FAMU-FSU Engineering

SoutheastCon 2020 Hardware Competition

Virtual Design Review 1

Team Introductions

Isabel Barnola
Lead Software Engineer

David Bowen
Project Manager & Lead Robotics Engineer

Diego Campos
Lead Signal Process Engineer

Alex Ndekeng
Lead Power Electronics Engineer

Abiel Souverain
Lead Design Engineer

Sponsor and Advisor

FAMU-FSU College of Engineering

<u>Engineering Mentor</u>
Jerris Hooker, Ph.D.

<u>Academic Advisor</u>
Bruce A. Harvey, Ph.D.

Abiel Souverain

Objective

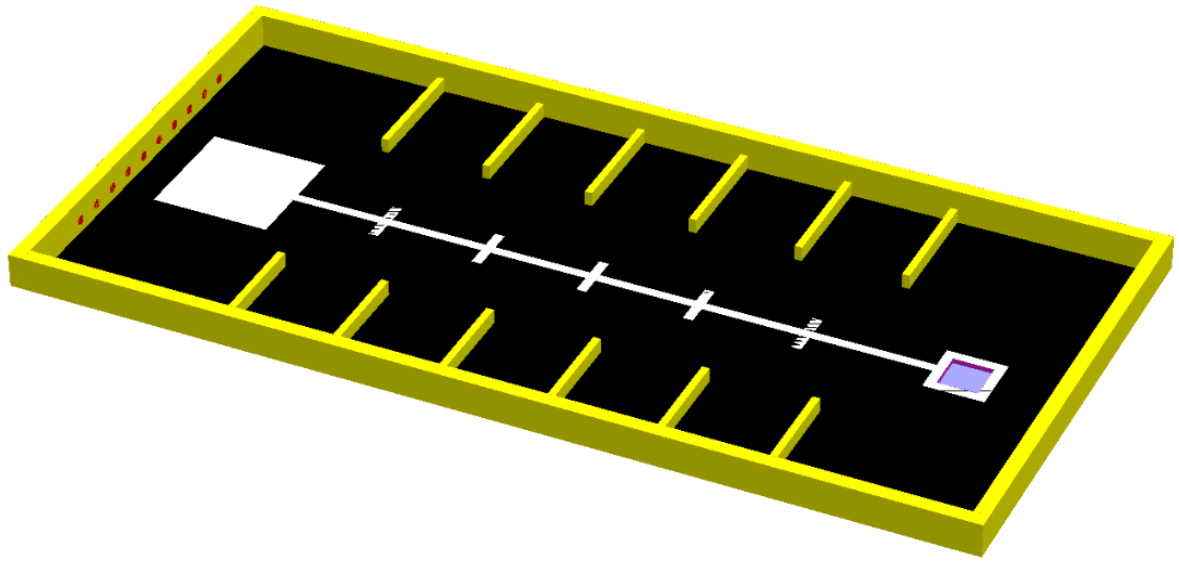
The objective of the project is to build an autonomous robot with the capabilities of completing at least one of the two challenges set for the 2020 SoutheastCon hardware competition.

Abiel Souverain

Project Background

2020 Southeast Con hardware competition

- 1st challenge: accurately stack Lego
  Duplo blocks representing the digits of pi.
- 2nd Challenge: push buttons in an order that represents the digits of pi



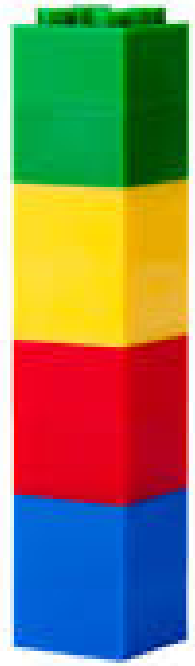
Description	Number of points
Total stack sequenced correctly	20 * N * N
Additional stack not sequenced correctly	N * N
Total button presses sequenced correctly	10 * N
Additional button presses not sequenced correctly	N (max of 100 counted)

Isabel Barnola

Project Scope

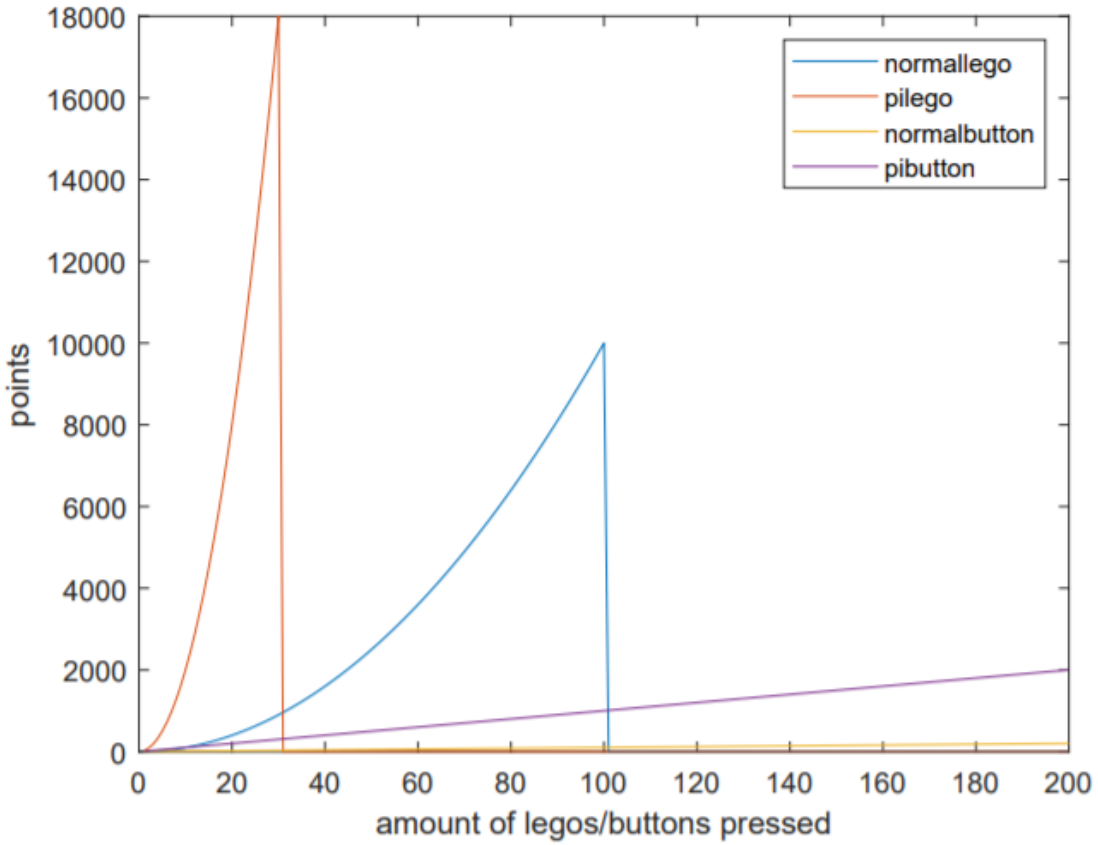
Key Goals:

- Build an autonomous robot, or robots, that meet the competitions specifications and can score as many points as possible.
- Stack 2"x2" Duplo colored bricks in the sequence that awards most points



Isabel Barnola

Project Scope

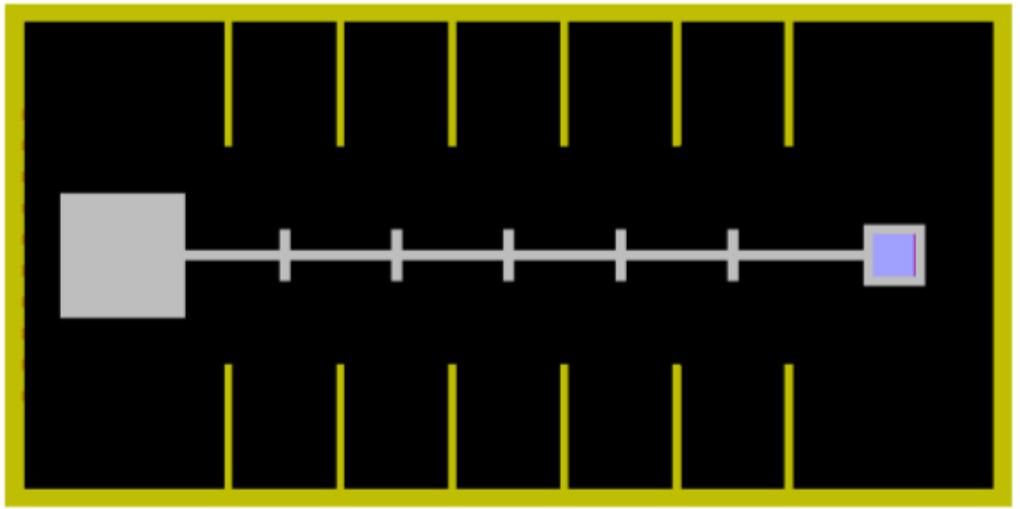


Isabel Barnola

Project Scope

Assumptions

- The measurements as well as the rules found in the competition's website will be accurate.
- The Duplo blocks purchased will be the same as those used in the competition.
- Playing field will be remain the same throughout the competition



Competition's Arena

Diego Campos

Customer Needs

- We're having our customers be the same as our primary and secondary markets as well as our stakeholders
- 12"x12"x12" autonomous Robot
- Ability to pick up to pick up Lego blocks and stack them
- Ability to push buttons recessed in a wall
- Ability to stack Legos or push buttons in the order of the numbers of pi
- Navigate through the arena

Diego Campos

Customer Needs

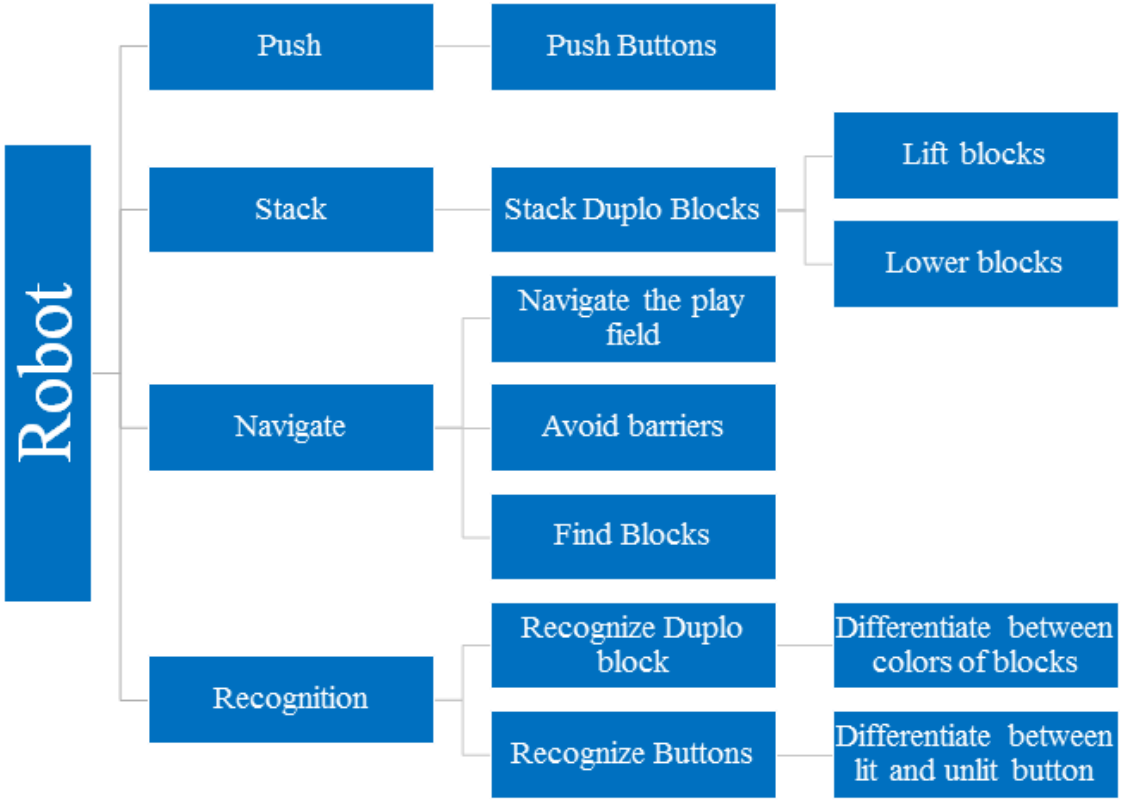
	Dr. Harvey	Dr. Hooker	Total(Lower is better)
Mobility	1	6	7
Accurate Stacking	4	1	5
Accurate Button Pushing	5	2	7
Stacking	2	3	5
Button Pushing	3	4	7
Color Recognition	8	5	13
Speed	7	7	14
Automatic Shutdown	6	8	14

Table from surveys given to Dr. Harvey, Dr. Hooker, and Dr. McConomy

- We can see the most important thing is to be able to stack the Legos and do it accurately
- The second most important thing is to be able to push buttons and do it accurately as well as have good mobility
- The other things are secondary according to our customers

Diego Campos

Functional Decomp



Alex Ndekeng

	System			
Function	Push	Stack	Navigate	Recognition
Navigate the play field			■	
Avoid Barriers			■	
Push Buttons	■		■	■
Find Blocks			■	■
Lift Duplo Blocks		■		
Lower Duplo Blocks		■		
Differentiate between blocks			■	■
Differentiate between buttons			■	■

Alex Ndekeng

Connection to Systems

- The most important system in our product, according to the cross-reference table is the navigation system.

- We will choose what sensors to use depending on what task we choose to have our robot do:
  - *Lego Stacking*
  - *Button Pushing*

David Bowen

Action and Outcome

- The goal of the IEEE SoutheastCon 2020 Hardware competition is to design a robot that stacks a series of Lego Duplo blocks, and/or inputs as many digits on a set of 10 pushbuttons in a three-minute competition. This product will be a robot that has all the characteristics necessary to do the challenges of the competition.

David Bowen

Thank you for your time

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David Bowen

FAMU-FSU Engineering

SoutheastCon 2020 Hardware Competition

Virtual Design Review 1

Targets and Metrics

- Some of the measurements will be taken through sensors
  - Several functions will use the same sensors
- Navigate the play field contains the critical target

Functions	Metrics	Target
Navigate the Play Field*	Number of path combinations completed	10
Avoid Barriers	Distance from barrier (inches)	>1 in
Push Buttons	Depth of button push (inches)	1/8 in
Find Block	Time to locate block (seconds)	<5 sec
Lift Duplo Block	Height reached (inches)	~1.5 block height above previous block
Lower Duplo Block	Height reached (inches)	1 block height above previous block
Differentiate between buttons	Time to locate proper button (seconds)	<10 sec
Differentiate between blocks	Time to reach correct bin (seconds)	<20 sec

* Indicates Critical Targets

Validation

- The mission critical functions include to navigate the playfield, recognize where the Duplo blocks are at, pick the Duplo blocks and stack them correctly at the base.

- Replica arena and blocks for testing.
  - Several tests will be made in order to assess the successfulness of the design.

Validation

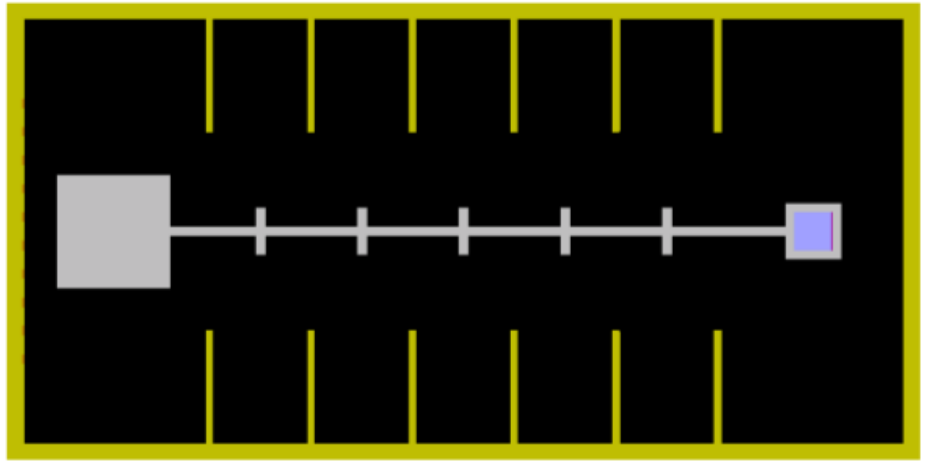
- **Navigation:** The robot will need to pass successfully different checks such as navigating correctly to the base, and to each of the bins.
- **Recognition:** The robot will be assigned to go to a bin having Duplo blocks and will need to stop once it encounters blocks at a “pick up” distance.

Validation

- **Pick up:** The robot will have several blocks laying at a “pick up” distance and it will need to pick them up successfully, this implies that the robot must pick up the blocks and not let them go unless specified.
- **Stacking:** A set of tests will be made to check that the robot effectively stacks the Duplo Blocks.

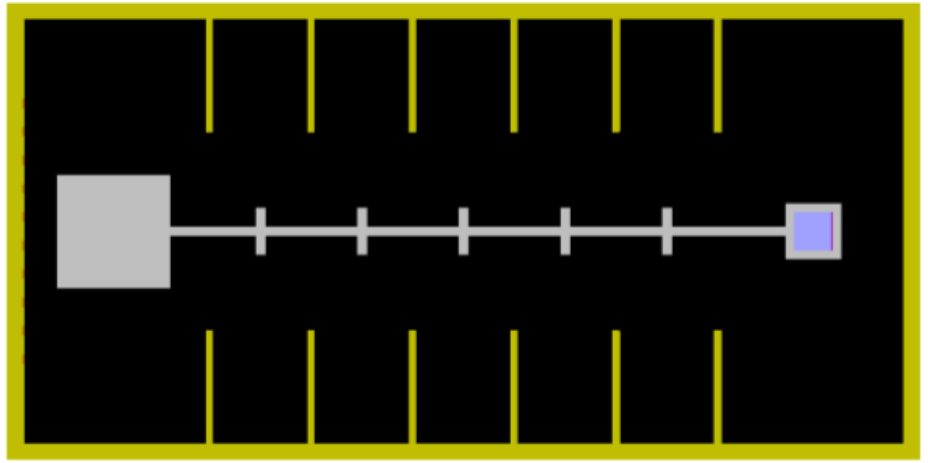
Minimum Targets

1. 100 points through button pressing.
2. Score at least as many points through stacking as through button pressing.



Maximum Targets

1. 1500 points through button pressing
2. 3380 points through correct block stacking (13 blocks)
3. 22500 points through incorrect block stacking (150 blocks)



Measurements

- The “navigate the play field” function is broad and may require some additional metrics to fully define it.

- The “avoid barriers” function will probably use the same sensors as the “navigate the play field” function.

Measurements

- Both the “Differentiate between buttons” and the “Differentiate between blocks” functions are measured by the time to reach the appropriate location.
- Lifting and lowering the block will be measured by the height difference between the current block and the previous block placed.