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EE 494 CAPSTONE DESIGN PROJECT

SYSTEM INTEGRATION TEST REPORT

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i. Introduction

In this report, the system integration of the overall system will be examined and some problems regarding to the integration will be listed.

The overall system includes the following subsystems to be integrated:

- Body Part: Chassis, Power Supply Unit and Microcontrollers.
- Detection Part: Camera, Ultrasound Sensor.
- Decision Unit
- Movement Part

ii. Construction Procedure

A. Construction of the Body Part:

At the first semester, the body part was constructed. But for several reasons, the design of this part has been updated and enhanced. (Done in the 1st Semester)

B. Embedding the Detection Part to the Body Part:

After the new body part was achieved, sensors and cameras were integrated to the body part. We examined two tests for this part given below:

- Accuracy of the Turning Algorithm:

In this test, the convenience of the sensors was examined. The details are provided in the next chapters. (Done in the 1st Semester)

- Plank Angle Detection Test:

In this test, the accuracy of the detected angle of the plank between 2 robots is investigated. The details can be found in the next chapters. (Done in the 1st Semester)

C. Decision Making Unit:

This part is about the process of making decision by using the angle coming from camera and data coming from the ultrasound sensors. For this part, we made several tests on the maze implementation. Some example tests on the decision unit are given below.

1st Part: Non-Collaborative Tests

- Going through a straight line by itself.
- Making the L turn by itself.
- Making the U turn by itself.
- Going through the whole maze by itself.

2nd Part: Collaborative Tests

D. Test Reports

When the overall system is investigated, the robot consists of 3 main parts in terms of modules.

1. Detecting the distance to the wall.
2. Detecting the angle of the plank.
3. Deciding the direction and move accordingly.

Detecting the Distance to the Wall

This part is quite important as the movement of the robot, especially in the L and U turns, depends on this data. For this purpose, ultrasound sensors have been used.

In the real maze implementation, a number of 10 trials for this module were proceeded. The results can be seen in the Table 1 below.

Error Reason	Frequency
Could not detect the wall and hit it. Then it could not make the turn.	2
Could not detect the wall and hit it. Then it could make the turn successfully.	2
Everything worked fine.	6
TOTAL	10

Table 1. Different Situations Occurred During the Tests.

Detecting the Angle of the Plank

Besides the distance to the wall, the angle of the plank is another important parameter to decide the successful move. To test this parameter, we adjusted a stick positioned at the rear of the robot. After this we took some measurements while the plank is attached to the robot. But as it is impossible to log angle data while the robot moves, we made this test at a fixed position. The details are provided in Table 2.

Error Reason	Frequency
The camera could not detect the angle because of the exposure issues.	2
Everything worked fine.	8
TOTAL	10

Table 2. Different Situations Occurred During the Tests.

Movement System

1. Going through a straight line by itself

In this test, the robot is supposed to enter a straight maze corridor and leave it successfully.

We applied this test 15 times and according to our observations, the robot completed the trials with 73% success rate. There are 4 unsuccessful attempts and they helped us with debugging process.

2. Making the L turn by itself

In this test, the robot is supposed to complete a L turn itself. For this purpose, we use the data coming from the ultrasound sensors.

On the real maze platform, we applied this test 15 times. 7 of these trials were successful. Reasons leading these errors can be seen from the Table 3.

Error Reason	Frequency
Could not detect the turn and hit the wall.	3
Detected the wall and made the L turn. But due to excessive turning (about 120^{o}), it failed.	4
Everything worked fine. But the cables within the chassis mislead the ultrasound sensors.	1
SUCCESSFUL ATTEMPT	7
TOTAL	15

Table 3. Different Situations Occurred During the Tests.