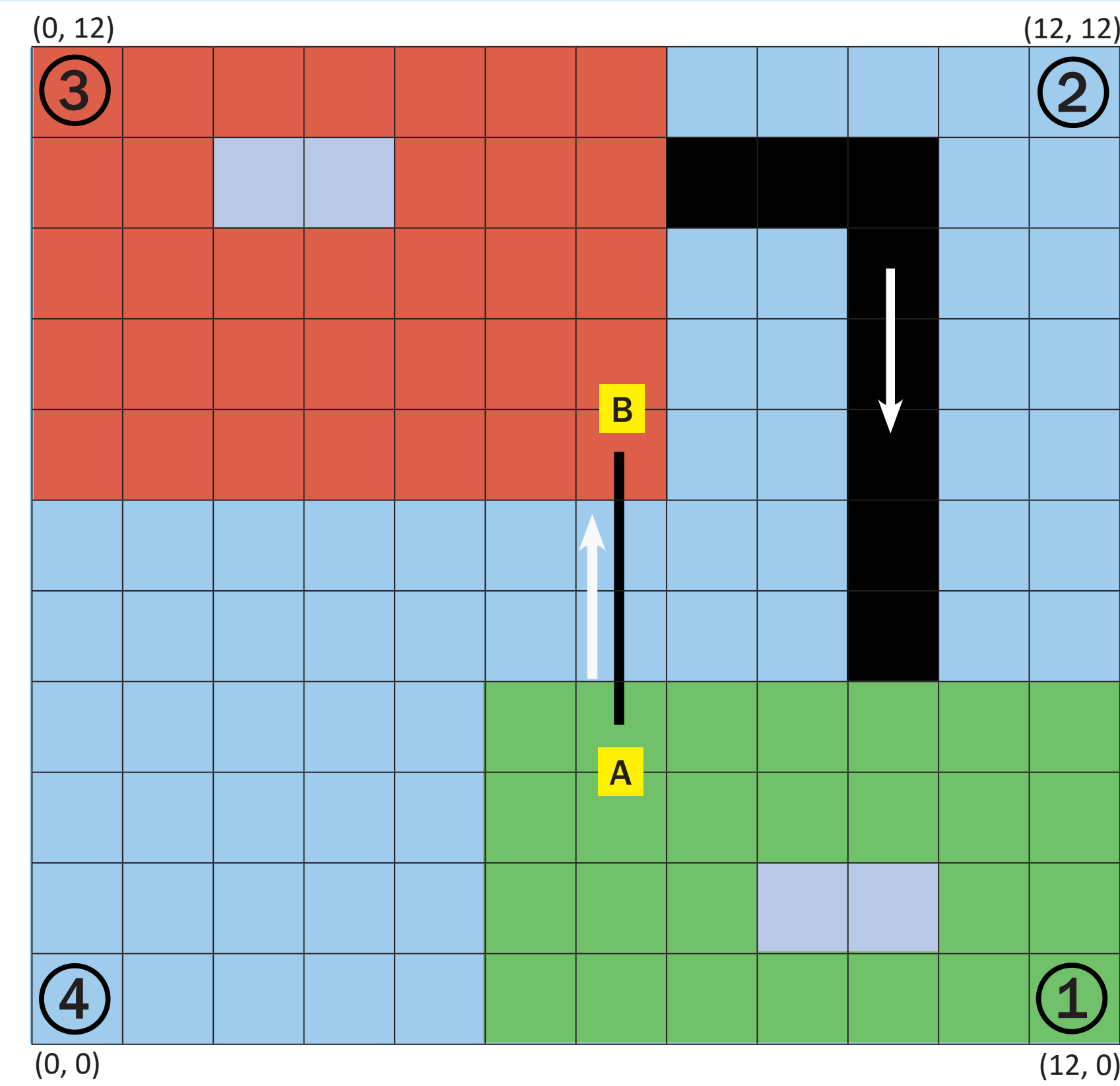# McGill

Robot / Team Name

Objective

The goal is to design a robot that is capable of autonomously playing a one-on-one game of capture the flag. At the start of play, the robot must receive the game parameters that describe the position of each element of the playing field. The robot must then navigate to the opponent's zone, find the appropriately coloured flag, and return to its starting zone. Both methods of crossing the water must be used, in the specified order.

Green Team

1. Receive game parameters
2. Localize to (7, 1)
3. Navigate to A and relocalize
4. Mount, cross, dismount zipline
5. Relocalize to B
6. Navigate to red zone and find flag

Red Team

1. Receive game parameters
2. Localize to (1, 7)
3. Navigate to green zone via bridge, find flag
4. Navigate to A and relocalize
5. Mount, cross, dismount zipline
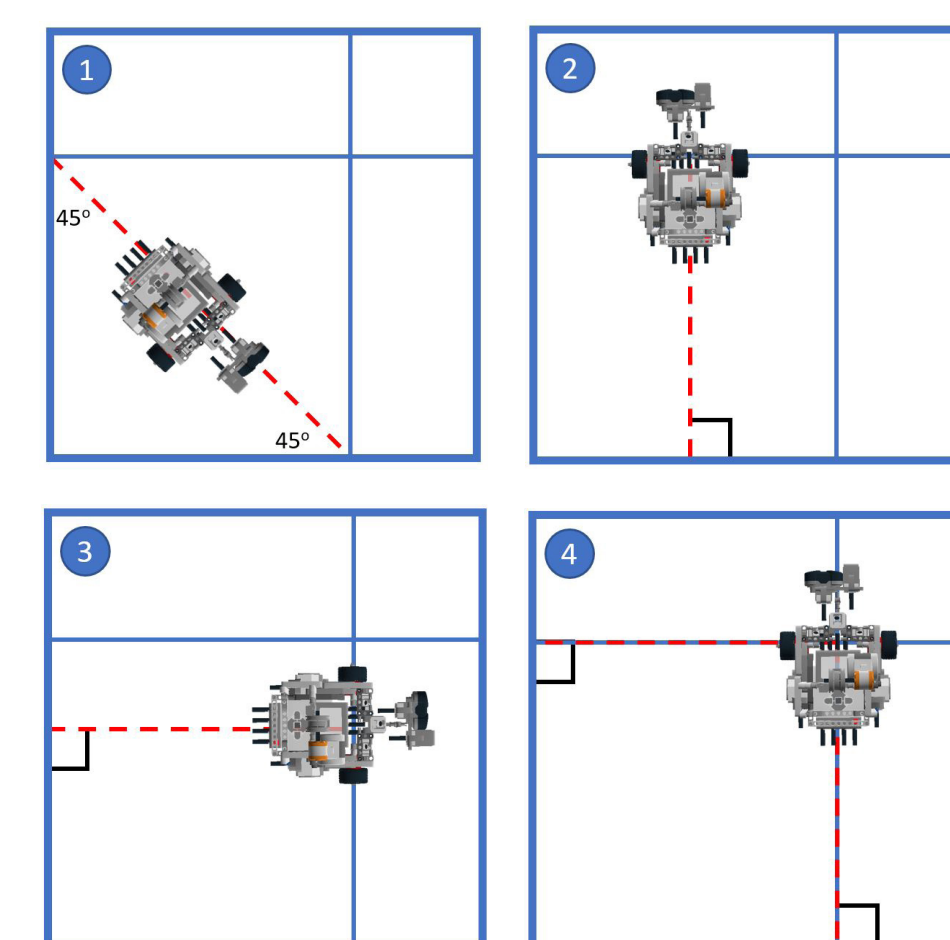6. Relocalize to B
7. Return to 3

Requirements of Play

- localization clock: 30 seconds
- game clock: 5 minutes
- no contact with ground during zipline crossing
- beep three times upon finding the opponent's flag
- after capture, return to base with the opposite crossing method
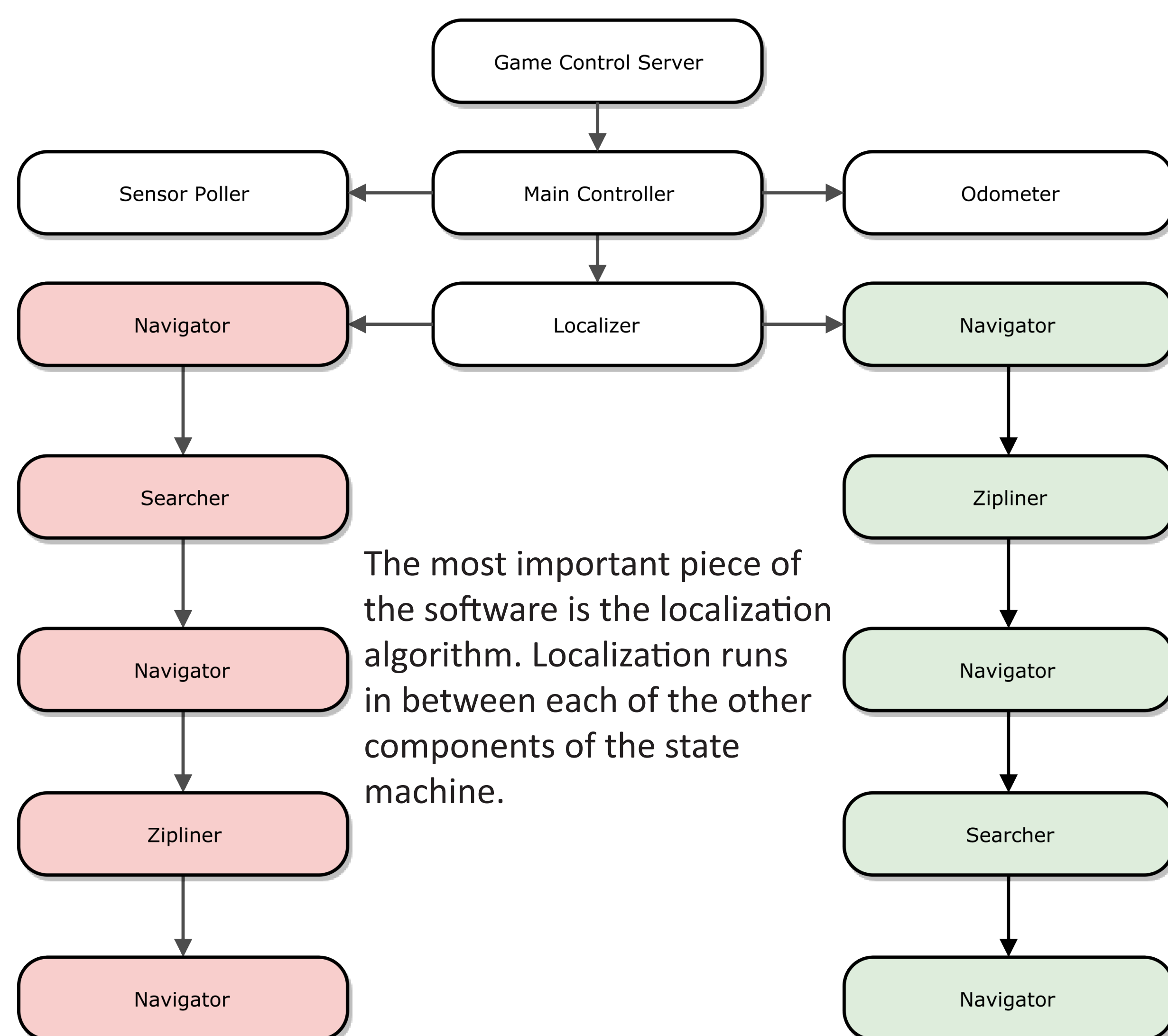
Hardware Design

3x Colour Sensor
- line detecton: 2 ground-facing sensors
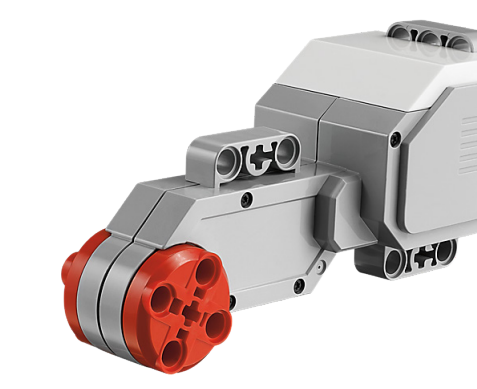- flag colour detection: 1 rotating sensor

1x EV3 Brick
- houses the processor, memory, and storage
- hub to connect sensors and motors

3x Large Motor
- driving the robot: 2 wheels on the ground
- zipline crossing: one pulley wheel

1x Sensor Motor
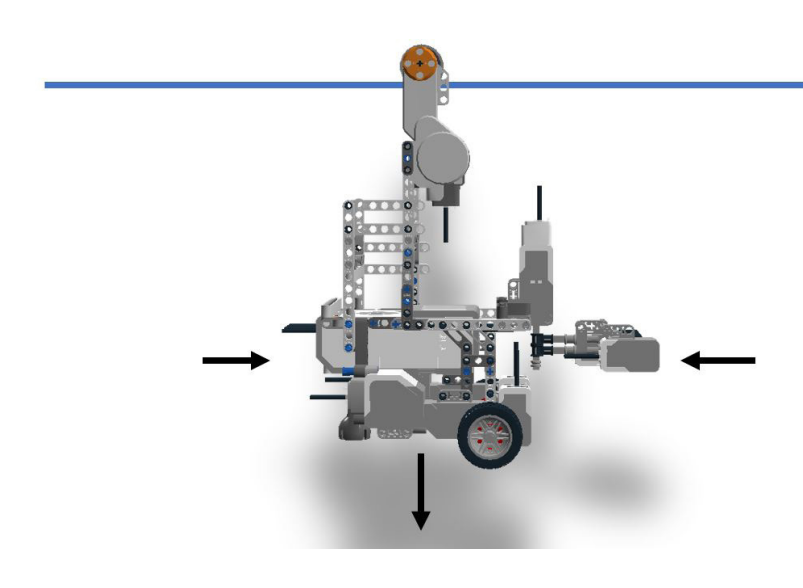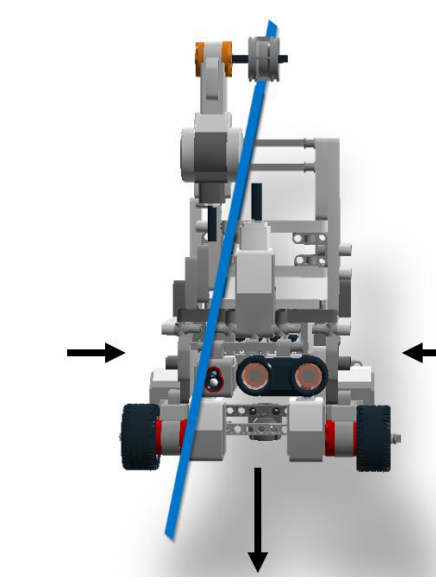- rotates the ultrasonic sensor and one colour sensor to face flags

1x Ultrasonic Sensor
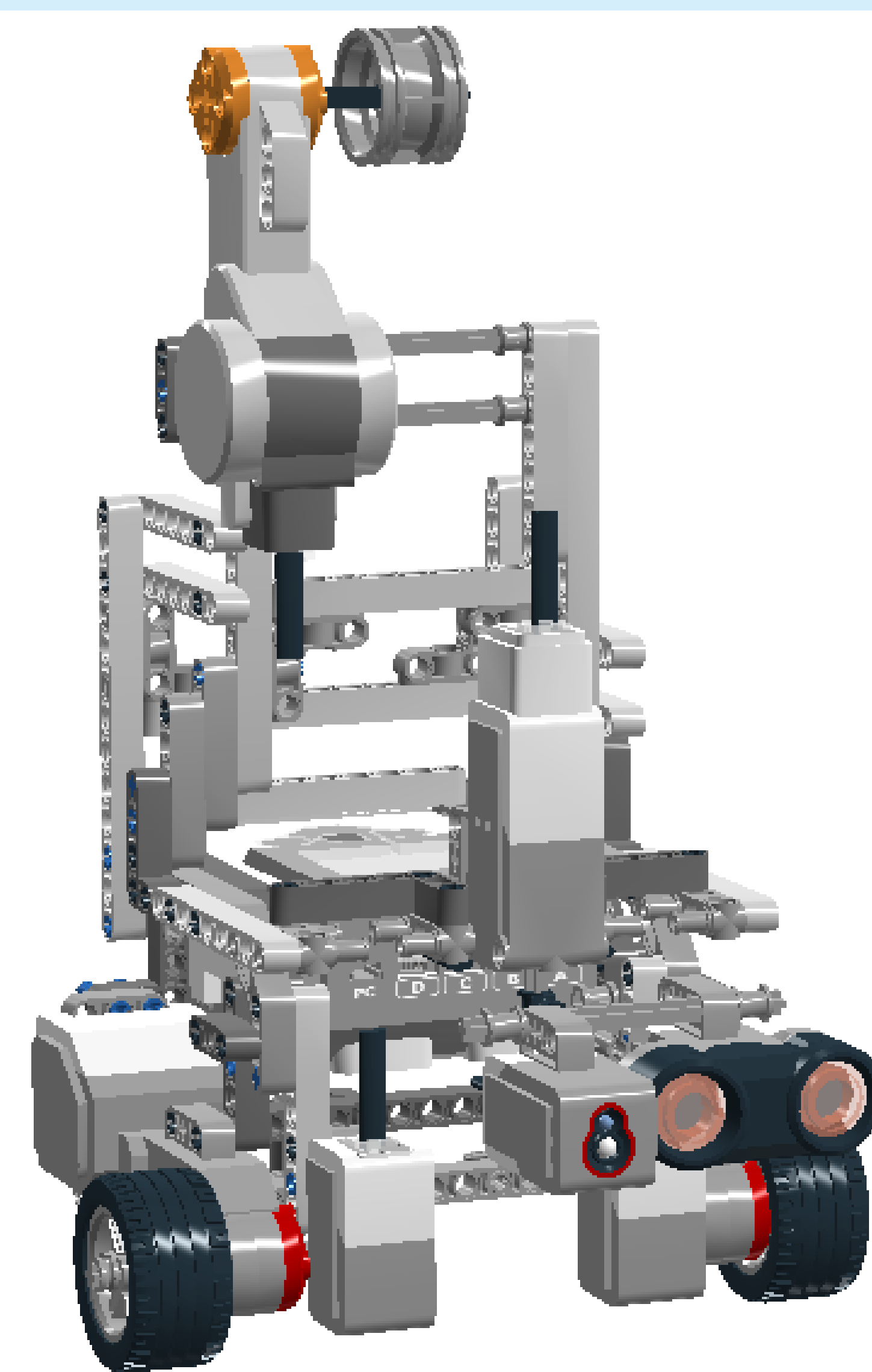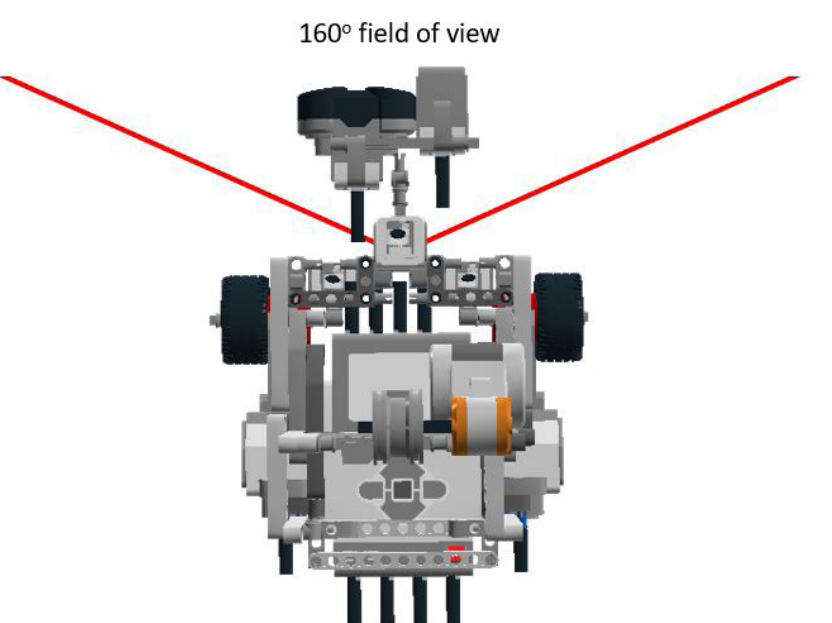- detects flags and obstacles

Zipline Stability

The robot is balanced such that it hangs vertically when traversing the zipline.

Sensor Range of Motion

The forward-facing sensors have a 60° range of motion, used to detect obstacles and flags.

160° field of view

Software Design

Game Control Server
Sensor Poller — Main Controller — Odometer
Localizer
Navigator | Navigator
Searcher | Zipliner
Navigator | Navigator
Zipliner | Searcher
Navigator | Navigator

The most important piece of the software is the localization algorithm. Localization runs in between each of the other components of the state machine.

Localization

Tools

Testing

Week 1 - 2
- sensor/motor characterization and selection
- ensure hardware stability on the ground
- determine centre of gravity on the zip line

Week 3 - 4
- find and adjust for robot navigation and localization accuracy
- evaluate performance during long periods of operation
  - ensure that battery depletion is not a limiting factor
- separately confirm performance and reliability of individual software components

Week 5 - 6
- full-game testing:
  - identify the weakest components of the run
  - develop methods to improve or circumvent weaknesses
- time-limit testing: localize in 30 seconds, full game in 5 minutes
- extreme case testing:
- encountering opponents, unexpected starting conditions, other extreme cases

Team Management

Role	Name
Project Manager	*Josh Inscoe*
Documentation Manager	*Alex Hale*
Hardware Team Leader	*Frederic Cyr*
Testing Team Leader	*Xu Hai*
Testing Engineer	*Xianyi Zhan*
Software Team Leader	*Justin Tremblay*

Budget Expenditure

Expenditure per Area

8%
20%
18%
21%
33%

Planning | Software | Hardware | Testing | Documentation