PROJECT BEEBOT

A report submitted to the

DEPARTMENT OF ELECTRICAL AND INFORMATION ENGINEERING

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SRI LANKA

In partial fulfillment of the requirements for the module

EE6304: EMBEDDED SYSTEMS DESIGN

by

Group 25

WEERASIRI G.M.I : EG /2021/4858

DAYANANDA G.G.A.I : EG /2021/4458

KASTHURIARACHCHI K.A.A.D. : EG /2021/4605

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1. INTRODUCTION

In large scale warehouses and sensitive and intoxicated laboratory environments, transporting goods and equipment between distant locations that requires human effort and time. This can lead to inefficiencies and safety risks. Project Beebot addresses this issue by introducing an autonomous robotic navigation system designed specifically to address these issues along predefined routes within such environments.

The whole concept of the system is built around a visual SLAM (Simultaneous Localization and Mapping) algorithm. This algorithm uses real time camera inputs to map the environment by localizing the robot, and detecting obstacles. A microprocessor is going to be use as central unit. This handles the image processing and decision-making logic. In the meantime, the mobile robot communicates with this central unit to receive navigation commands using microcontroller and Wi-Fi technology.

Objective

To develop a cost-effective, LiDAR- and IMU-free robotic system that enables autonomous movement in structured indoor spaces.

Scope and Limitations:

- The system is optimized for indoor environments with fixed pathways.
- The robot does not perform dynamic rerouting but can avoid detected obstacles along the path.
- The robot is not designed for autonomous good-picking or manipulation.
- Requires manual loading and unloading of goods.

2. SPECIFICATIONS

- The system uses real time mapping using visual inputs and image processing. This allows to construct an accurate path for mobile robots to travel in desired paths.
- The central unit is responsible for interpreting incoming video feeds, generating navigational maps and planning safe paths for robot to follow by identifying obstacles.
- Wi-Fi technology is used to establish reliable and continuous wireless communication connection between the central unit and mobile robot.
- Mobile robot receives path instructions and executes motion according to those instructions.
- The system is capable of real time obstacle detection through image analysis.
- This system operates in structured indoor environments such as warehouses and laboratories, where there are flat surfaces with clearly defined pathways and consistent lighting conditions.

3. BLOCK DIAGRAM

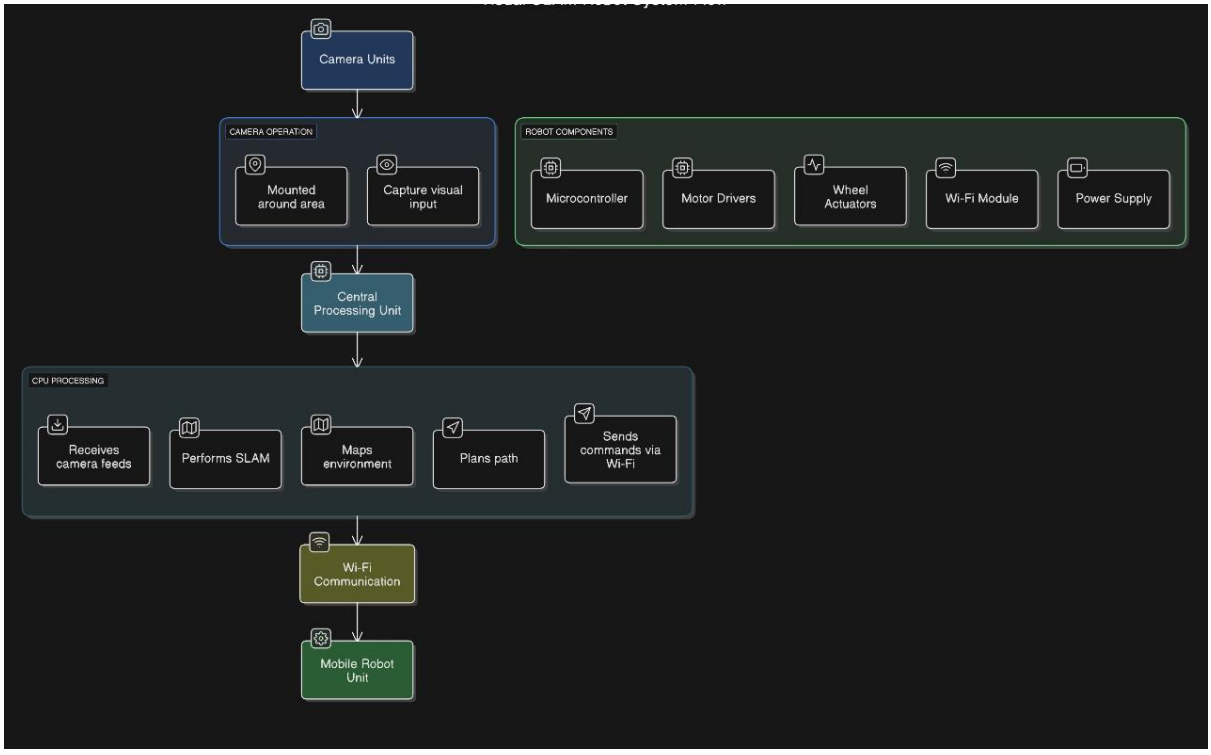

Figure 3.1: Block Diagram for Project Beebot

4. REFERENCES

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[2]Basheer Al-Tawil, T. Hempel, A. Abdelrahman, and Ayoub Al-Hamadi, “A review of visual SLAM for robotics: evolution, properties, and future applications,” *Frontiers in robotics and AI*, vol. 11, Apr. 2024, doi: https://doi.org/10.3389/frobt.2024.1347985.

[3]Pushyami Kaveti, Shankara Narayanan Vaidyanathan, Arvind Thamil Chelvan, and H. Singh, “Design and Evaluation of a Generic Visual SLAM Framework for Multi Camera Systems,” *IEEE robotics & automation letters*, vol. 8, no. 11, pp. 7368–7375, Nov. 2023, doi: https://doi.org/10.1109/lra.2023.3316609.