Intermediate Project
Wednesday 13^{15}
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Micromouse

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Abstract:
The paper describes the steps of construction of a mobile robot of a class (2,0). The goal of the project was to build a micromouse robot that would use a collection of sensors and motor system to properly get around the maze. Finished construction gives the ability to communicate with the sensors and is prepared for the implementation and tests of different search algorithms.

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Contents

1 Introduction

1.1 Goals

Main goals:

- selection of proper sensors, mechanical elements, microcontroler,
- design of robots mechanics: main construction, sensor placement etc.
- design of robots electronics, main PCB board, PCB board for encoders
- construction of the robot, soldering of the elements to a PCB board,
- programming: motor control, sensor readings

Hope to do:

- implementatnion of the search algorithm such as floodfill [1] etc.
- keeping the discovered maze in the robots memory
- robot prepared for the start in competitions

1.2 Assumptions

The following assumptions were proposed:

- The construction will have the dimensions no more than 10x10
- Robot should be able to communicate using Bluetooth
- Sensors mounted in the robot should be tested
- The robot should be prepared and ready for the implementation of the search algorithms

2 Implementation

In this section the development of the robot will be described – all the elements used and the construction process.

2.1 Construction

Elements used:

- Microprocessor STM32F411RET6
- Pololu motors 30:1
- Miniature encoders for pololu motors
- H-bridge TB6612

- Pololu VL53L1X time-of-flight sensors
- IMU - LSM9DS1
- Battery Li-pol(250mAh)7,4V
- voltage stabilizer LM1117 5V and 3.3V
- switches
- LED's

The choice of the above elements is dictated by the desire to create a robot which can determine it's position in the labyrinth precisely and move with great speed. A fast microcontroller with a large number of peripherals can perform a large number of calculations needed to determine the position of the robot and trajectory of the movement in short time. Optical encoders with 20 impulses combined with 30:1 motors provide quite accurate readings of wheels positions. The flight time of the light sensors gives accurate readings of distance in millimeters as a result of measurement, also they are characterized by a large range of measurement.

2.2 Schemes

All schemes of electronics and PCB board for the robot were designed using Autodesk Eagle program with the students licence.
Figures presented below shows electronic schemes of the most important parts of the robot. Not including power supply, LED's, buttons, communication connections.

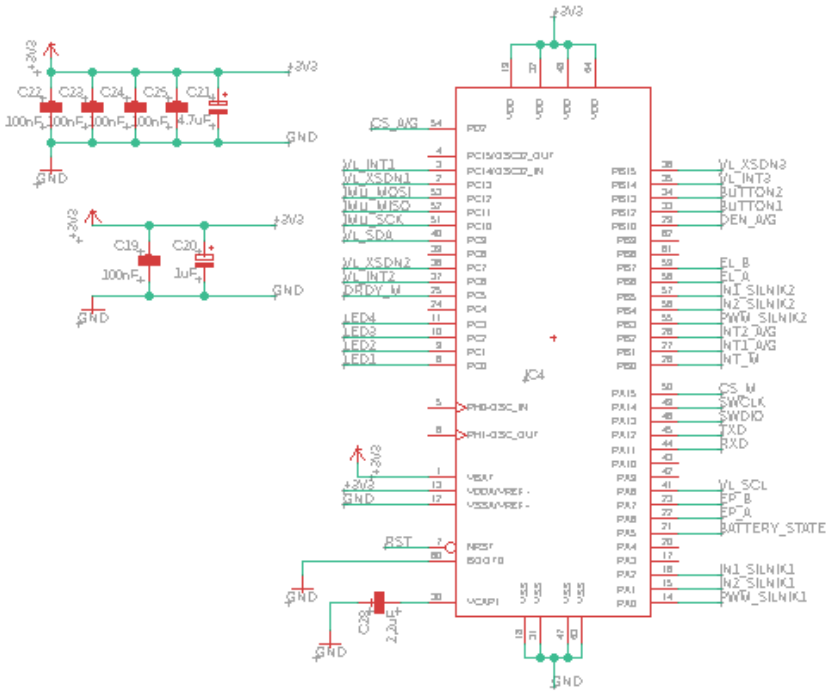

Figure 1: Scheme of microcontroller STM32F411

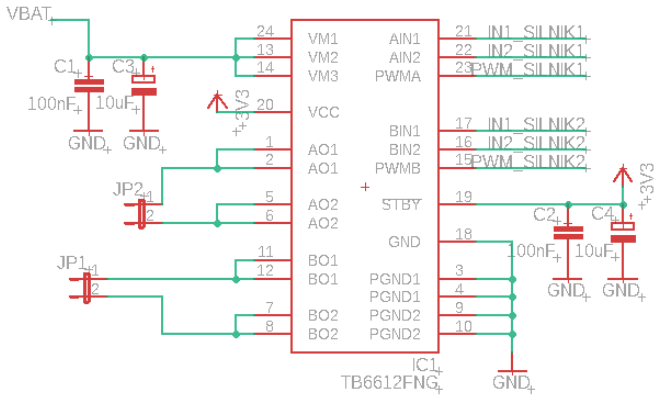

Figure 2: Scheme of TB6612

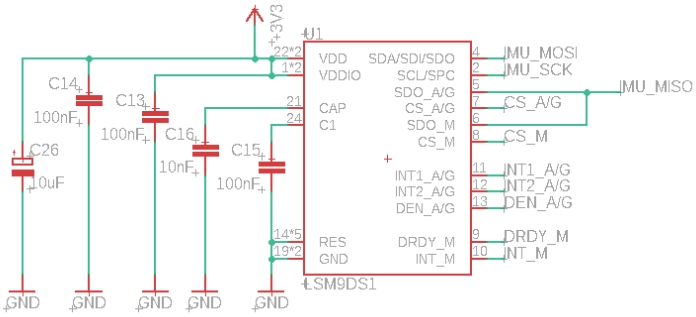

Figure 3: Scheme of IMU LSM9DS1

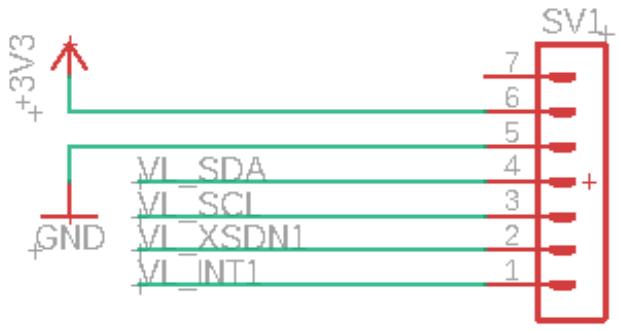

Figure 4: Scheme of TOF sensor VL53L1X

2.3 PCB board project

Below both sides of the designed PCB are presented on figures 5 and 6. Figures are not in the real scale.

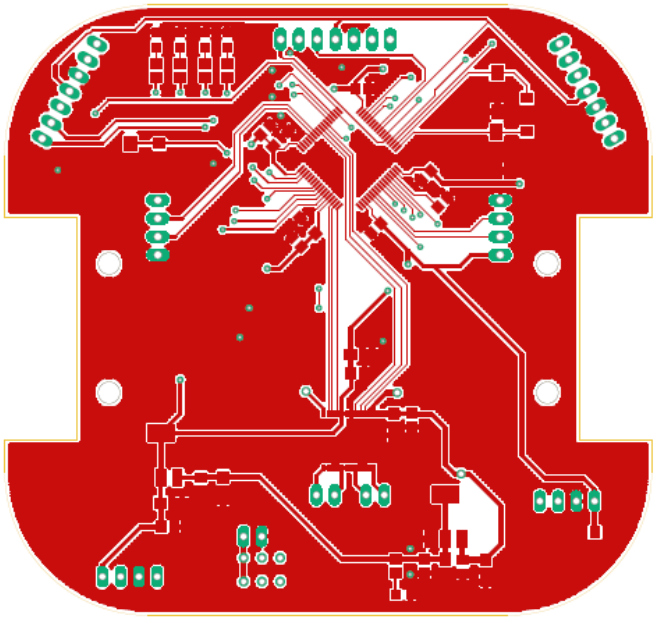

Figure 5: Top part of the board

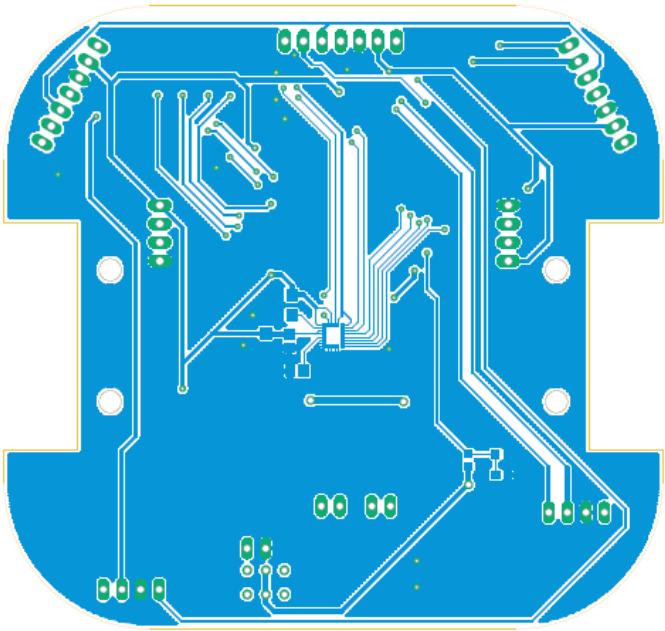

Figure 6: Bottom part of the board

2.4 Finished construction

The PCB board has been made by an external company [2], the finished and delivered product can be seen below on figure 7. Completed construction with all components attached to the pcb can be seen on figures 8 and 5

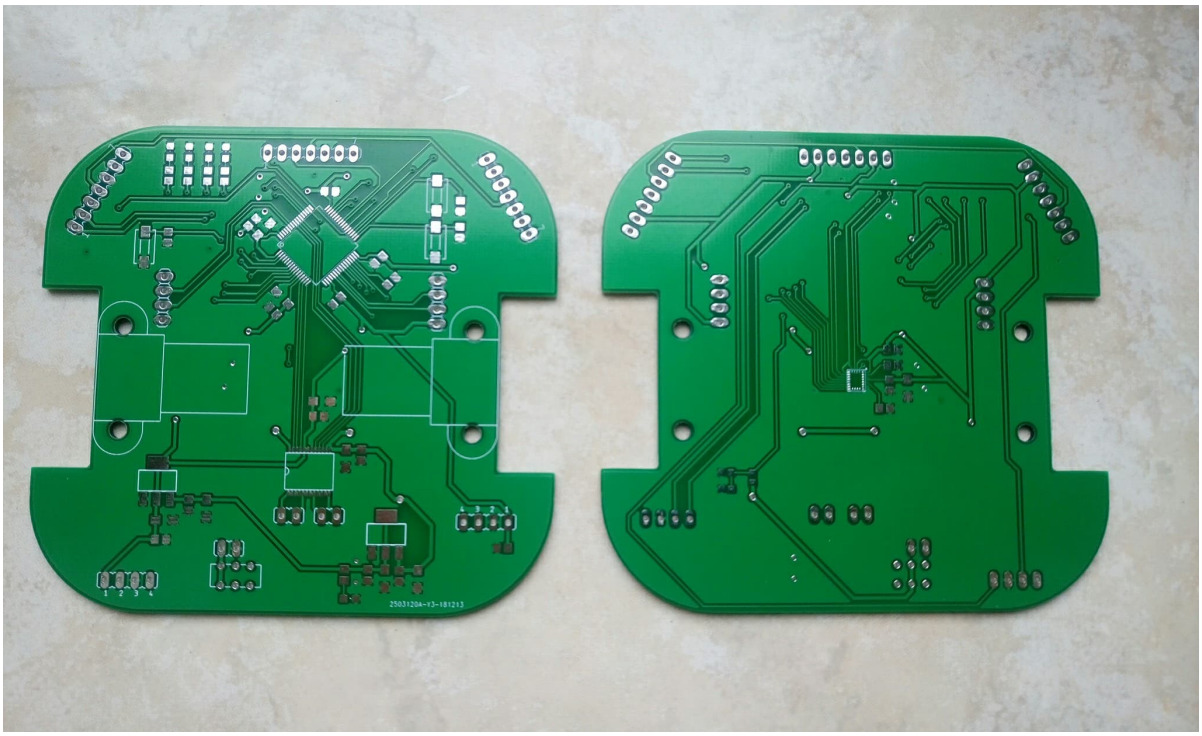

Figure 7: Bottom part of the board

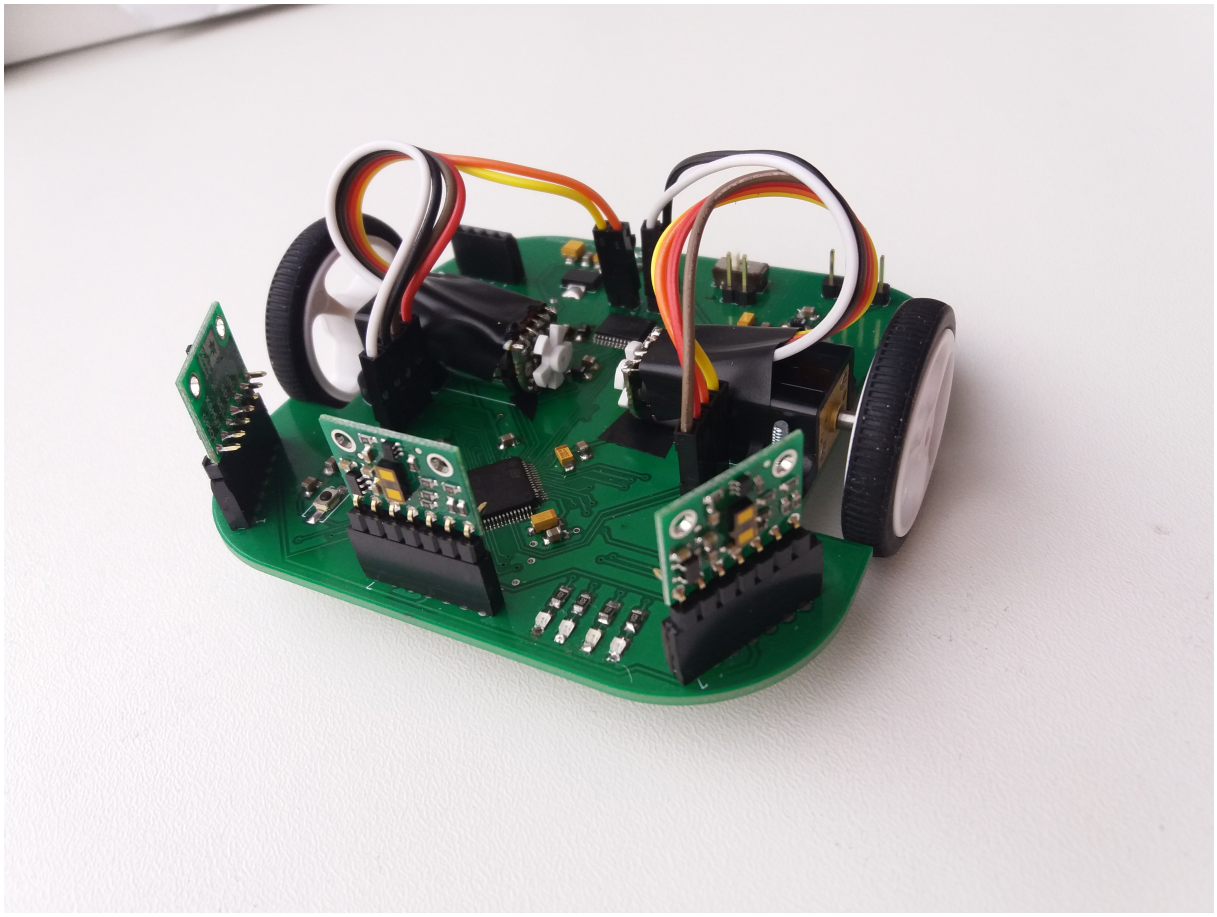

Figure 8: Construction from the front

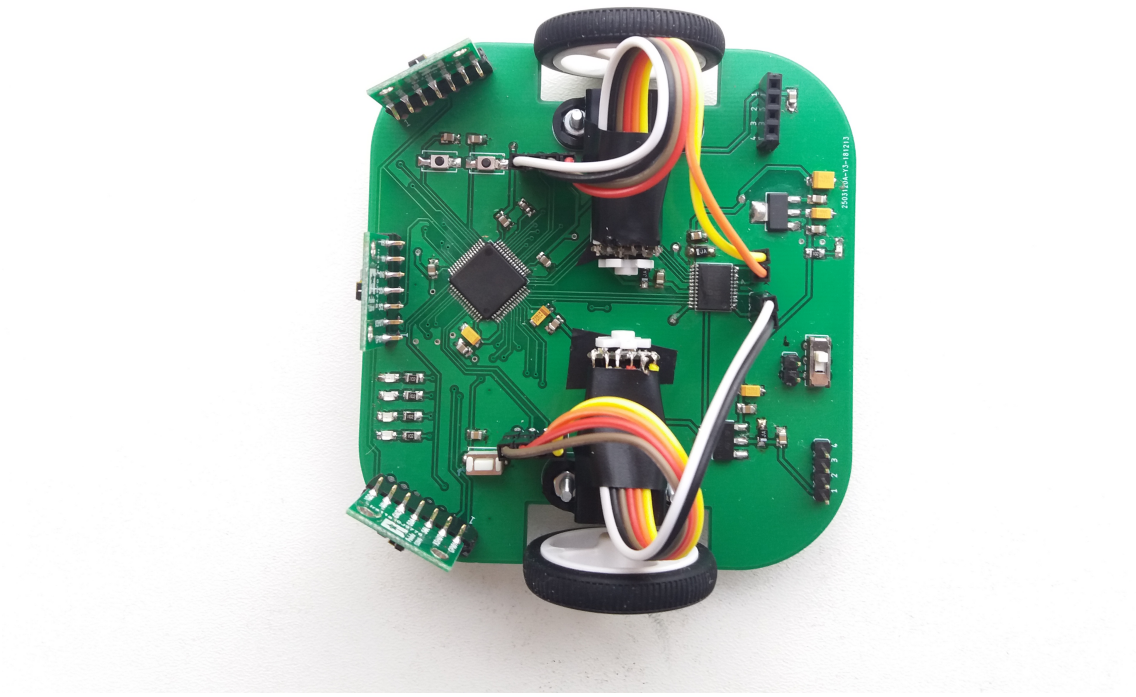

Figure 9: Construction from the top

2.5 Software

Software necessary for operating chosen components like encoders, IMU, TOF sensors and H bridge has been written [3], therefore robot is ready for implementing the algorithms to move in the maze. The speed profiler allows the robot to move with chosen speed and acceleration. PD regulators are used for that.

The assembly of the appropriate sequence of movements together with the maze search algorithm based on the method of flooding allows to find the shortest paths in the maze. To effectively eliminate unavoidable errors the robot uses a calibration method based on keeping in the middle corridors by measuring the distance from the side walls.

3 Conclusion

The main goals of the project were completed. The mobile platform of a class (2,0) were build. Included components allows the implementation of different types of search algorithms and also a good positioning the robot in the maze.

During building process a problem with optical encoders was encountered. They were not working properly and a lot of effort was needed to fix them. Eventually one of them was burned and require replacement.

References

[1] Wikipedia page about FloodFill algorithm,
https://pl.wikipedia.org/wiki/Flood_fill

[2] *PCB fabrication manufacturer*
https://jlcpcb.com/

[3] Course about STM microcontrollers programming
https://forbot.pl/blog/kurs-stm32-f4-1-czas-poznac-hal-spis-tresci-kursu-id14114