Final Project Proposal

Dual Mode Sweeping Robot

Team 23:
112062129 Song-Ze, Yu
112062232 Yun-Zhong, Lai

Table of Contents

1. Project Details

(1) Abstraction

Our project aims to design and implement an dual mode sweeping robot capable of cleaning its environment. Our robot has two modes: one is the Bluetooth remote control mode, where the user can fully control over its movement and cleaning using phone. The other is the automatic mode, where it navigates on its own, just like commercially available robot vacuums.

(2) Features

1. Dual-Mode Operation

1.1 Bluetooth remote control mode

Basic Mode

- The robot can be controlled via a smartphone app (e.g. BLE Scanner).
- Movement Controls: Move forward, backward, left, and right.
- The user has full control over the robot's movement and basic cleaning functionality.

Optional Mode

- In addition to movement controls, the user can adjust:
  - Suction Power: Control the airflow strength of the cleaning mechanism.
  - Speed Settings: Adjust the robot's movement speed for different scenarios.
- Design our own web app or flutter app for more customize features.

1.2 Automatic control mode

Basic Mode: Random walking.

Optional Mode: Using walk following algorithm to cover the corner and zigzag pattern to cover the whole area.

2. Cleaning Mechanism

Basic Mode:

- The robot uses a lint roller to pick up dirt and debris from the floor.
- This is a low-cost and simple solution to simulate cleaning functionality.

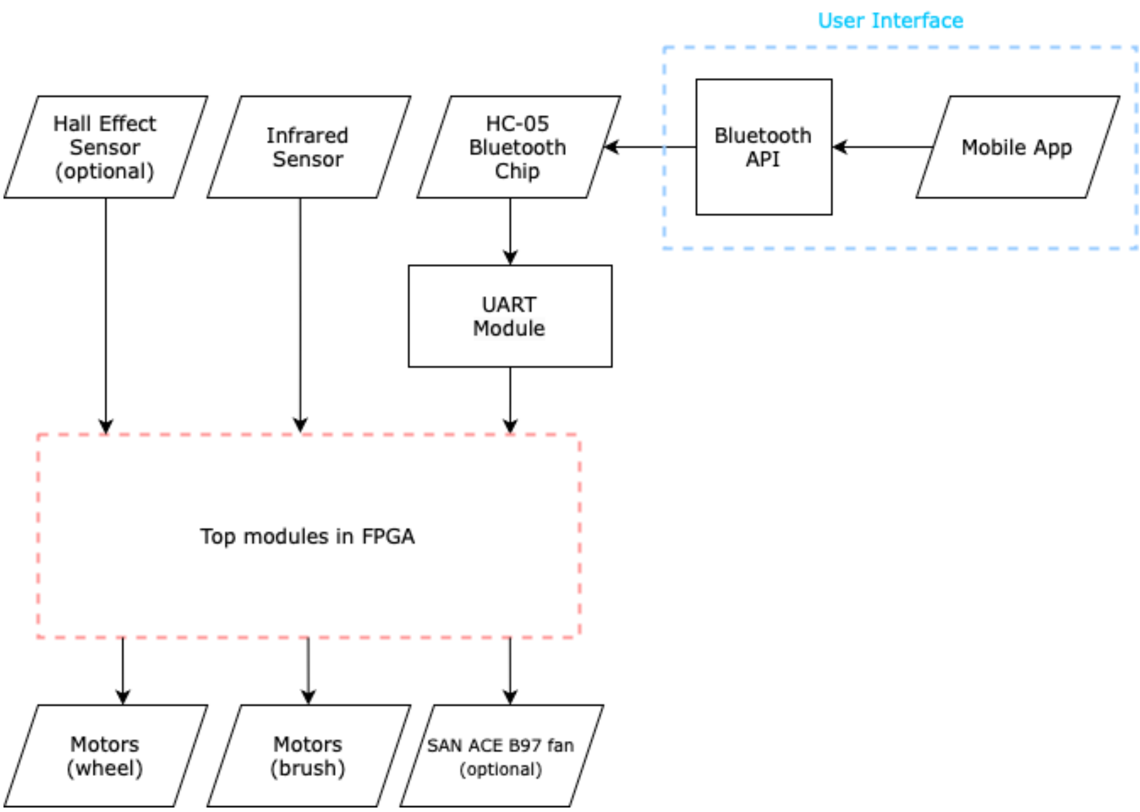
Optional Mode:

- Integrates a SANYO SAN ACE B97 fan to create a vacuum-like suction mechanism.
- Designed for enhanced cleaning performance, allowing the robot to collect finer dust and particles more effectively.

3. Obstacle Detection and Avoidance

- The robot uses an infrared sensor to detect obstacles in its path.
- Avoidance logic ensures it doesn't collide with walls or objects.

(3) Illustration



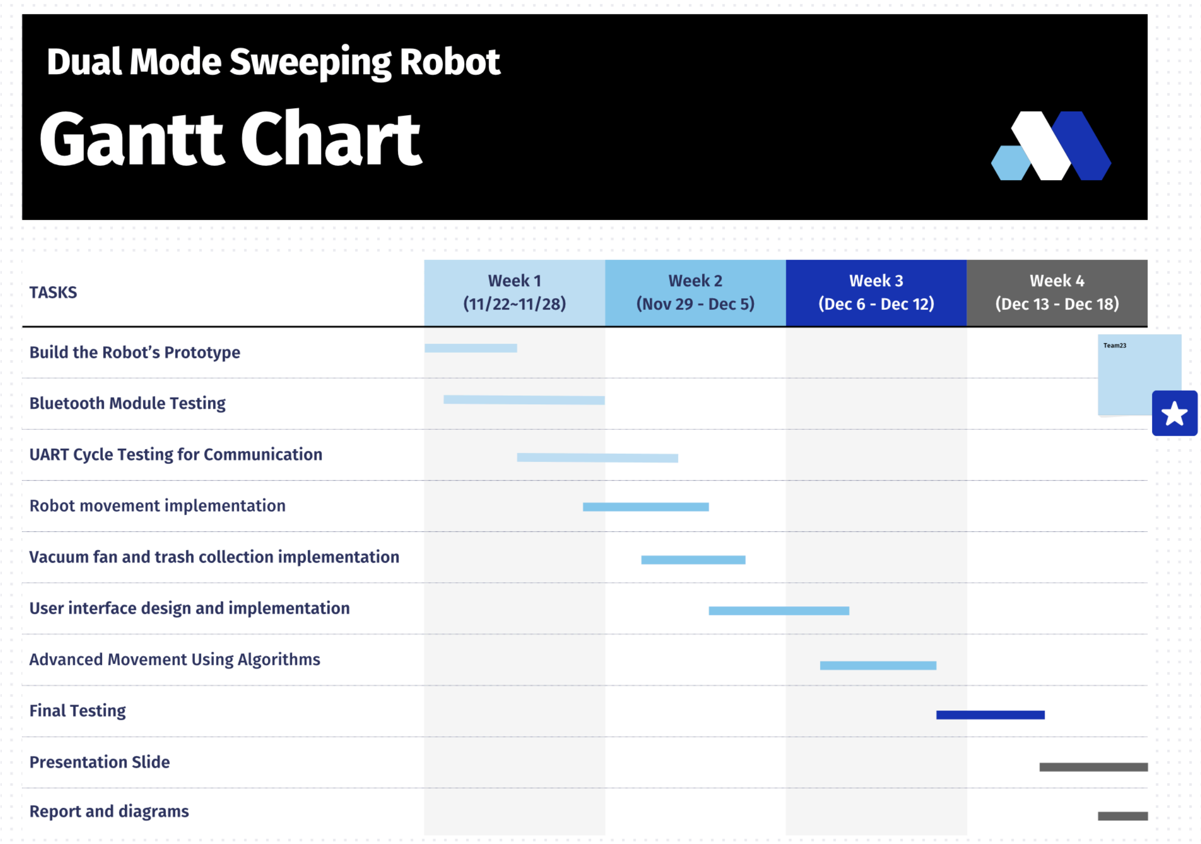
▲ Figure.1 The top module of our whole design

2. Estimated cost

Item Name	Quantity	Price/item (NT)	Source	Total Cost (NT)
Small Brushes	10	5	grocery store	50
HC-05 Bluetooth Module	1	120	https://reurl.cc/jQqQep	120
SANYO SAN ACE B97	1	310	https://reurl.cc/WAEAo9	310
Infrared Sensors	2	0	provided by class	0
Small DC Motors + Wheels	2	0	provided by class	0
Basys 3 FPGA Board	1	0	provided by class	0
Motor Driver Module	1	0	provided by class	0
A3144 Hall Effect Sensor	4	35	https://reurl.cc/eG9Vx7	140

3. Schedule

(1) Gantt Chart



▲ Figure.2 The gantt chart of our whole design

(2) Task details

Week 1 (Nov 22 - Nov 28): Robot Prototype and Communication Testing

1. Build a prototype:

- Use materials such as cardboard, plastic, or other accessible items to assemble the robot's base.
- Estimate the robot's volume (體積) so that maybe we can later recreate its exterior using better materials, such as 3D printing or laser cutting (advanced).
- Mount motors and basic structure for sweeping and obstacle detection.

2. Bluetooth module testing:

- Test the HC-05 Bluetooth module for basic communication between the FPGA and the computer.
- Establish the UART protocol for bidirectional data transmission between FPGA and computer.

3. Test the cycle for communication:

- Measure the number of clock cycles required to transmit data from FPGA to the computer.
- Analyze communication latency to ensure real-time control and data updates.

Week 2 (Nov 29 - Dec 5): Environment Setup and Core Functionalities

1. Robot Movement Implementation:

- Implement basic movement logic, including forward, backward, left, and right controls.
- Ensure smooth operation of the motors under manual (Bluetooth-controlled) conditions.

2. Trash Collection Implementation (Basic Cleaning):

- Begin integrating the rolling adhesive drum for basic debris collection.
- Ensure the cleaning mechanism works synchronously with the robot's movement.

Week 3 (Dec 6 - Dec 12): Advanced Features

1. Advanced Movement:

- Implement movement algorithms including Zigzag and Wall Following and ensure the robot explores the entire environment while avoiding obstacles.
- Use Hall Effect Sensor to precisely determine the rotation angle by interacting with 4 magnets adhered to the wheels.

2. Vacuum Fan and Trash Collection Implementation (Advanced Cleaning):

- Integrate the SANYO SAN ACE B97 fan to simulate vacuum suction cleaning.
- Test its performance for collecting fine particles and synchronizing with movement.

3. User Interface Design and Implementation:

- Design the user interface (e.g., a smartphone app or web page) for Bluetooth control.
- Add basic features like movement controls and toggles for suction power and speed adjustment.

Week 4 (Dec 13 - Dec 18): Final Testing and Report Preparation

1. Final Testing:

- Test the robot in various mock environments with different obstacle arrangements and cleaning scenarios.
- Optimize all systems, including Bluetooth control, cleaning mechanism, and autonomous movement, for stability and reliability.

2. Presentation and Report:

- Derive a PowerPoint presentation summarizing the project.
- Write the final report including:

    Circuit diagrams (e.g., motor control, sensor connections).

    State diagrams for movement and data transmission logic.

    Document challenges, solutions, and results for the presentation.