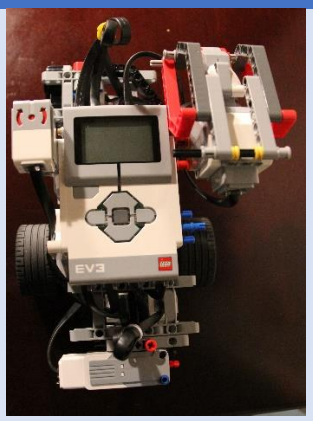
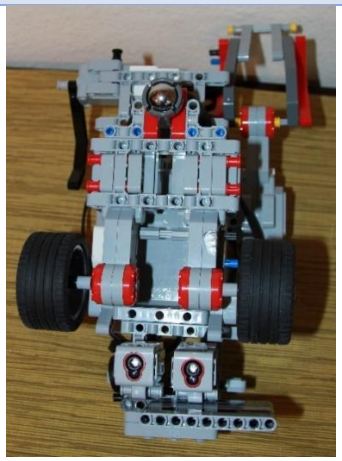
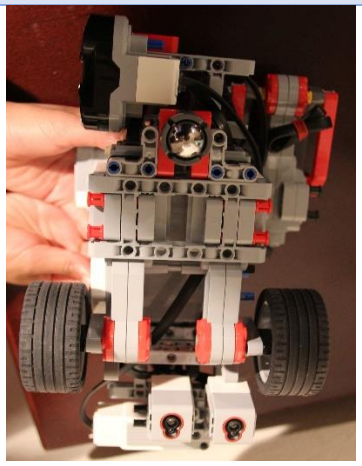
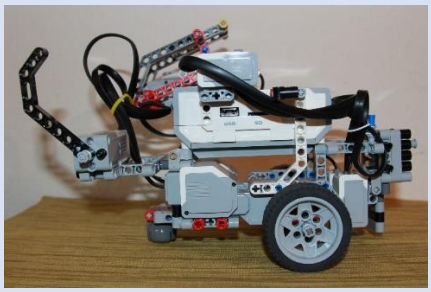
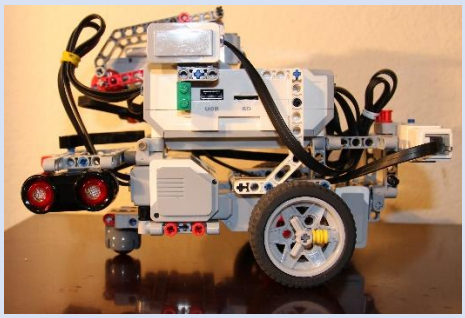
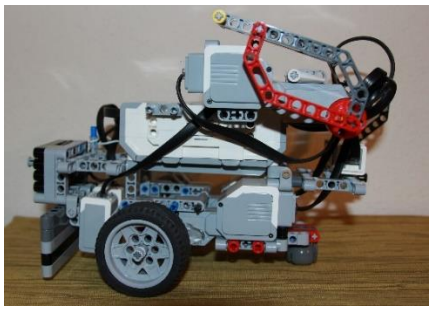
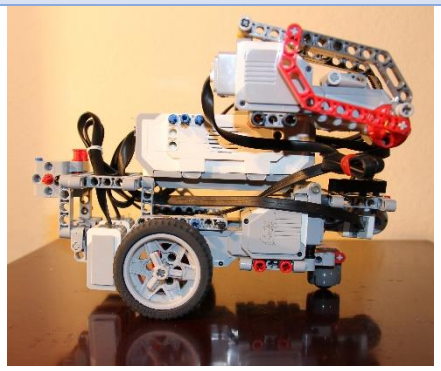
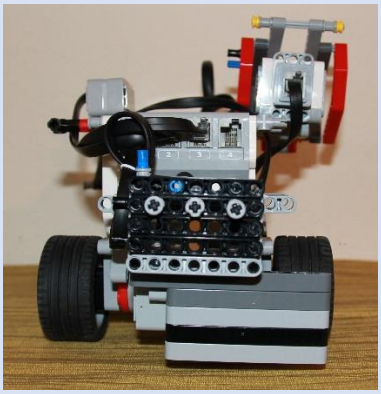
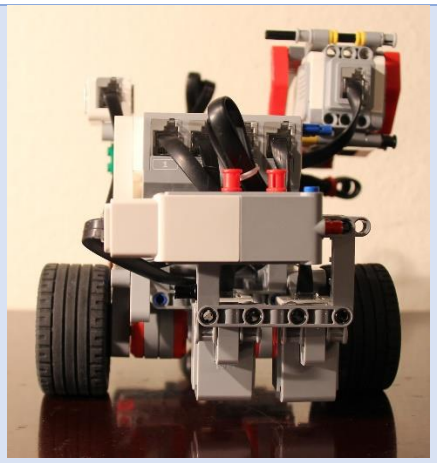
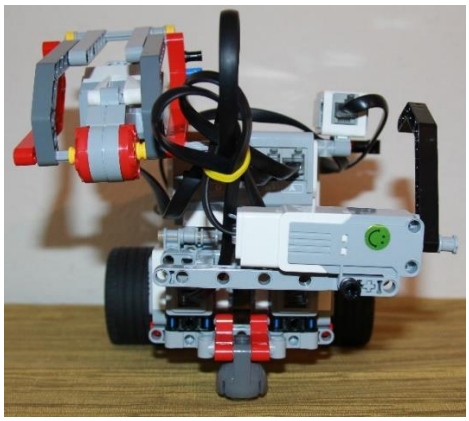
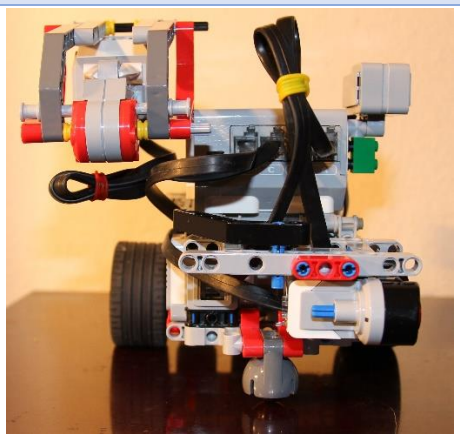
FLL Robot Design Executive Summary (RDES)

Team Members:	FLL Team Number: 14302	
Aditya, Ayasha, Joshua, Keala, Michael, Neil, and Theresa	Team Name: The Dark Knights	
	Coach:	Mrs. Blanco and Mrs. Chowdhury
	Programmers:	Neil and Aditya
	Robot's Name:	Georgie Bot

Photos of Robot:

View	*Qualifier Round*	*Semifinal Round*
Top		
Bottom		

Right (gyro side)		
Left (shooter side)		
Front (bumper side)		
Back (caster side)		

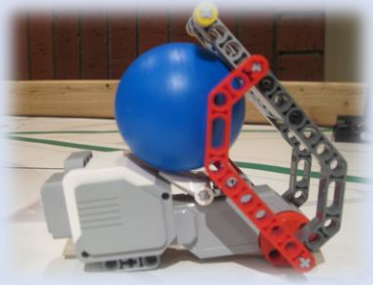
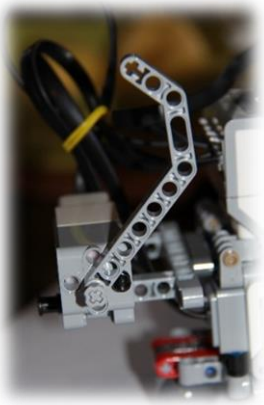
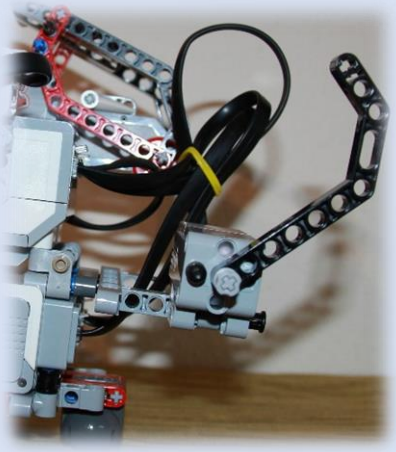
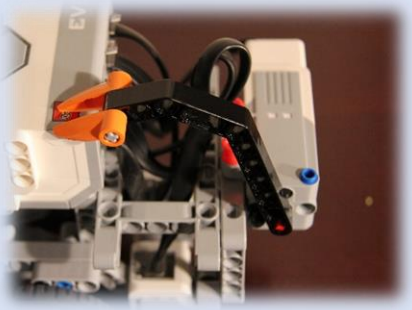
Strategy

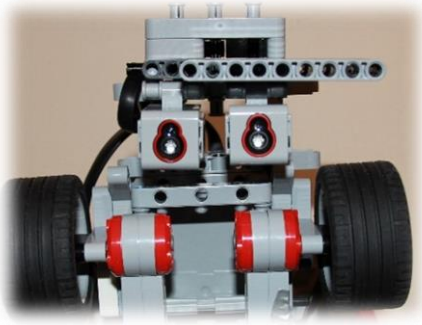
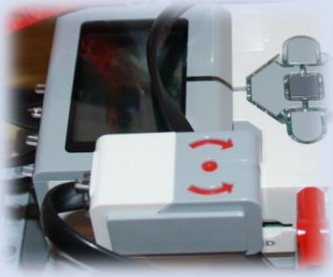
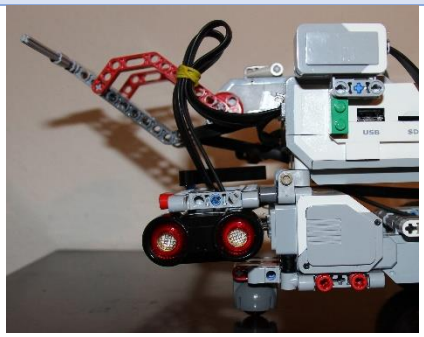
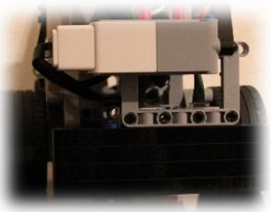
The team strategy is to run as many easy missions close to Base on a single trip. The team keeps a notebook that they use to record decisions, strategy, robot designs, sketches, and project research materials. We also look for simple missions that are worth many points. We also divided the missions into five zones, numbered 0-4.

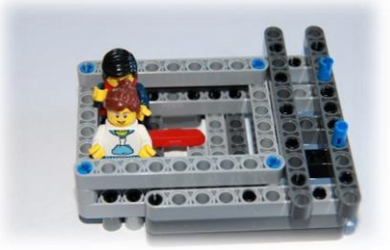
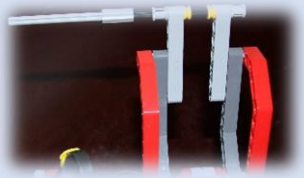
Mission	*Distance to Base*	*Difficulty*	*Point*	*Attachment*	*Program*	*Description and Strategy*
Opening doors	Zone 0	Easy	15	Color Sensors/ Large Motor (port C)	Door	Move forward, lower arm to push down door handle and drive forward to push the door open.
Apprenticeship	Zone 0	Easy	20 or 35	Color Sensors/ Model Cradle	Door	After the door opens, the pusher pushes the model to the white circle.
Search Engine	Zone 1	Medium	15 or 60	Color sensors/ Ultrasonic sensor and Medium motor claw (port D)	Door Engine	1. After the model reaches the white circle, turn and hit the slider. 2. Follow the red line, grab the right loop, and come back to base.
Changing Conditions	Zone 1	Easy	15	Color sensor and Gyro/ Lower bumper	Sports	Move forward until the model rotates 90 degrees counter clockwise
Engagement	Zone 2	Easy	20	Color sensors/ Large motor (port C)	Sports	After changing conditions, use the shooter to hit the yellow bar.
Sports	Zone 2	Hard	30 or 60	Color sensors and Gyro /	Sports	After Engagement, move forward and stop at the green line. Then

				Large motor - shooter (port C)		release/shoot the ball to the net.
Using the Right Senses	Zone 4	Medium	40	Color sensors/ Lower Bumper, Medium motor claw (port D)	Sports	After scoring, follow the green line and pick up the loop.
Remote Communications / Learning	Zone 4	Easy	40	Ultrasonic sensor	Sports	After grabbing the Senses loop, rotate Motor B 1.7 rotations and pull the slider.
Reverse Engineering	Zone 3	Medium	30 or 45	Color sensors/ Large motor (port C)	Sports	After pulling the slider, rotate Motor A 2 rotations and grab the Reverse Engineering box.
Green Loop	Zone 2	Medium	[N/A]	Lower Bumper	Sports	When coming back to base, use the bumper to strategically push the knowledge back.
Project-Based Learning	Zone 0	Medium	0 to 50	Color sensors and Large motor (Port C)	Scale	Go forward until the red line, use the large motor to drop the knowledge, then return to base.

Photos of Attachments – *before* & *after* Qualifier

Attachment Name	*Qualifier Design*	*New Design*
Large motor (Port C) – Shooting, Pushing the door open		Unchanged
Dragging Claw (Port D)		Removed
Scooping Claw (Port D)		

Light Sensors		Unchanged
Gyro Sensor		Unchanged
Ultrasonic Sensor	Nonexistent	
Upper Bumper		Removed
Lower Bumper		

Model Cradle		Unchanged
Model Pusher		Unchanged
Reverse Engineering Grabber	Nonexistent	
Project-Based Learning Loop Deliverer		

Design Process:

The team initially brainstormed how to design the base and used EV3 robotics books and videos as references. We decided to use the EV3 LEGO education base model (see *Figure 1*) to take advantage of a well proven base design that is also modular. The team's strategy was to keep it simple with minimal use of parts to reduce the time to repair and modify. The robot contains 2 large servo motors for steering, medium size wheels and 1 caster wheel for stability. This challenge requires the use of a color sensor.

Although the Education model was useful, our team decided to modify it. The wires connecting the servo motors to the ports were too long and made it difficult to attach sensors and other parts. Therefore, we decided to switch the direction of the brick, and sensors were put in the appropriate position (see *Figure 1*).

When running into issues and decisions, we chose the path that kept the robot modular. Initially the team decided to attach the catapult (large EV3 motor) to the front of the base. Later the initial design was improve and simplified by attaching the catapult to the top right side of the base.

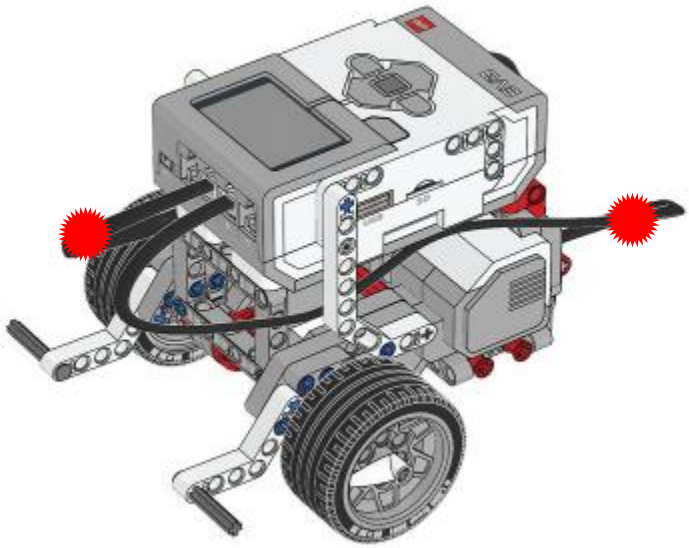


Figure 1 – EV3 LEGO Education Model

Innovation:

The team's most innovative idea was the method used to shoot the ball to the net. Instead of the original catapult idea we used the snapping mechanism. The beams push the ball, and this mechanism makes the ball roll. When the ball rolls up the ramp, an upward force is exerted, so the ball is slightly lifted in the air. (see *Figure 2*)

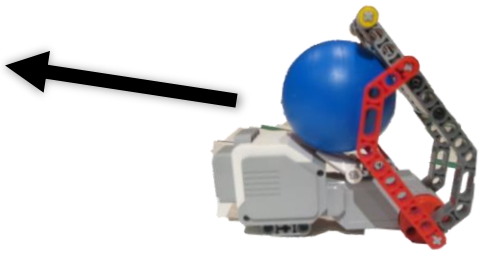


Figure 1 – Catapult motor in action

Mechanical Design:

The structure of the robot has 2 EV3 large servo motors for movements, 1 Large EV3 motor as the catapult (see *Figure* 2), and 1 EV3 medium motor for picking up *Knowledge loops*. The robot is durable because of the sturdy base, and that there are plenty of connecter pegs linking studded beams. We also used plenty of O- and H- frames, which were included in the new EV3 sets. (see *Figure* 3). The robot can resist competition without repairs and damage. Most of the attachments can easily be attached/removed to/from the EV3 brick. The robot drivetrain is front wheel drive, which ensures that the robot moves in a straight line.

We made our robot as simple as possible, making attachments snap-on and snap-off. The attachments are the model pusher, the rear-ramp shooter (Motor C), the bumper, the Reverse Engineering box grabber, the Scooping Claw (Motor D), and the Project-Based Learning Loop Deliverer.

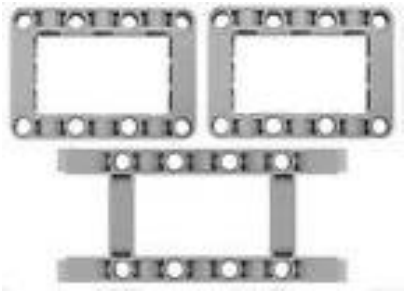
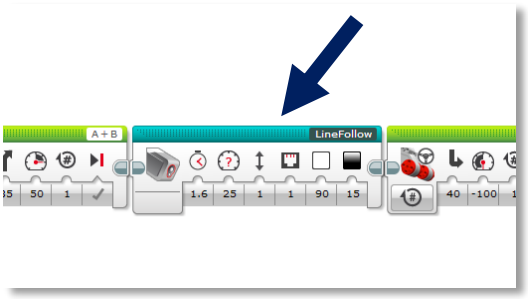


Figure 2 – O- and H-frames

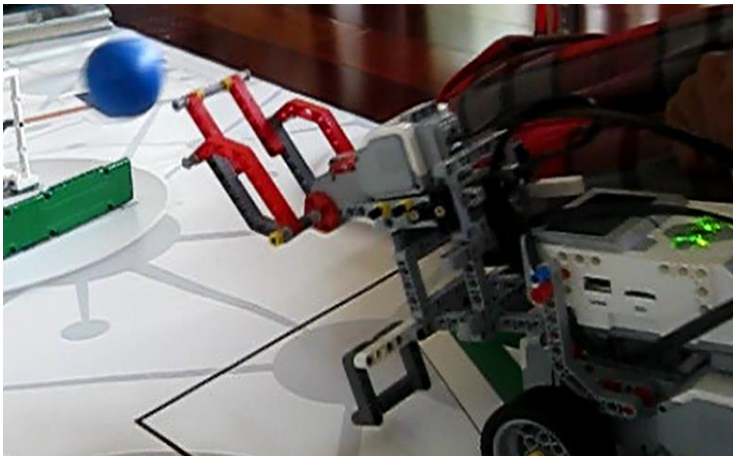
Programming:

The robot consist of three programs: Open Door, Engine and Sport. Most of the programs tell the robot, to move forward, backwards, rotate with color sensor feedback. We also use the gyro sensor to make sure that the robot is aligned. All the programs are straightforward and easy to understand, you do not need to know programing to understand the code. All members of the team can run the programs consistently.

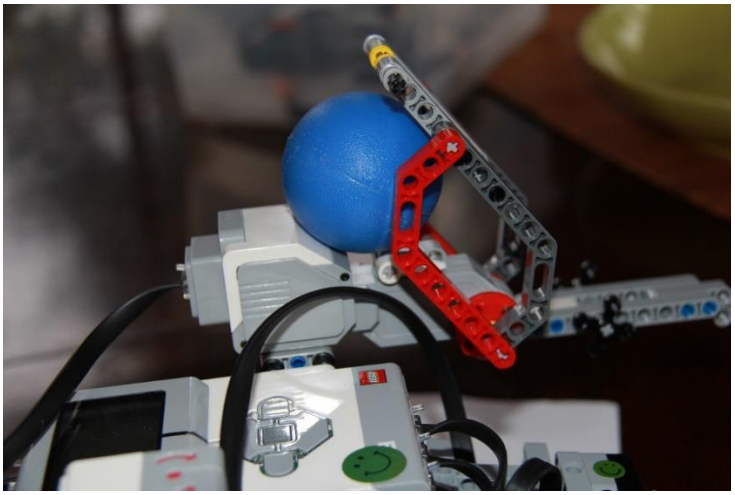
We use MyBlocks in our programs frequently, such as the Line Following MyBlock.



Front Shooter vs. Rear Shooter: Evolution of DESIGN



Front-shooter design. Note how the robot is tilting forward during the shot.



Rear-shooter design. Note how the ball easily rests in the motor.

Fun:

One time, when our robot was immeasurably inconsistent, we all started chanting "*IT WILL WORK! IT WILL WORK!*" Our robot then began to complete all of the missions successfully. Later, while running the same program, we chanted "*IT WILL FAIL! IT WILL FAIL!*" Sadly, as

expected, our robot failed. Georgie broke everything in its trail, and the board looked like a mess.

References:

- https://www.youtube.com/watch?v=7NbvcJZeODM