IDP Group M213: Final Software Documentation

System Diagram
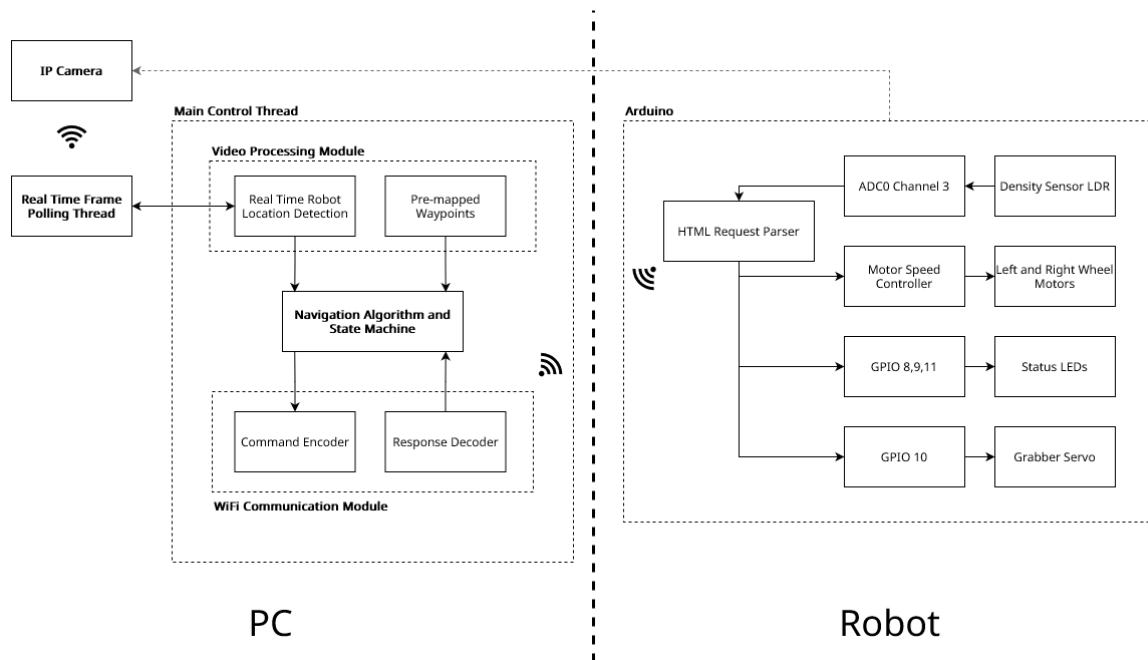
The overall system diagram is as shown below

Figure 1: Overall System Diagram

Communication between the robot and the control PC was done via HTTP GET requests over WiFi. This allowed robust passing of commands and parameters, as well as reading back of the robot status and density reading.

Overall, the control algorithm is run in 2 separate threads: one dedicated to polling the IP camera for the latest frame to clear any buffers within the image pipeline, thus minimizing latency; and the other handling the calibration and pathfinding routines.

The main state machine is implemented on the control PC. Thus, there is minimal logic on the robot itself – the robot only parses incoming commands and executes them.

The robot does not have internal closed loop control over its linear and angular displacement, all movement commands sent only specify the duration that the robot should translate or rotate. Hence, the control script also carries out a calibration routine at the start of each run to obtain a multiplication factor for distance moved and angle rotated per millisecond of movement.

Code Structure and Algorithm

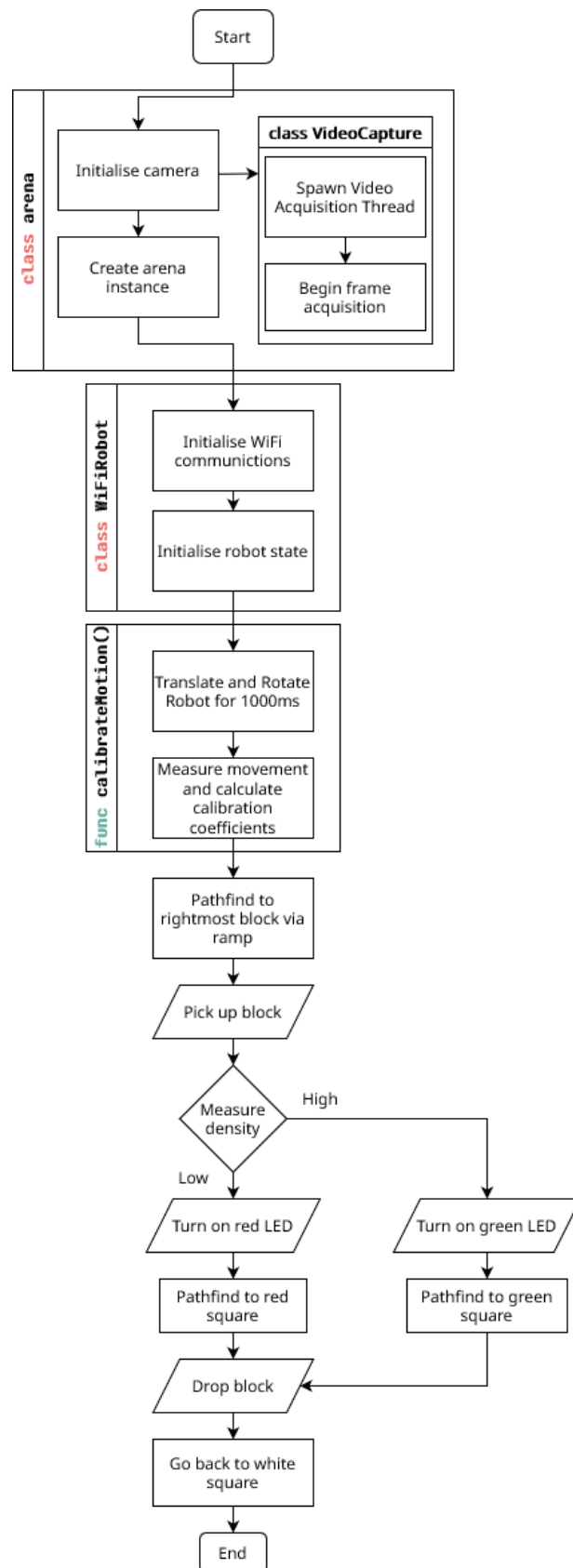The initialization and control flow is illustrated below:

Figure 2: Initialization and Control Flowchart

The details of the initialization, logic behind the pathfinding functions, as well as the recovery manoeuvre designed to free the robot if it gets stuck within the tunnel or if it veers out of the field of view of the camera, are all omitted from the flowchart for simplicity.

Source Code

The sources consist of the command parser to be uploaded onto the Arduino, as well as the main navigation script along with its helper scripts and dependencies.

All the required files can be downloaded here:

https://drive.google.com/drive/folders/1mn8MTJ9kZoEhpzb0ZUAg0k9sgz_IOSJ1?usp=share_link