



# *Graduation Project 2:*

Smart Vacuum Cleaner

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# *Why a Smart Vacuum Cleaner?*

- Traditional vacuuming is manual and time-consuming
- Existing robot vacuums use random or inefficient navigation
- Need for accurate, autonomous, and complete cleaning solutions

# *Project Objectives*

- Design a robot that can clean autonomously
- Use LiDAR for environment mapping
- Apply SLAM for real-time mapping + localization
- Implement obstacle avoidance + full room coverage

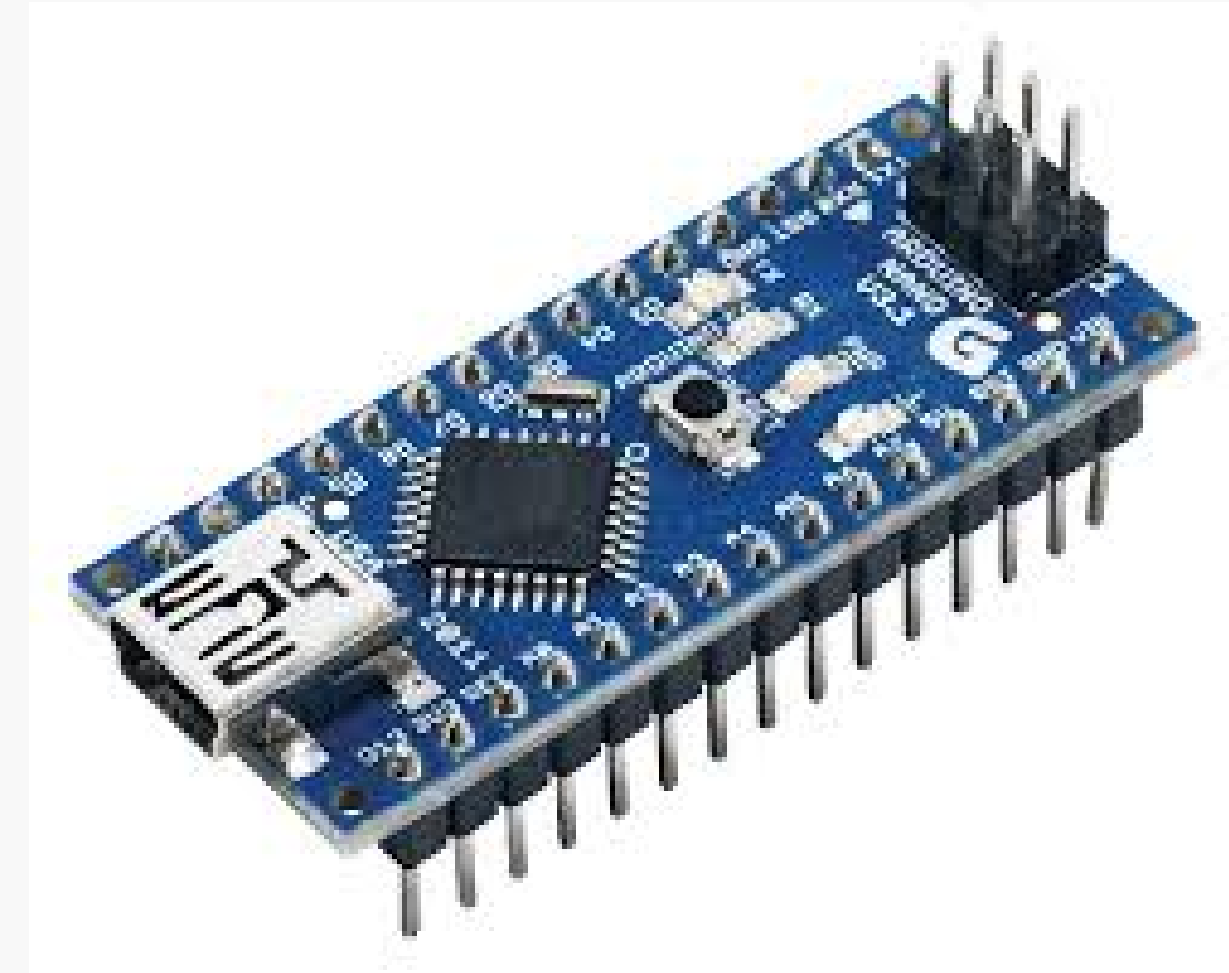
# *Hardware Components*



**RPLIDAR A1**  
**2D laser scanner**



**Raspberry Pi 5**  
**Main controller**

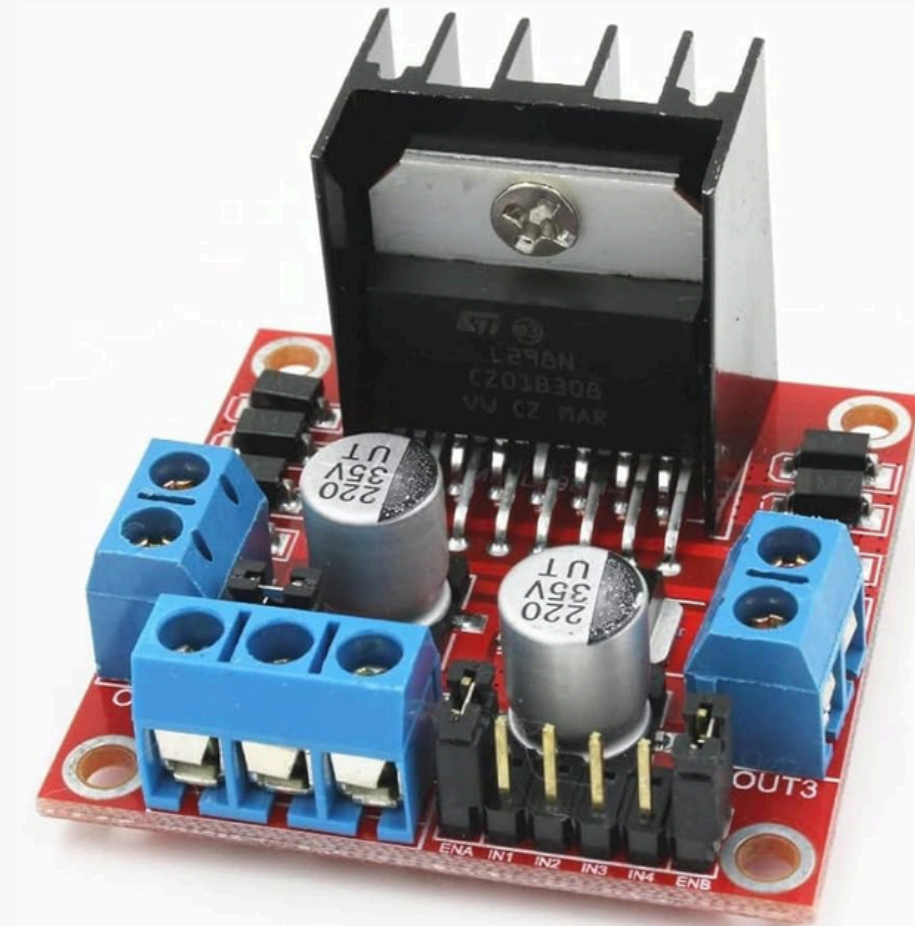


**Arduino Nano**  
**Motor controller**

# Hardware Components



**DC Motors with  
built-in encoder**

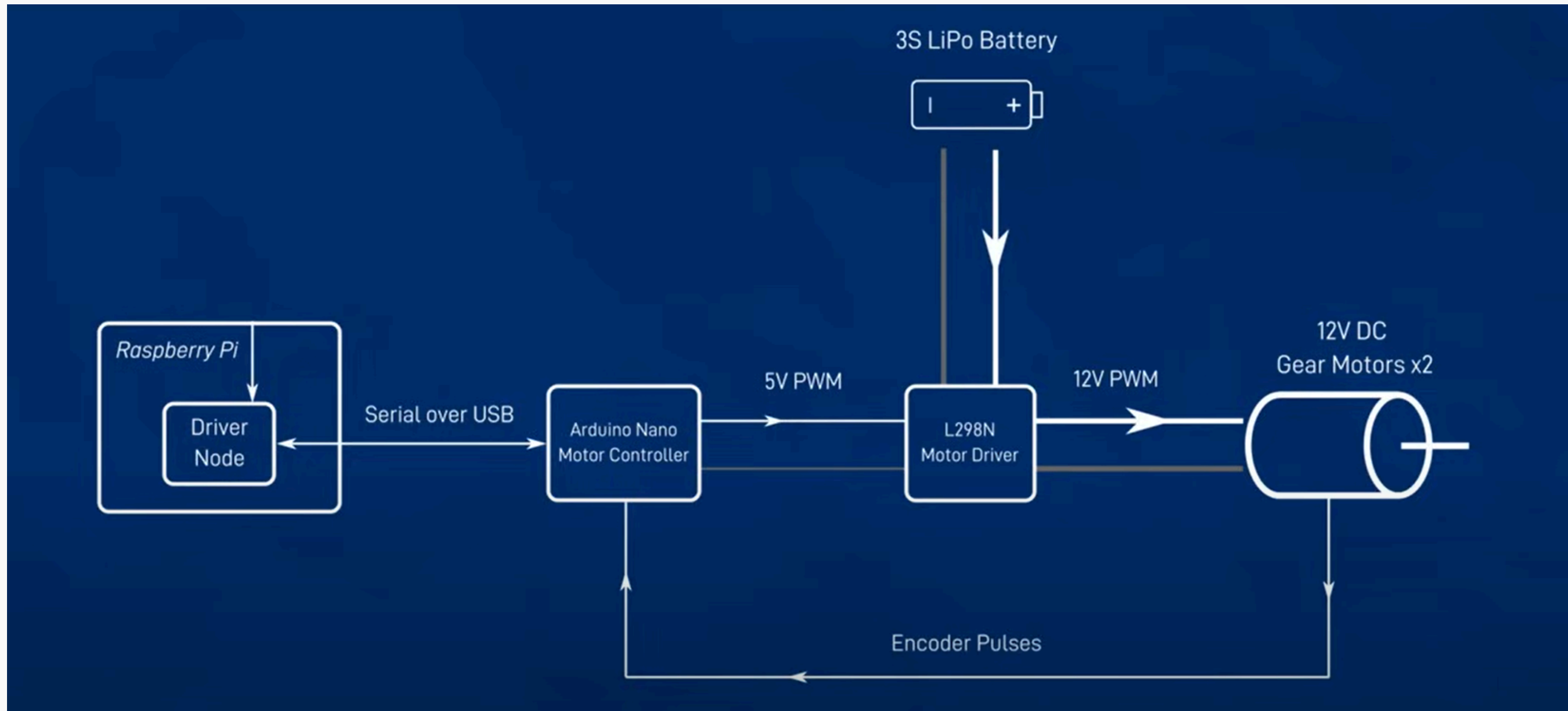


**L298N Driver**



**Power Bank + 12V Battery**

# Full system architecture



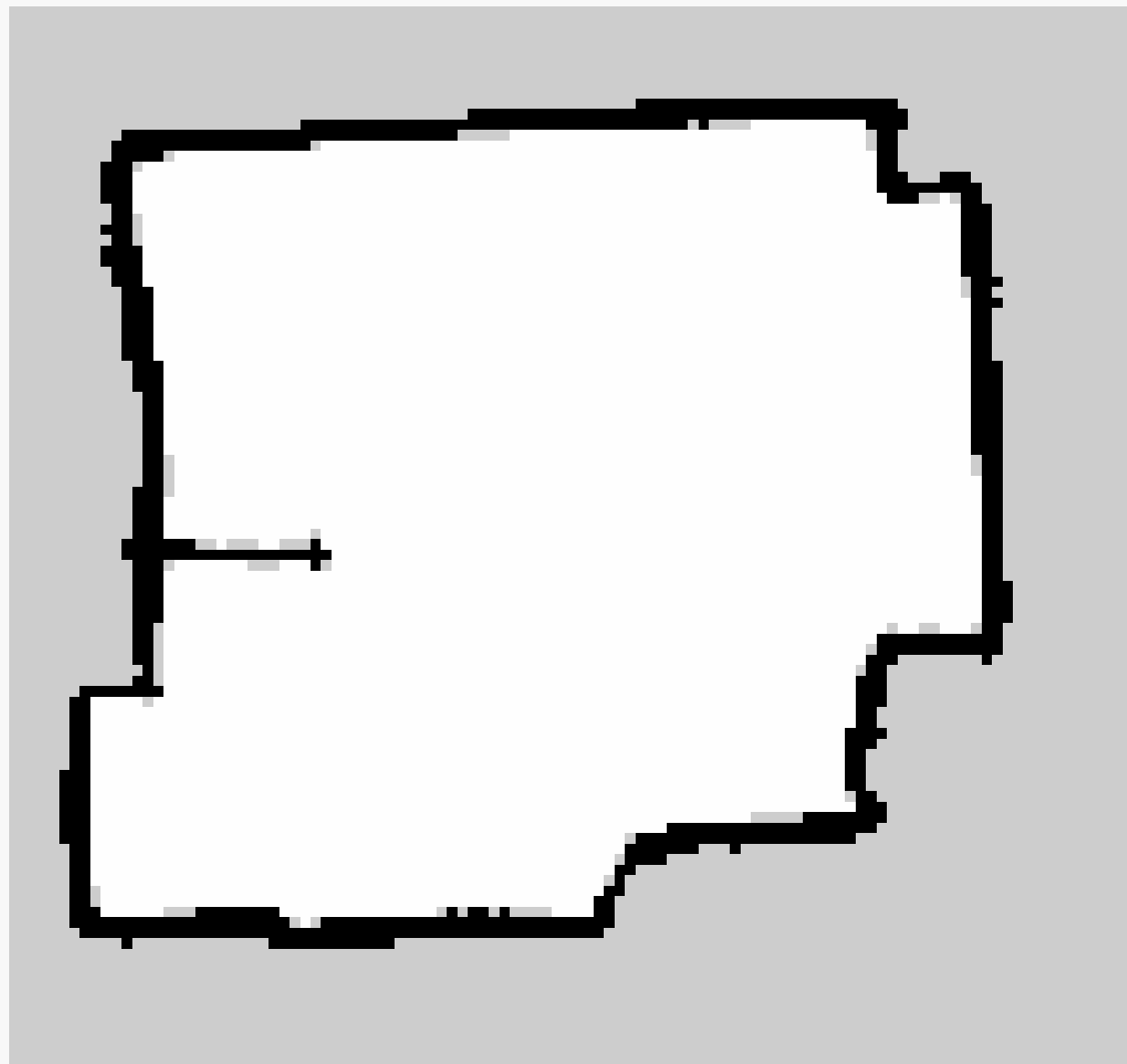
# *Movement and Speed Control*

- *Encoders for speed measurement*
- *Calculated linear & angular velocities*
- *Published as /odom topic*

# *Mapping & Localization*

- *Mapping: Google Cartographer SLAM*
- *Localization: Adaptive Monte Carlo*
- *2D map built in real-time*
- *Robot tracks its location accurately*

# *Mapping & Localization*



*Room's Map*

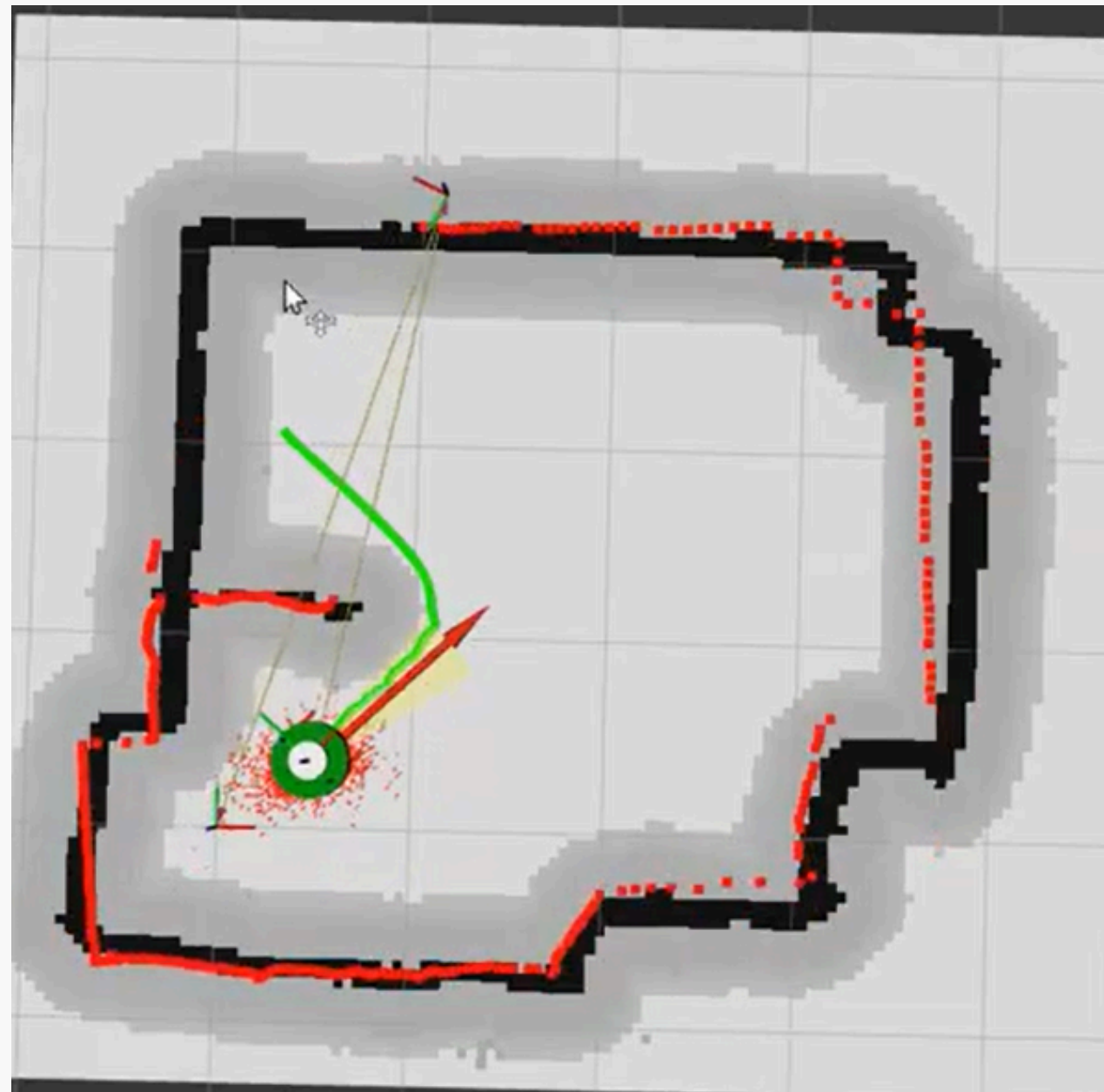


*Robot Localization*

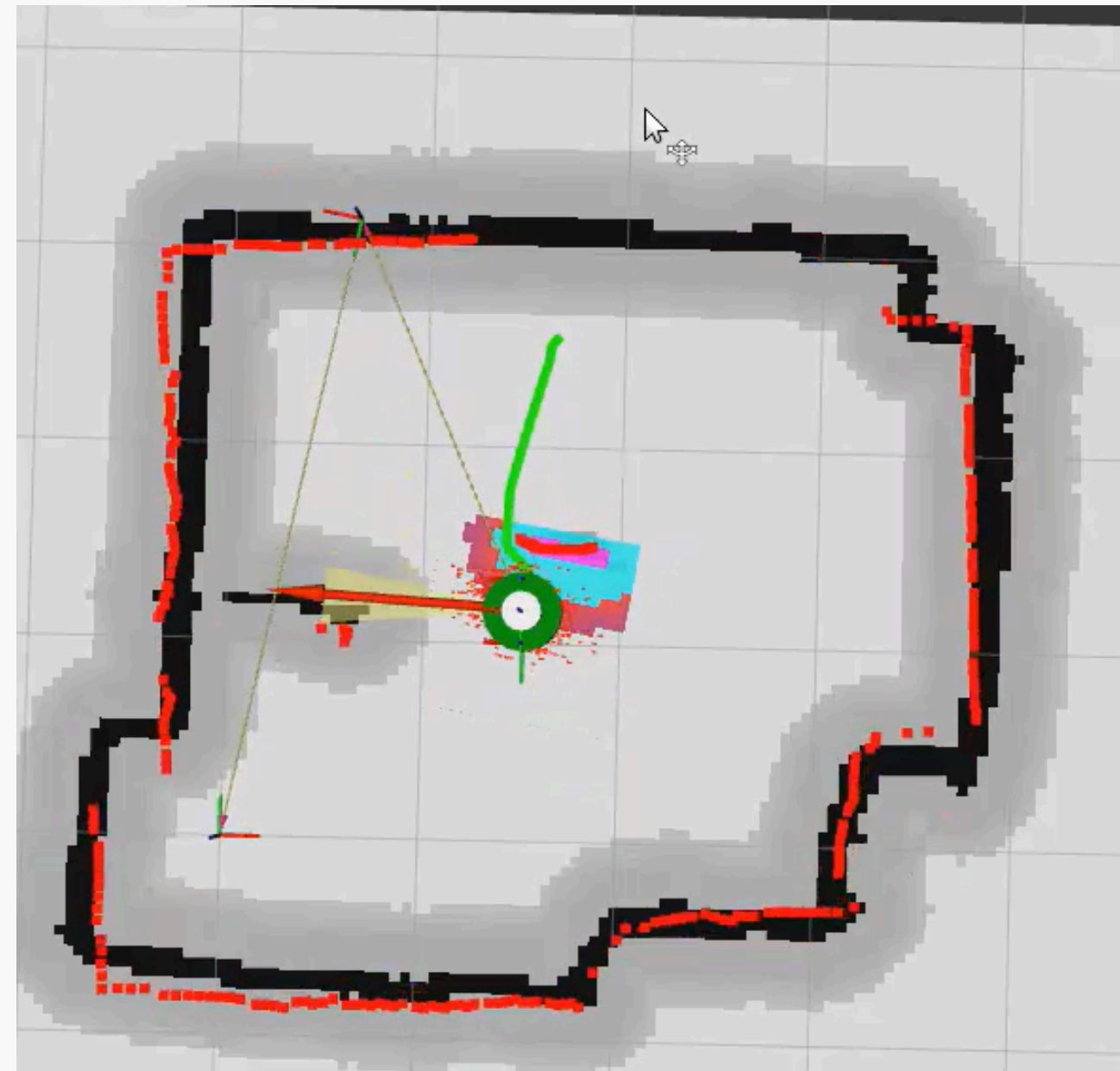
# *Path Planning*

- *Dijkstra Algorithm for shortest path*
- *DWA for dynamic obstacle avoidance*
- *Global & Local planners used*
- *Linear & Angular velocity sent to wheels*

# *Path Planning*



*Room Map*



*Dynamic obstacles*

# *Cleaning the Whole Room*

- *Robot follows predefined pattern*
- *Ensures complete coverage*
- *Returns to base when done*





# *Constraints Faced*

- *Power limitations (5V 3A for Raspberry Pi)*
- *Motor mismatch at low speeds*
- *Low resolution on Raspberry pi*

# *Future Work*

- *Add ultrasonic sensors for low-height obstacles*
- *Add IR sensors for stair detection*
- *Enable remote control and monitoring*
- *Integrate with smart home systems*



*Thank you*

