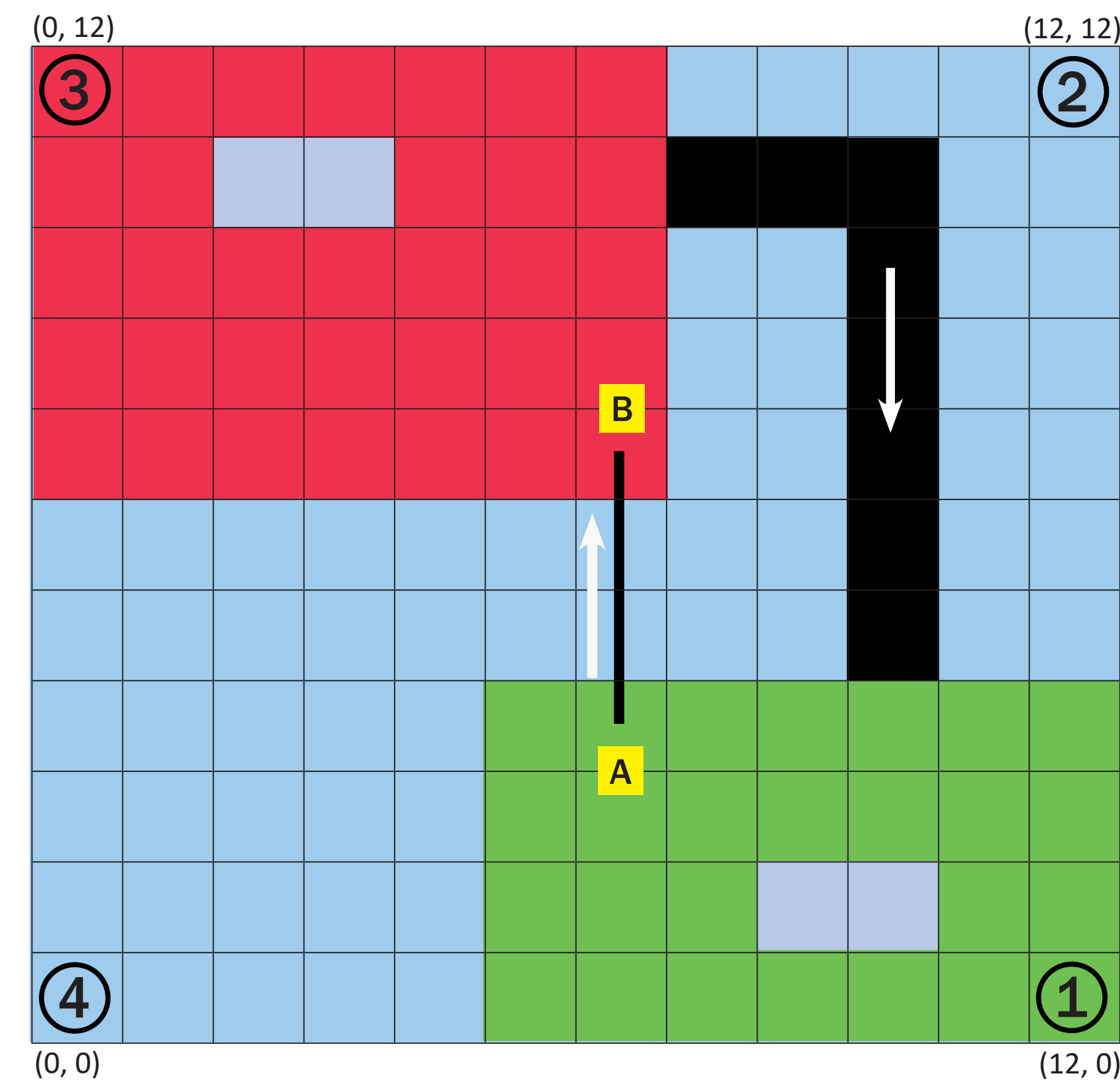## Objective

(0, 12) ③ (12, 12) ②

B

A

④ (0, 0) ① (12, 0)

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.

Green Team

1. Receive game parameters
2. Localize to (11, 1)
3. Navigate to point A and relocalize
4. Mount, cross, and dismount zipline
5. Relocalize to point B
6. Navigate to red search zone and find flag
7. Return to corner 1 via the bridge

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 the starting corner
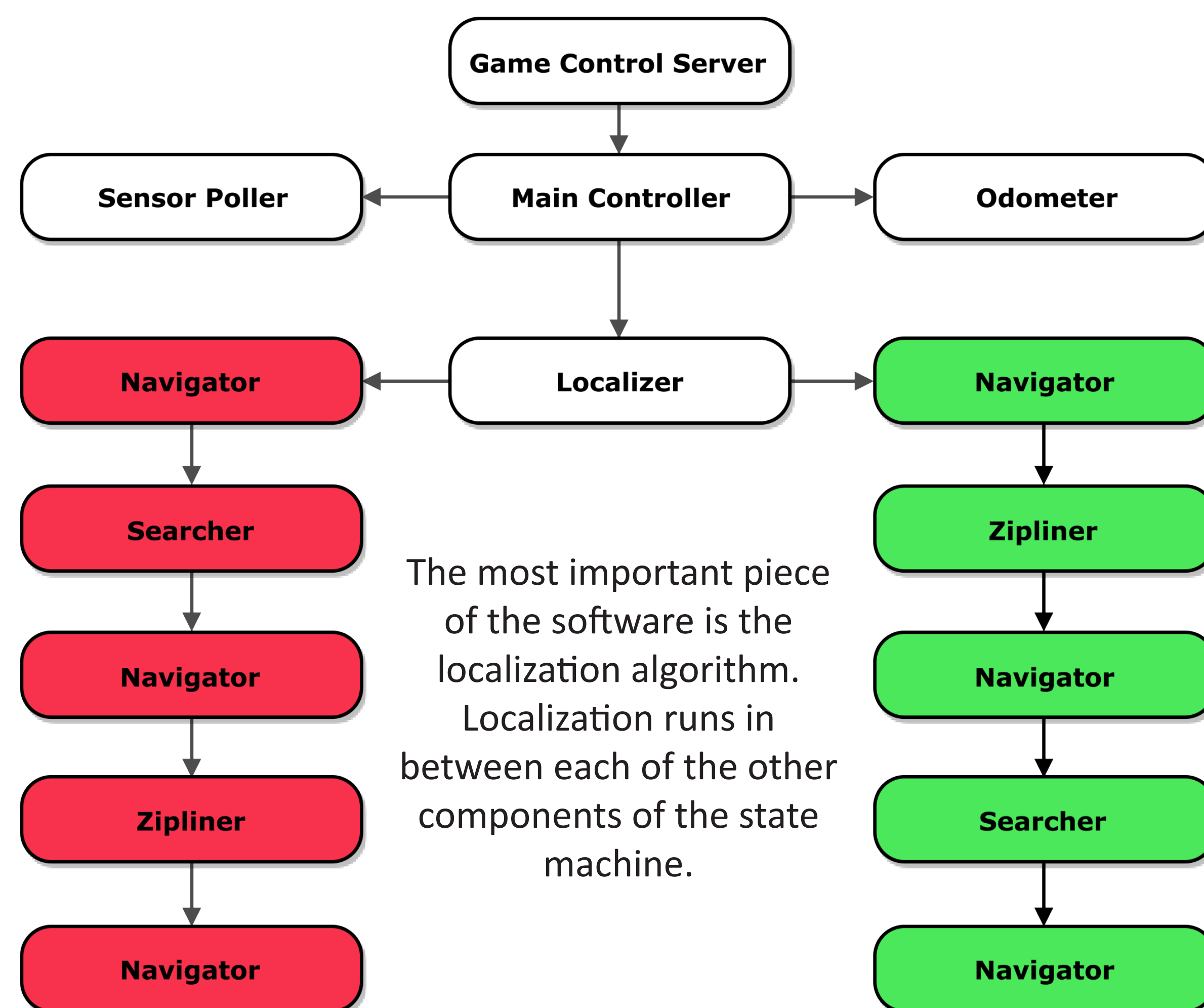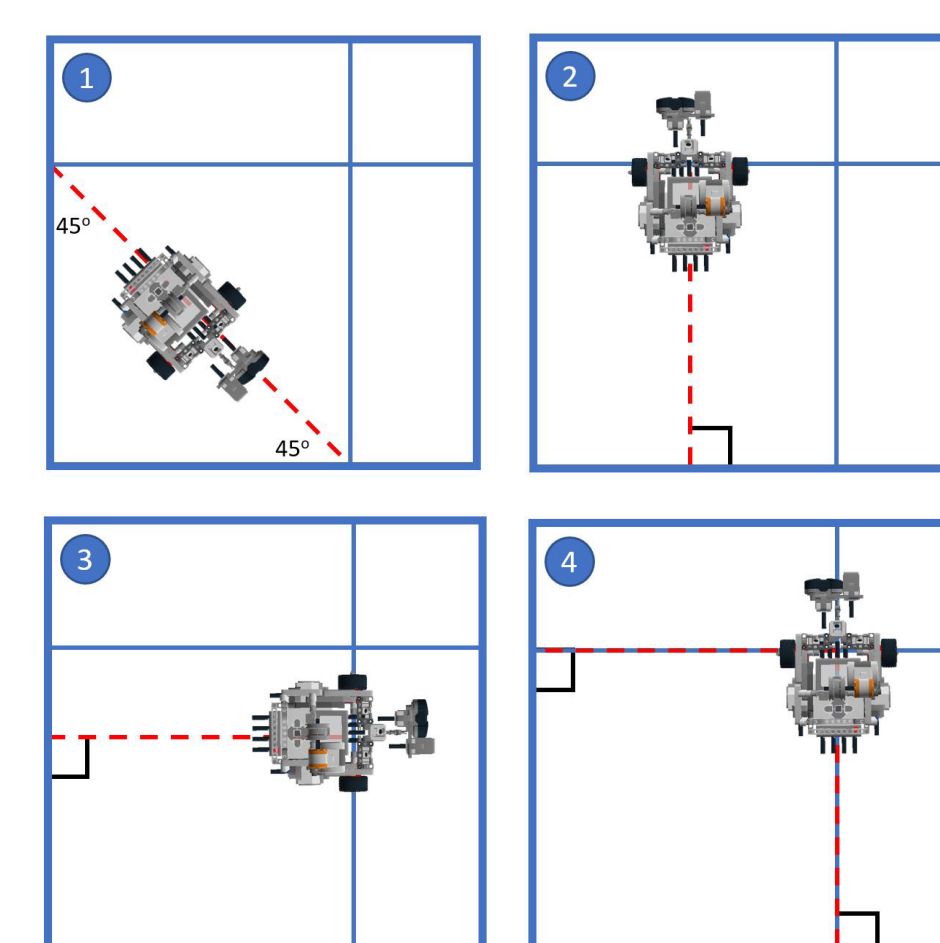- cross the zipline and bridge in the required order

Red Team

1. Receive game parameters
2. Localize to (1, 11)
3. Navigate to green search zone via bridge, find flag
4. Navigate to point A and relocalize
5. Mount, cross, and dismount zipline
6. Relocalize to point B
7. Return to corner 3

Hardware Design

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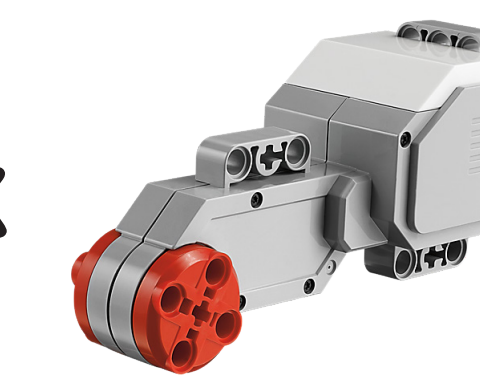- flag colour detection: 1 rotating sensor

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
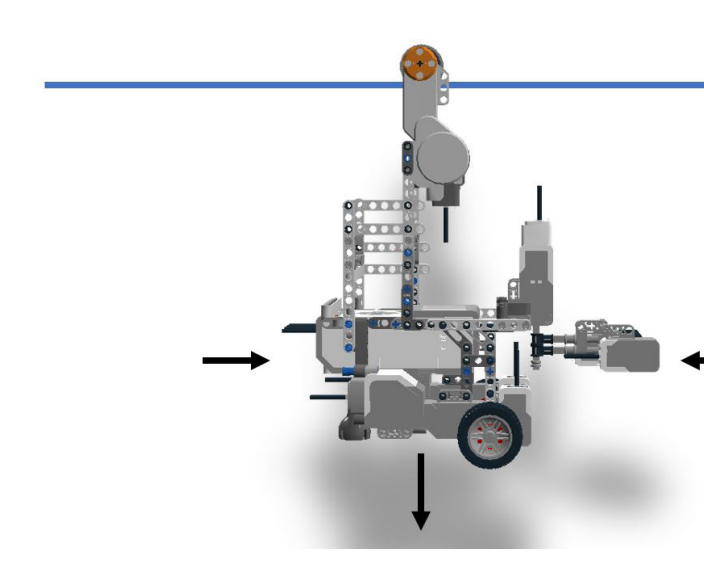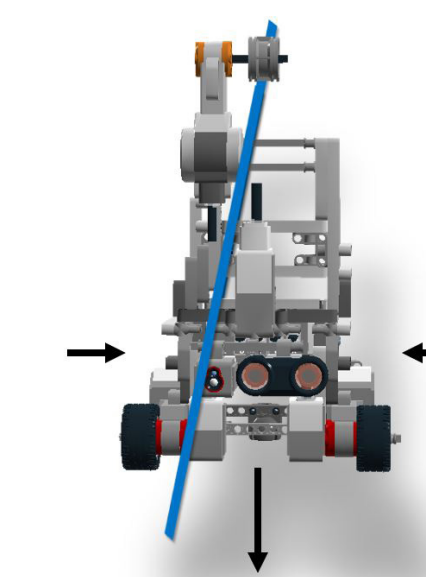- rotates the ultrasonic sensor and one colour sensor to face flags

1x Ultrasonic Sensor
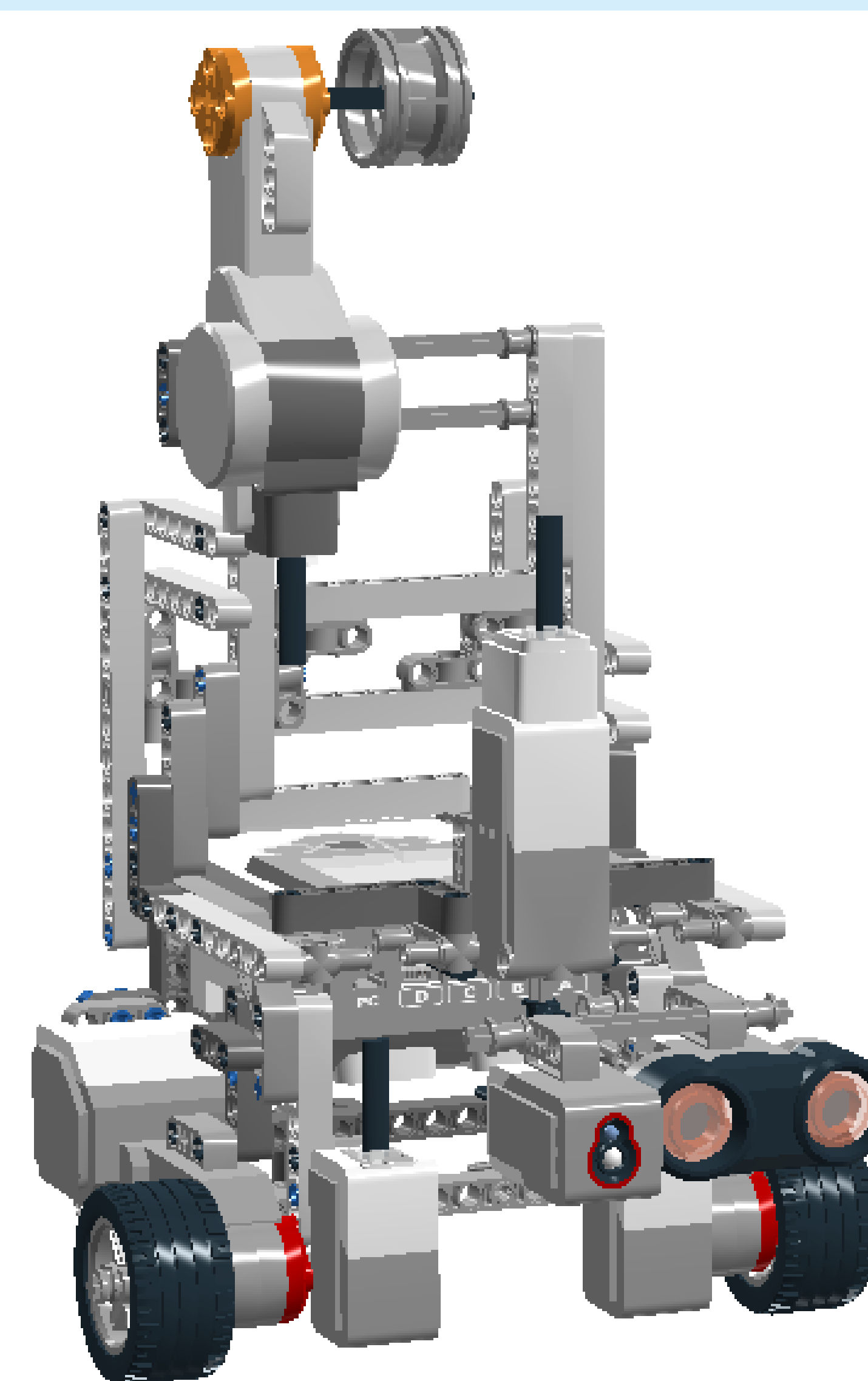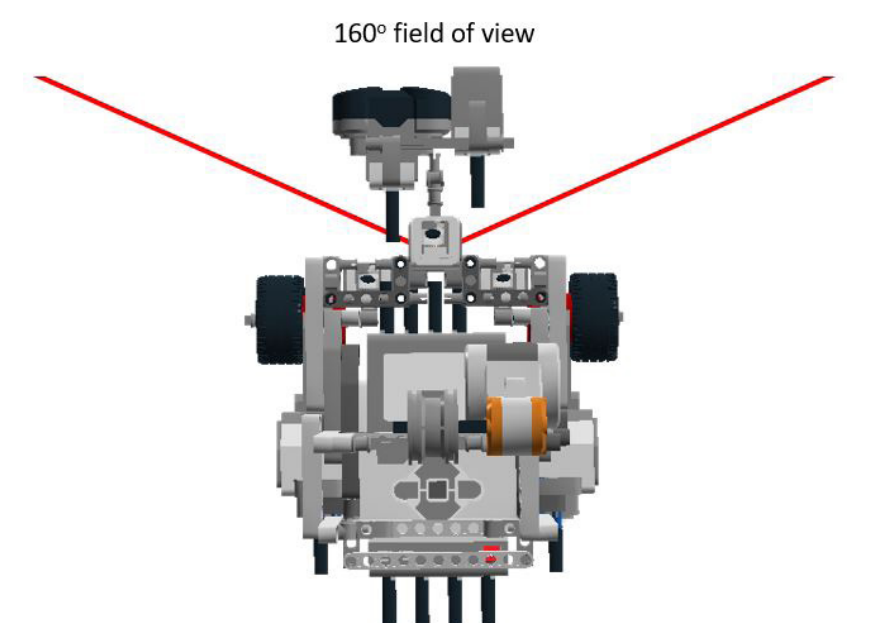- detects flags and obstacles

160° field of view

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.

Software Design

```
Game Control Server
Sensor Poller  —  Main Controller  —  Odometer
Navigator  —  Localizer  —  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

① 45°
②
③
④

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

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*

76.4% used

8%
20%
18%
21%
33%

Planning Software Hardware Testing Documentation

Expenditure per Area