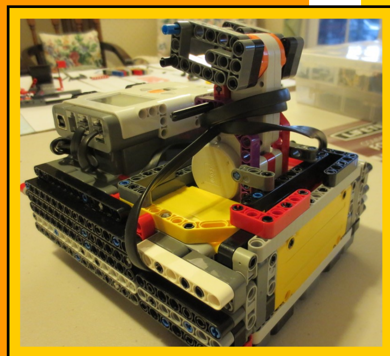
ROBOT DESIGN EXECUTIVE SUMMARY

FLL TEAM 116 | WHS ROBOTICS | THE BEE'S KNEES

MECHANICAL DESIGN

Specifications

- Dimensions: 15.2cm x 20.7cm x 7.5cm
- Attachment Motor: implemented into the main robot structure
- Sensors: two color sensors (on each side) ultrasonic sensor (back)
- Bracing Types: Double Shear protection (for wheels), Central (NXT), Cross Bracing (underneath). Squares/ Triangles
- Drive Train: two motor control with Lego wheels (41 mm Znap Thin Tread)
- Back Support: two skids



Our Robot

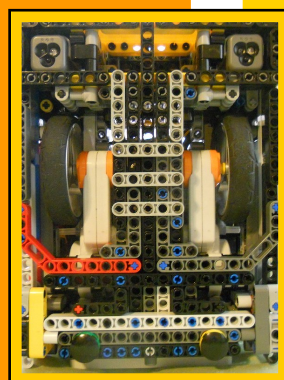
SPECIAL FEATURES

Battery Access

Our robot's NXT can be removed by pulling upwards. The denser bracing is necessary in regard to the motors, while we have minimal but sufficient affixation of the NXT allowing for quick battery access and overall stability.

Functional Structure

Our robot is like a rectangular prism with level surfaces on the front and sides. Our coaches and mentors have described it as brick-like. This adds the convenience of squaring up on walls, which adds ease of use programming wise.



The Underside

Attachments

Our attachments are versatile. We often use the same attachment for whole runs to save time. Their simplicity is a result of last year's failure with more complex attachments. Despite creating attachments with simplicity in mind, there is a level of bracing and complexity we need for stability.

STRATEGY

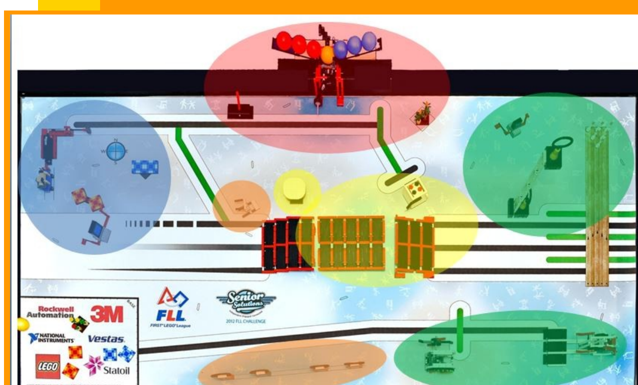
Our strategy's basic principle was to group nearby missions in certain regions to be completed in each run. The factors that we considered were:

- Estimated time to complete each mission
- Feasible accuracy and probable risks
- Time invested in each mission's program and attachment (relative value)
- Value of each mission (point-wise)

Our final six robot run groupings are as follows by order of completion):

1. Strength Exercise, Bowling, Flexibility, East Video Call
2. Series of Cardiovascular Exercise clicks
3. Medicine Packs
4. West Video Call, Blue Quilts, Red Quilts, Woodworking Chair to base
5. Ball Game, Switch, Stove, Chair to table

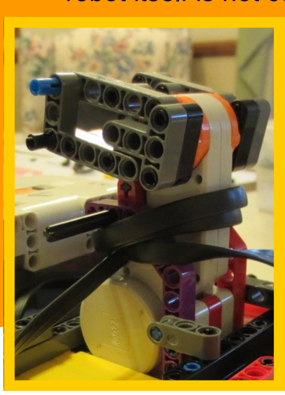
Note that most of our runs involve at least one click of the cardiovascular machine



Run 1: Green, Run 2: blue, Run 3: orange, Run 4: red, Run 5: yellow

INNOVATION

1) **NXT Detachment:** Our robot was built so that the NXT brick is able to be removed by simply yanking up on it. This was a feature we had in mind while building the robot, so the robot itself is not centrally braced toward the NXT.



2) **Attachment Method:** This year, we ended up with a system where attachments slide onto a beam system on the attachment motor, and are secured on both ends by four axles going through the attachment, into the motor. To make sure the axles stay in, they are built with rubber bands constraining them.

Attachment Method

ATTACHMENTS BY RUNS

TIMELINE

8/9: Motor & Sensor Matching
We tested our motors and sensors for best configuration for consistency

8/24: Feature Matching
With choices on size, structure, wheel type, and others, we made arrangements that fit together well for the robot.

8/24 – 29: PID (Vs. 1)
A week into building the robot, we saw that it was too wide, leading us to scrap this version.

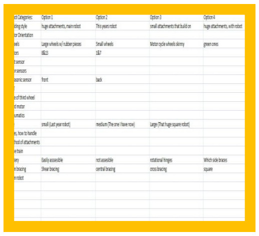
9/3-12/31: Brick (Vs.2)
Qualifier and Regional robot. After regional we realize the limitation of our wheels and the weight.

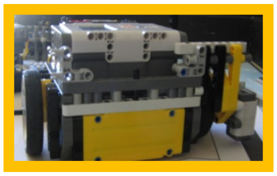
12/31: Tank (Vs.3)
Basic Structure
The central bracing with motors was made, with the main intent of keeping it compact and dense.

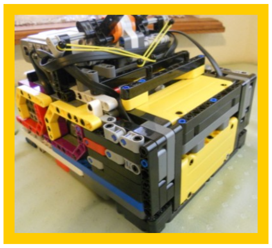
1/1: Development
The other bracing, such as the shear bracing, was completed, and the light guard for color sensors was started.

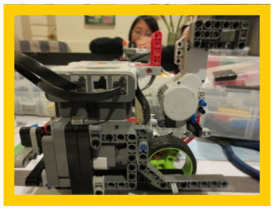
1/4: Final Touches
The rest of the front of the robot/light guard was finished, and the attachment motor was braced more.

4/15: Finalizing
Programs and completed major changes to all attachments.



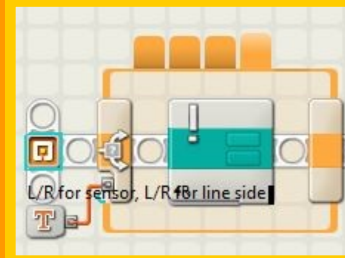






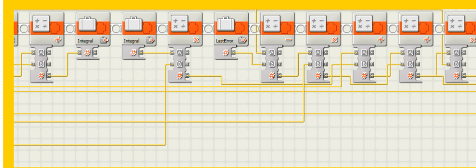
PROGRAMMING

Programming is a collaborative effort. With suggestions from our coaches and mentor, we have been able to develop our own method of confronting the problem of the complexity of older programs.

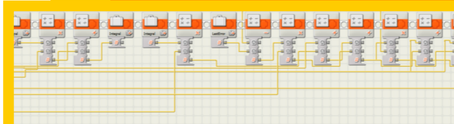


PID Line Following
Proportional Integral Derivative Control

P: create proportional changes which are based on an error value and a variable.

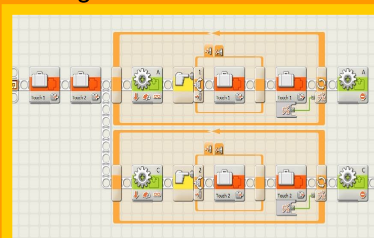


I: Accumulate error to compensate with more or less power by multiplying by a variable for conversion for application to motor power



D: Changes the function and error in the p-controller to predict and compensate for errors in a predictive manner.

With the new design of our robot we also established a shift constant within our PID to allow our robot to follow the line with off center light sensors.



Our programs include the usage of a perpendicular line follower, MyBlocks, and two touch sensors, which are used to square up against a wall.

FUN FACTS

1. Our previous robot's name "brick" makes the NXT a brick within a brick. (brick-ception!)
2. The current robot is actually a third version, after making improvements to two prototypes.
3. The namesake of our robot came to be once we added the projectile launcher to our robot for bowling, hence the name tank.
4. The front hollow area of the robot was once called a hiding spot.
5. Our robot's proportions is nearly a square.

The bowling attachment

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