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Sensors System For a Motorized Wheelchair

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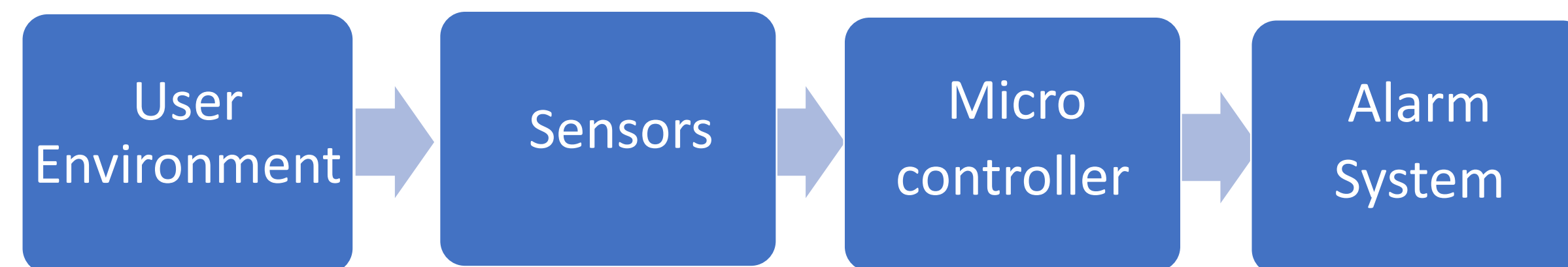
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Introduction

In our project, we designed a sensors system for a motorized wheelchair. Our main goal is to help students with Cerebral Palsy (CP) to drive and control the motorized wheelchair.

The system will alarm the user from objects on their driving view while driving forward and backward.

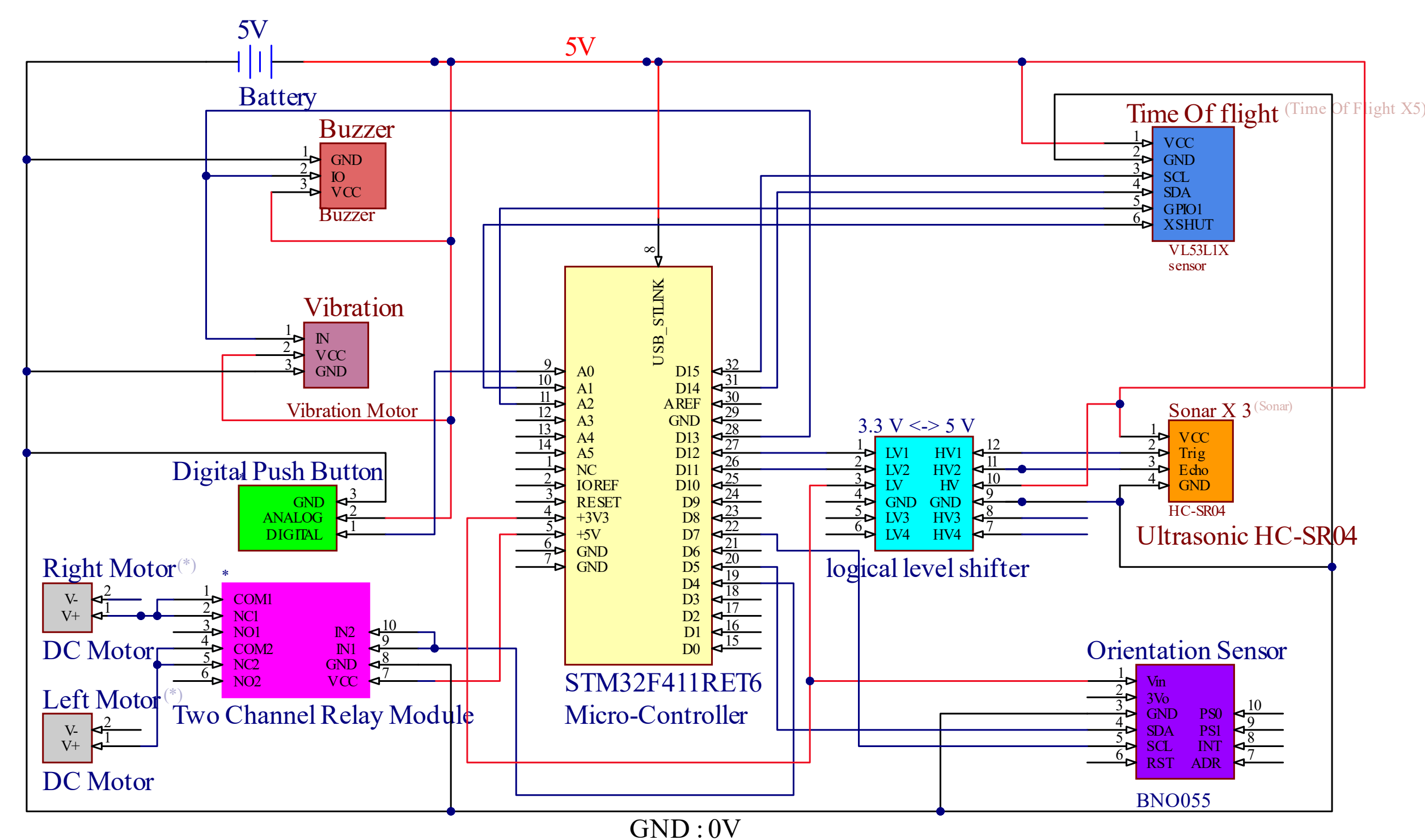
The system includes distance sensors, microcontroller and an alarm system. The block diagram of the circuit is presented below:



The sensors will scan the user's environment in real-time to find obstacles along the way. The microcontroller processes the information from the sensors and will activate the warning system before a collision with an obstacle.

Implementation

The circuit diagram is presented below:



The project is based on the following components:

- STM32 32-bit microcontroller with Arm Cortex-M4 running at 100 MHz.
- VL53L1X Time-of-Flight, laser-ranging sensor with accurate ranging up to 4 m and fast ranging frequency up to 50 Hz.
- HC-SR04 ultrasonic distance sensor, provides up to 4 m measurement with a ranging of 3mm.
- BNO055 Orientation sensor, provides acceleration data on three axis.

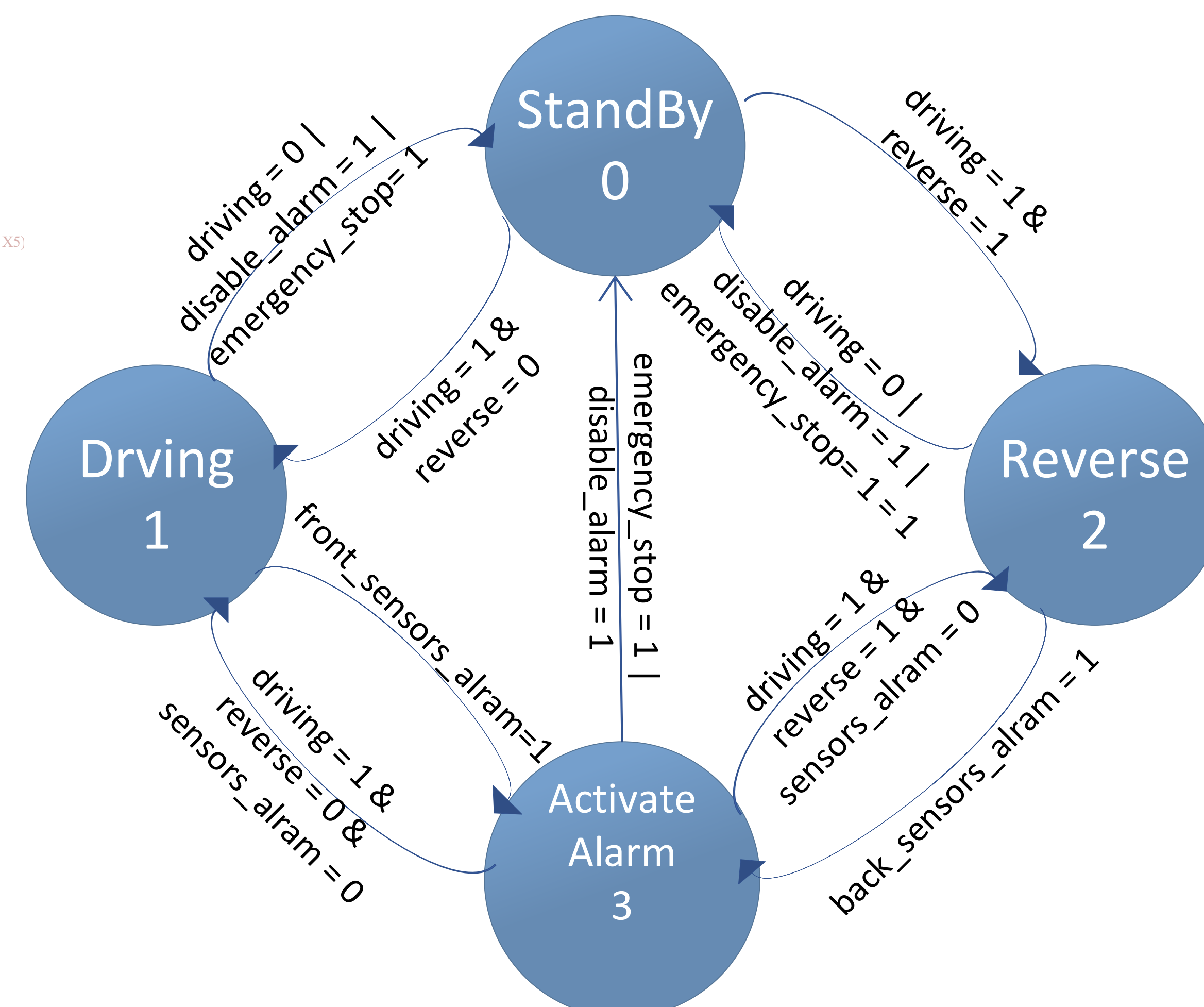
The alarm system:

- Buzzer module and vibration motor module.
- Digital push button, the user can push the button to disable the alarm system for 5 minutes.
- Two channel relay module, will switch off the motor power.

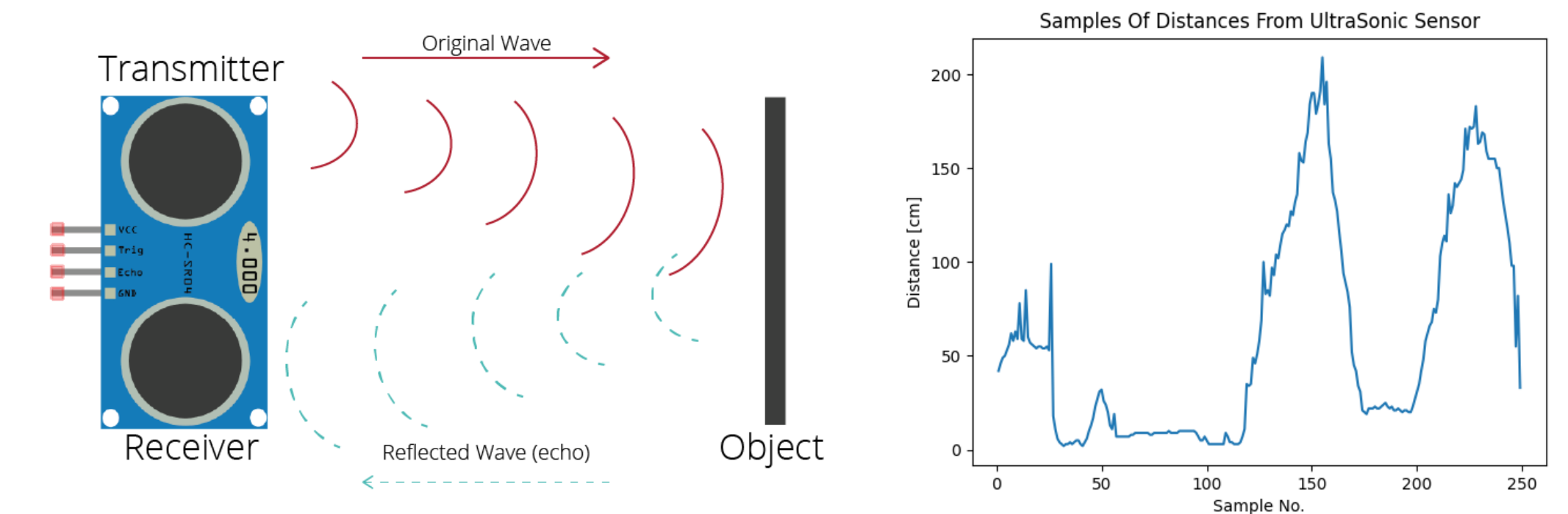
The algorithm we are using is written in STM32CubeIDE C development platform.

Driving and reverse parameters are determined by the acceleration data provided by the orientation sensor.

The algorithm is based on the following state machine:



Presented below is a simulation of the output of the distance sensors as a function of time, and how the ultrasonic sensors work:



Results

The prototype of the system we designed and the location of the different components on the wheelchair is shown in the following scheme:



Conclusions

In this project, we designed an alarm system for a motorized wheelchair. We chose the different components and integrated them together with the sensors, microcontroller, and alarm system to work in real-time and with high accuracy.

Bibliography

[1] Mesa Ricardo "MicroPython: HC-SR04 Ultrasonic Sensor" Random Nerd Tutorials 19 Aug. 2021