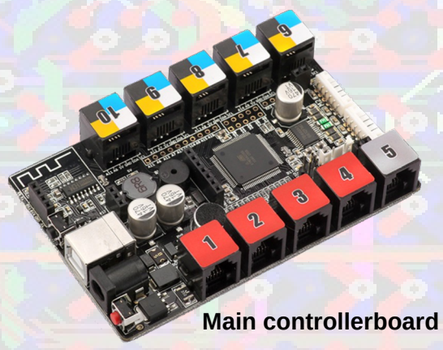
TEAM BIGG-IRMI

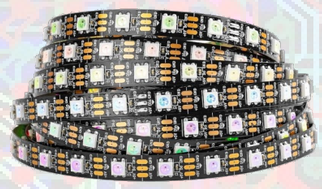
Rescue Line

Front Camera Module

The front camera module comprises two ESP32S3 µCs. Each of these is connected to a 120/160° wide-angle OV2640 camera. The primary camera (right, 120°) is responsible for line tracking. The secondary camera (left, 160°) is responsible for the AI-based detection of the evacuation zone entrance.



Main controllerboard

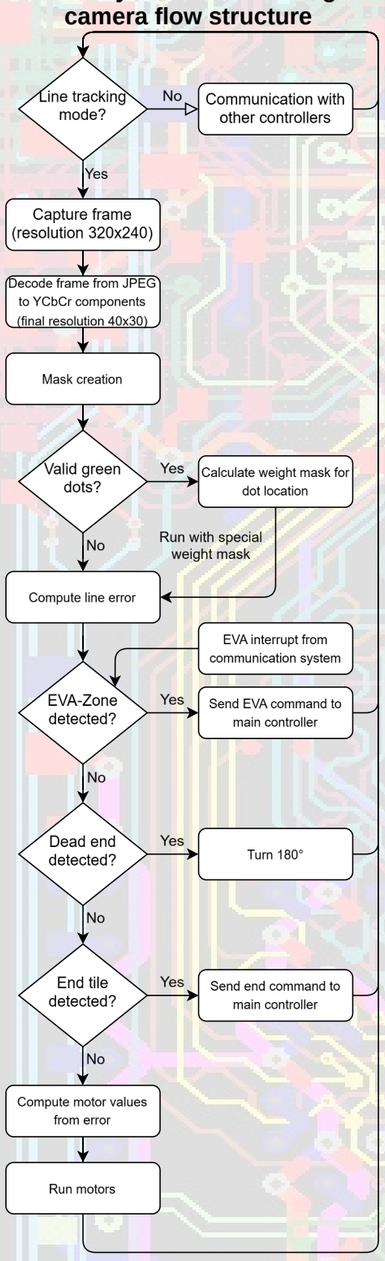


WS2812b addressable LED strip

Software

Our software consists of several elements, each running on a separate microcontroller. Each element contains our basic UART communication module and can therefore easily send motor commands, read sensor values and control servos. All programs are written in C++.

Primary front line tracking camera flow structure



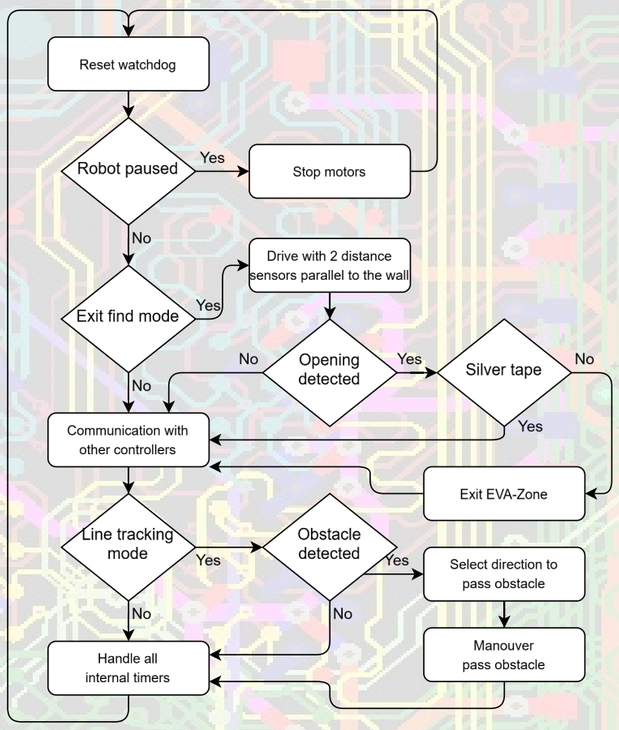
Line Tracking

The program operates using the primary front camera (camera #1), which contains a bespoke line tracking algorithm that has been developed from ground up. A variety of sophisticated techniques were employed to optimise runtime performance. These optimisations enable us to process approximately 20 FPS (30 ms capture, 29 ms decode, 800 µs line tracking)

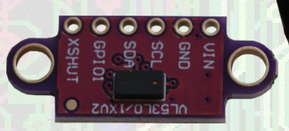
Main Controller

It runs on the main controller board and is responsible for controlling the motors, the victim presence sensor and our 4 VL53L0X distance sensors. It receives commands from the front/rear cameras and performs tasks for them, such as turning on the lights or measuring the distances. In line tracking mode, it constantly checks the front distance sensor for obstacles. It also handles the start/stop commands given by the button. In addition, a watchdog is employed to guarantee optimal performance during operation.

Main controller flow structure

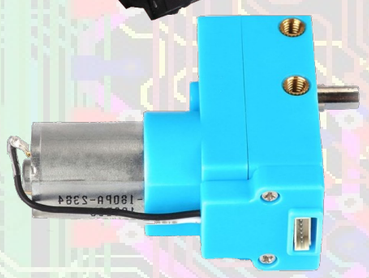


3x 12V Cooling fan



4x VL53L0X Time of flight distance sensor

3x ESP32S3 camera µC



2x 12V Makeblock optical encoder motor

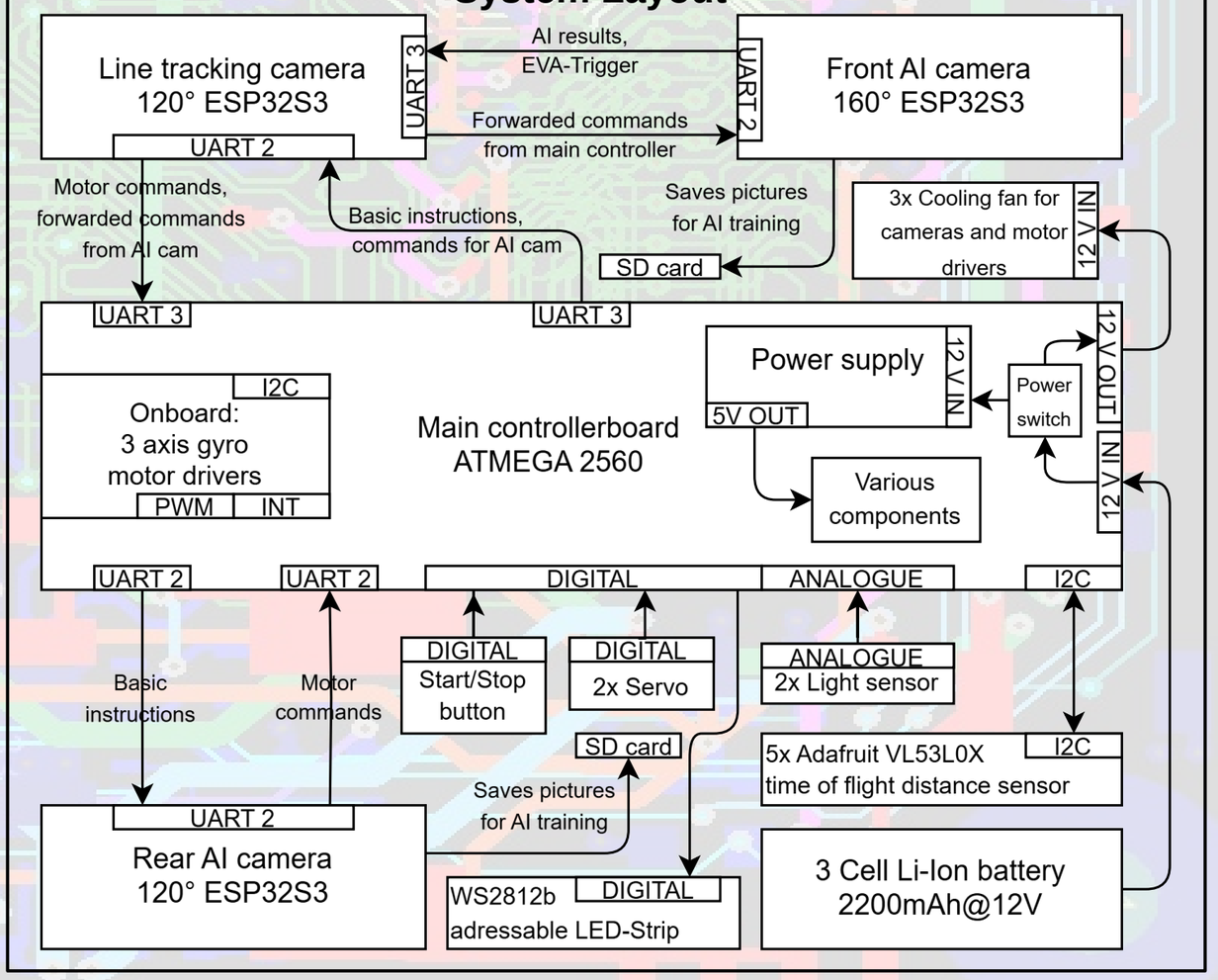
3x OV2640 120/160° wide angle camera

MG90 metal geared micro servo

12V 2200mAh Li-Ion battery pack

Makeblock metal geared high torque Servo

System Layout



Iren Biggel:

- Born in 2008, Germany
- Team captain
- Embedded software development
- Project management
- Hardware design
- Testing

Mila Biggel:

- Born in 2011, Germany
- Team member
- Mechanical CAD
- 3D manufacturing
- Video production
- Testing

Achievements

2025 Qualification for European Championships achieved

2025 5th Place German Open Nürnberg
2025 2nd Place German Open Qualification Tournament
2024 7th Place European Championships Hannover
2024 1st Place German Open Qualification Tournament
2023 1st Place German Open Qualification Tournament
2022 2nd Place European Championship Portugal (Entry)

Our GitHub Repository