Interim Design Report

Micromouse Sensor Subsystem

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Date

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Chapter 1

Introduction

1.1 Problem Description

The project involves the design and development of an autonomous micro-mouse robot for maze navigation, using 4 subsystems, the motherboard, the processor, the power subsystem, the sensor subsystem, this specific report focuses on the design of the sensor subsystem. Which is the eyes of the micro-mouse capable of detecting obstacles (walls, corners) within the maze environment. Obstacle detection must be accurate and timely for efficient and safe maze navigation. The sensor subsystem design must have low power comsumption to maximize battery life, stay within the project's budget constraints, have seamless integration with the provided motherboard and other subsystems of the project, the sensor must also be the compact size for the micro-mouse maneuverability.

1.2 Scope and Limitations

The scope of this project is to develop and design a sensor subsystem for a micromouse, focused on obstacle detection within a maze. This involves the selection of an efficient sensor technology that balances functionality with project constraints, designing and developing the sensor PCB with schematics and component selection, developing basic sensor data acquisition software for communication with the robot's control system (interfacing with the provided processor board), and testing the sensor module for functionality, accuracy, and power consumption. The sensor of choice will be limited by accuracy, range, power consumption, budget constraints. Resources available like components, methods of fabrication, and testing equipment which might constrain development. The subsystem integration with other subsystems may have limitations until the entire micro-mouse is finalized. These limitations will be addressed through making sure our sensor subsytem functions well while staying within budget, optimizing the effectiveness of resources available and testing methods.

1.3 GitHub Link

https://github.com/TP0111/EEE3088F-2024-/tree/main/Sensor

Chapter 2

Requirements Analysis

2.1 Requirements

The requirements for a micro-mouse sensor module are described in Table 2.1.

Table 2.1: User and functional requirements of the sensor subsystem.

Requirement ID	Description
UR01	The sensor must successfully detect obstacles such as walls in front and on the sides usin
UR02	The sensor PCB connector pins must effortlessly connect to the processor board.
UR03	The size of the sensor must be within minimum range to fit within the micro-mouse and
UR04	The sensor must operate with minimum power consumption.
UR05	The sensor design must stay within budget constraints.
UR06	The system must be minimal to 15 degrees change in angle
FR01	

2.2 Specifications

The specifications, refined from the requirements in Table 2.1, for the micro-mouse sensor module are described in Table 2.2.

Table 2.2: Specifications of the sensing subsystem derived from the requirements in Table 2.1.

Specification ID	Description
SP01	The output voltage must be between 2.6V and 3.6V so that the GPIO pins will be able to
SP02	2X14 Connector pin
SP03	The board must be within 80mm x 50mm in size in order to fit within the micro-mouse an
SP04	The system must use 1S1P battery and draw current of less than 400mA and run for 2hrs.
SP05	The total budget of the system should be below $30 and the total cost of components mus
SP06	The sensor must not be able to sense changes in angles less than 15 degrees, but when cha

2.3 Testing Procedures

A summary of the testing procedures detailed in chapter 4 is given in Table 2.3.

Table 2.3: CAPTION

Acceptance Test ID	Description
AT01	The Voltage being supplied to the system should be measured and monitor the LED b
AT02	Test if the sensor PCB connector fits into the motherboard
AT03	Rotate the micro-mouse to see if the micro-mouse can move through tight spaces.
AT04	Observe the sensor's power usage in standby mode and operating mode and see if it is
AT05	Test the effect of the change in rotation if the angle changes by 15 degrees.
AT06	Confirm the price will be determined by Bill of Materials on JLCPB website.

2.4 Traceability Analysis

The show how the requirements, specifications and testing procedures all link, Table 2.4 is provided.

Table 2.4: Requirements Traceability Matrix

#	Requirements	Specifications	Acceptance Test
1	UR01	SP01	AT01
2	UR02	SP02	AT02
3	UR03	SP03	AT03
4	UR04	SP04	AT04
5	UR05	SP05	AT05
6	UR06	SP06	AT06

2.4.1 Traceability Analysis 1

Sensor output voltage (SP01) within 2.6V and 3.6V ensures proper GPIO pin detection (AT01) for the presence of an obstacle. Therefore AT01 indirectly verifies obstacle detection (UR01).

2.4.2 Traceability Analysis 2

SP02 introduces a 2x14 pin connector which ensures physical fit with the processor board (UR02). Thus AT02 directly tests physical connection (UR02).

2.4.3 Traceability Analysis 3

SP03 limits PCB size(80mm x 50mm) to fit within the micro-mouse (UR03). AT03 tests maneuverability in tight spaces, which indirectly verifies compact sensor size (UR03).

2.4.4 Traceability Analysis 4

SP04 specifies power consumption for 1S1P battery and operation time. Thus AT04 directly measures sensor power consumption (UR04).

2.4.5 Traceability Analysis 5

SP05 limits the total budget to $30 and component cost to $8, Which is required by (UR05). AT05 directly confirms the total price, and component price.

2.4.6 Traceability Analysis 6

SP06 defines the minimum angle change detectable which is 15 degrees. AT05 tests the change in response at 15 degrees angle shift, verifying insensitivity to smaller changes (UR06).

Chapter 3

Subsystem Design

3.1 Design Decisions

3.1.1 Final Design

The following design...

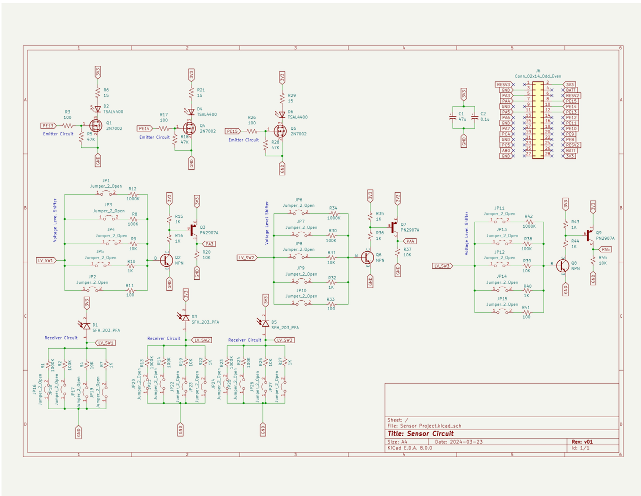
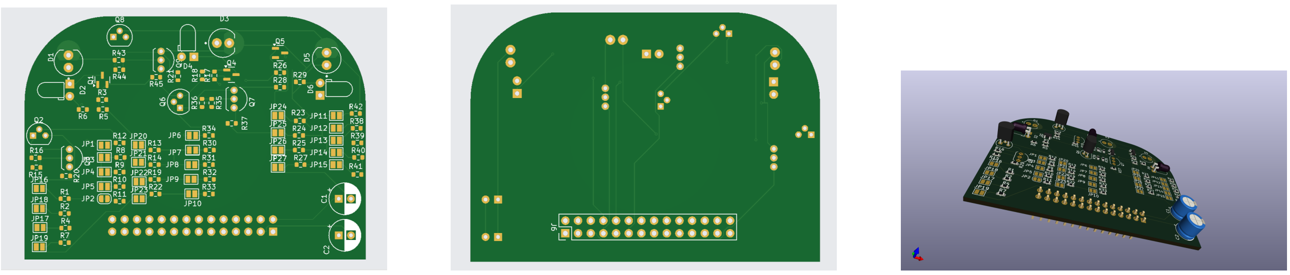


Figure 3.1: Schematic



(a) Front PCB (b) Back PCB (c) 3D PCB

Figure 3.2: PCB

Table 3.1: CAPTION

Name	Description

3.2 Failure Management

3.3 System Integration and Interfacing

To integrate the subsystem with the rest of the system ....

Table 3.2: Interfacing specifications

Interface	Description	Pins/Output
I001	Interface the right sensor with the micro-controller	• R: Emitter to PE15(PWM) • R: Receiver to PA5(GPIO pin, Analogue)
I002	Interface the front sensor with the micro-controller	• F: Emitter to PE14(PWM) • F: Receiver to PA4(GPIO pin, Analogue)
I003	Interface the left sensor with the micro-controller	• L: Emitter to PE13(PWM) • L: Receiver to PA3(GPIO pin, Analogue)

Chapter 4

Acceptance Testing

4.1 Tests

Table 4.1: Subsystem acceptance tests

Test ID	Description	Testing Procedure	Pass/Fail Criteria
AT01	Powers on	• •	
		• •	

4.2 Critical Analysis of Testing

Table 4.2: Subsystem acceptance test results

Test ID	Description	Result
AT01	Powers on	

4.2.1 AT01

This worked, this did not work. I suspect that is because of x y and z.

Chapter 5

Conclusion

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5.1 Recommendations

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