

Problem Description:

AGVs in factories must navigate safely around humans and obstacles. Ultrasonic, IR, and PIR sensors detect proximity and motion. Sensor data is uploaded to the cloud where ML models drive navigation decisions. Data analytics identifies movement bottlenecks, high-traffic zones, and route efficiency. Visual tools support AGV traffic optimization and reduce collision risks, improving overall productivity and safety.

Problem Statement

- AGVs often face challenges navigating factory floors with unpredictable human movement and dynamic obstacles.
- Traditional systems rely on static paths or expensive hardware like LIDAR, which lack flexibility and cost-efficiency.
- Failures in AGV navigation can lead to collisions, bottlenecks, production delays, and safety hazards.
- In high-density industrial environments, optimizing AGV paths with accurate, real-time sensing and smart rerouting is critical to both productivity and worker safety.

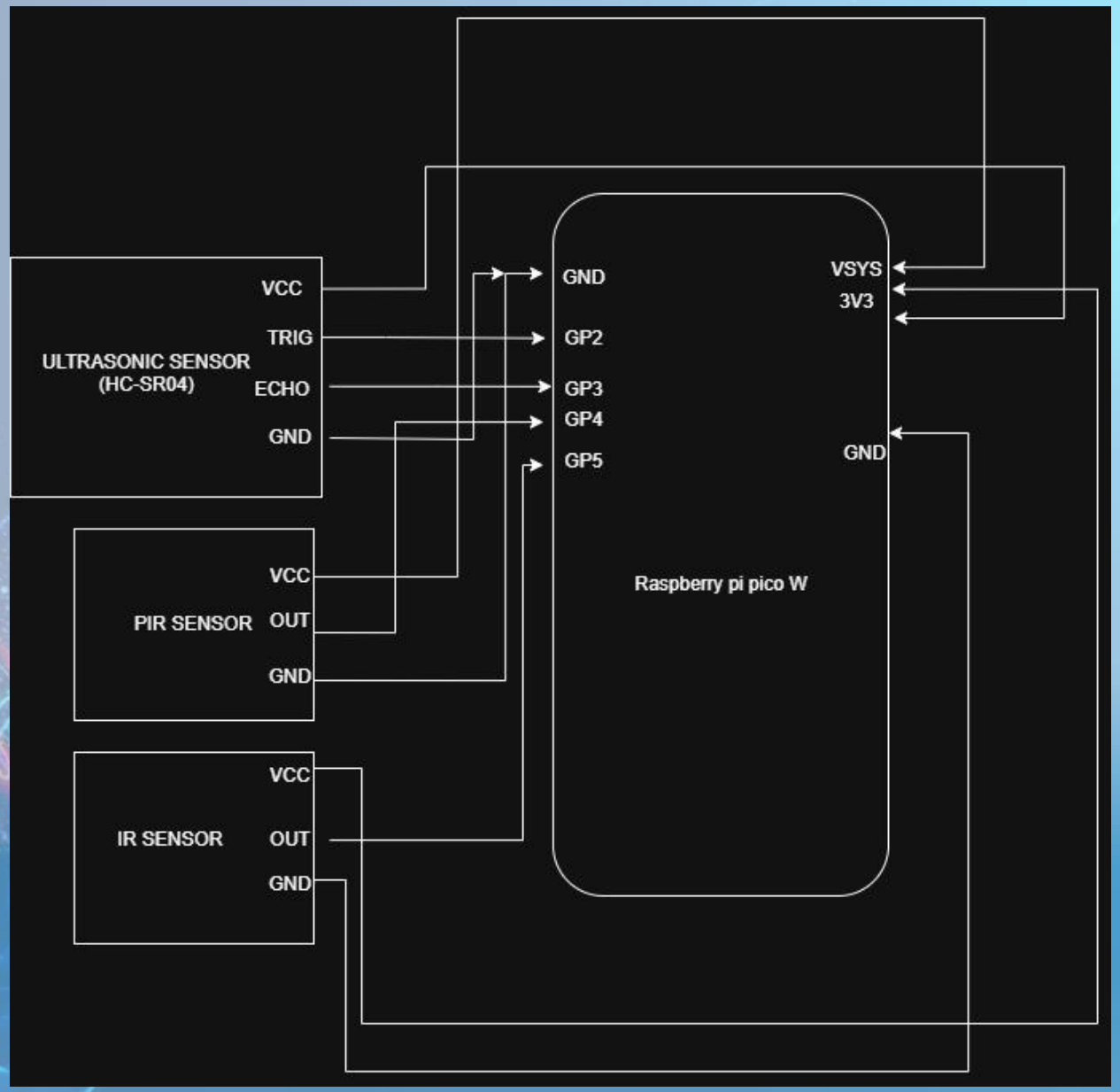
Project Goal & Objectives

- Build smart AGV navigation with sensors & cloud.
- Integrate Ultrasonic, IR and PIR sensors with Raspberry Pi Pico W.
- Stream sensor data to ThingSpeak cloud.
- Generate and download CSV dataset logs.

Proposed Solution

Embedded System + ML Integration:

- Embedded board processes & transmits data
- Cloud ML predicts future sensor readings (1-hour forecast)
- Predictions used for traffic optimization & collision avoidance



Resources Utilized

- **Hardware:** Raspberry Pi Pico W, Ultrasonic Sensor, Infrared Sensor, PIR Sensor
- **Software & Tools:** Thonny IDE, ThingSpeak, Wokwi, MS Excel
- **Datasets/ML Models Used:**
  - Source: ThingSpeak Cloud
  - Type: CSV file
  - Size:

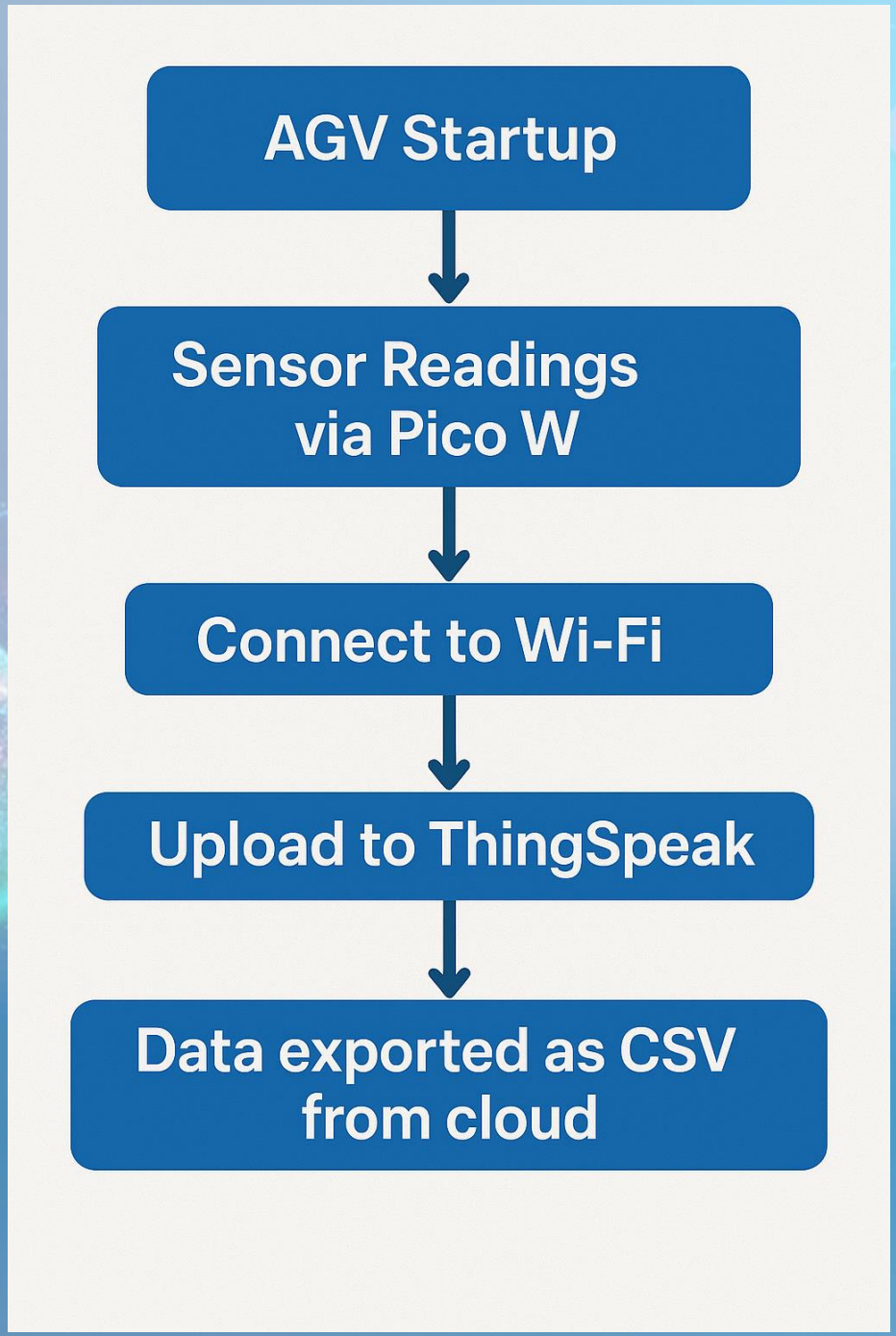
System Design

Inputs (to Raspberry Pi Pico W):

- **Ultrasonic Sensor** – Distance measurement for obstacle detection
- **IR Sensors** – Line following or edge detection
- **PIR Sensor -** Motion detection

Outputs (from Raspberry Pi Pico W):

- **Wi-Fi Module (built-in on Pico W)** – Sends data to ThingSpeak cloud
- **CSV Export** – Dataset generated will be available for download from ThingSpeak



Implementation Details

Hardware and Micropython setup:

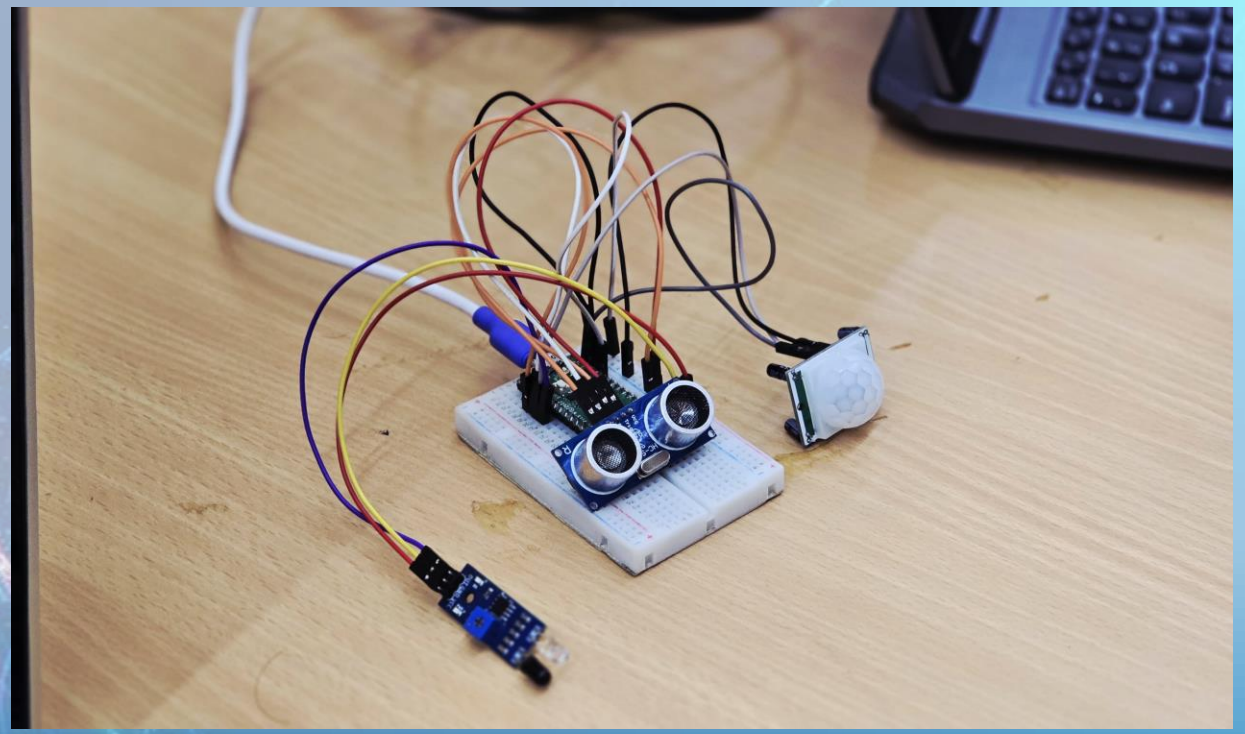
- Raspberry Pi Pico W and sensors are configured
- GPIO wiring
- Thonny IDE

Wi-Fi and ThingSpeak Integration:

- Credentials set up
- Channel ID, API keys

Data Logging and Cloud export:

- Real-time sensor data
- Auto-updating graphs
- Export the csv file



Advantages & Limitations

Advantages:

- Low-Cost Implementation
- Wireless Data Logging

Limitations:

- Limited Processing Power
- Basic Security

Future Scope

Dynamic Route Recalculation

- Integrate real-time alternate path planning using obstacle detection
- Useful for AGVs in dynamic warehouse or factory environments

Advanced Sensor Integration

- Upgrade to LiDAR, 360° cameras, IMUs for precision navigation
- Enables accurate mapping and obstacle avoidance

Sensor Type	Example Industrial Sensor	Purpose / Usage
Ultrasonic Sensor	Pepperl+Fuchs UC2000	Measure distance to obstacles/walls
IR Sensor	Omron E3Z-T61	Detect object presence / proximity
PIR Sensor	Steinel IS 345 MX Highbay	Detect human motion in area (safety zone)

Conclusion

- Successfully interfaced sensors with Raspberry Pi Pico W
- Enabled wireless data logging using ThingSpeak cloud
- Achieved real-time monitoring and CSV export for analytics
- Laid foundation for scalable AGV systems with smart navigation potential

Thank you