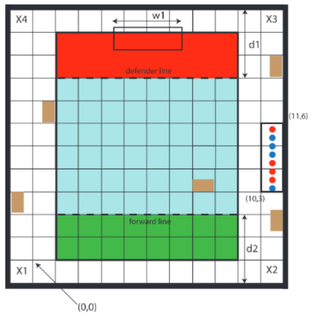
THE BEHEMOTH: GROUP 9

Design Principles and Methods
Winter 2016

OBJECTIVE

"Construct an autonomous, one-on-one soccer-playing robot capable of operating in either an offensive or defensive position with a 12' x 12' enclosure. At the start of the competition, each robot receives a message over WiFi indicating whether it plays offense or defense, and the parameters of the field (that are changed at the start of each round)."

– Profs David A. Lowther and Frank P. Ferrie

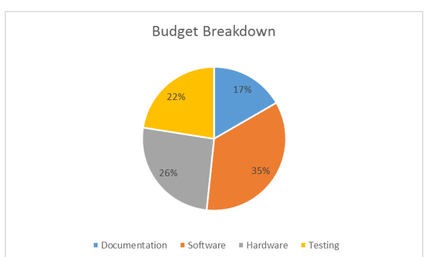


Other Specifications:

- The robot has to be able to avoid obstacles placed randomly within the field.
- There is a time limit of 5 minutes per round for a total of 4 rounds.
- The robot should be able to localize within 30 seconds.
- When playing offense, the robot must be able to retrieve a ball of a specified color (red or blue) and attempt to score a goal.

BUDGET

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Total
Abby	2	4	7	8	10	15	46
Rony	3	6	9	9	8	14	48
Wole	1	4	8	8	9	13	43
Peter	5	9	9	11	11	15	60
Santiago	2	7	7	9	6	13	44
Marcel	2	6	7	8	8	13	44



Maximum Budget: 324 Hours
Budget Spent: 285 Hours

88% Spent

HARDWARE

GENERAL CONCEPT

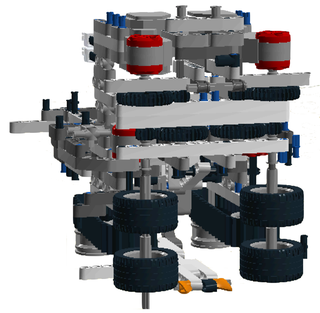
The final design of our robot incorporated the strongest aspects from our three preliminary designs. The robot starts by **localizing** in a corner then **navigating** to its desired location. It would then use a **Ultrasonic sensor** to identify the location of the ball and retrieve it. Once **retrieved**, a light sensor is used to determine the color of the ball and if **correct**, the robot will attempt to shoot in the goal.

BALL LAUNCHING & RETRIEVAL

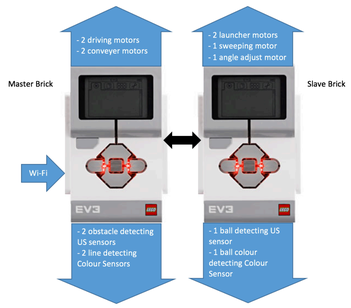
The shooting and retrieval mechanism has been combined allowing it to be **more efficient**.

Two motors spin the **customized wheels** to either draw in the balls or accelerate the balls being launched. Using 8 gears significantly **increased the speed** at which the wheels turn and is able to launch the balls.

The balls are drawn in and stored on a conveyor belt before being launched. A **light sensor** is located above the conveyor belt for a more accurate detection of the color of the ball.



BRICK TO BRICK COMMUNICATION



The choice of using two bricks was to allow **more flexibility** and options for the hardware design as there would be more motor and sensor ports available.

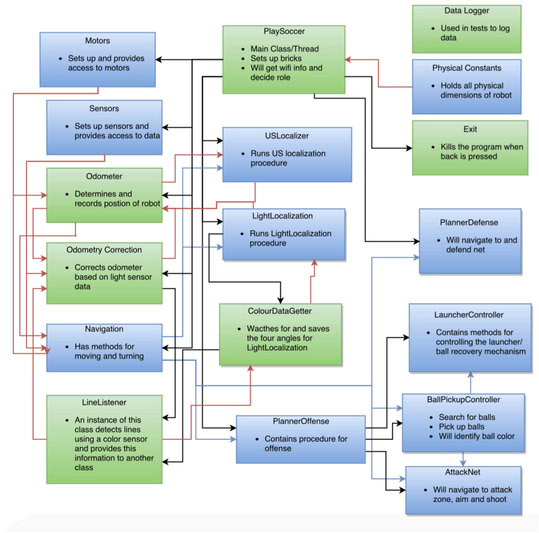
The connection between the two bricks was established by using the **PAN (personal area network) feature** added to Lejos 9.1. The two bricks are connected VIA USB cable as this was the most reliable and provided the quickest transmission of data between the two bricks.

The master brick is the primary brick and executes the code. The slave brick acts as an extension of the master brick's available ports allowing them to be accessed by the master brick when connected.

TEAM MEMBERS & ROLES

Abby Li	Project Manager and Documentation
Rony Azrak	Testing Lead
Wole Obayomi	Software Development
Peter Quinn	Software Development
Santiago Bernal	Hardware Development
Marcel Morin	Hardware Development and Testing

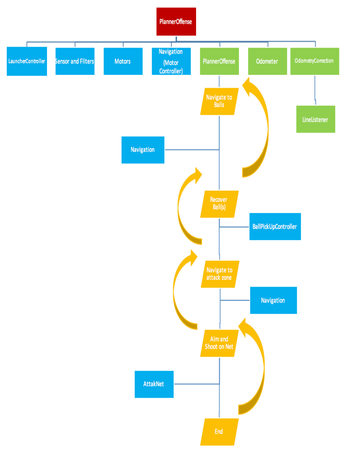
SOFTWARE



THREADING STRATEGY

One of the goals for this project was to keep threads to a minimum so as to **simplify** the code and **prevent issues** such as deadlock or data corruption through improper synchronization which is common when using threads. Careful steps were taken to ensure all threads included a sleep time in order to properly share the CPU resources, the sleep time was determined based on how often the code was needed. The majority of our threads are run throughout the operation of our robot and are therefore created and started in the main, PlaySoccer. In the final version of our software, **a maximum of six threads** are running at any time.

OFFENSE ALGORITHM



DEFENSE ALGORITHM