Antiviral Delivery System

Section 508, Teams 17 & 18

Spring 2016

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Code of Cooperation

In our group we will:

- maintain a productive environment during meetings
- make a concerted effort to attend
- contribute to the tasks at hand
- fairly divide work
- make up work missed
- be prepared for meetings
- bring all necessary equipment
- help each other be successful

A GroupMe will be the primary source of communication to discuss meeting time, location, and other business related to the project

Digital files will be shared through email and the Google Drive

All project related files should be made accessible to the group before submission (preferably 12 hours before deadline to allow critique and changes to be made)

Formatting Notes

To make the notebook not get jumbled up we should use page breaks when starting a new topic

>> Insert (dropdown)

>> Page break

To make the notebook's table of contents look nice use the title fonts

>> Near the font area, find the dropdown that says normal text

>> Selecting any of the 'Heading' options will add the title to the TOC

Font and Sizing

>> For heading titles use Times New Roman 18 pt.

>> For the body use Times New Roman 11 pt.

Glossary

POS: Pellet Operating System
(The whole shebang)
OPAAT: One Pellet At A Time
(Wheel, turbine, propeller)
PAS: Pellet Agitating System
(Agitator, blender, bottle blender, bottle agitator, FUNNEL AGITATOR, Container agitator)

Scheduled Group Meetings

3/10/16 - Present Members: Lauren, Leilani, Joseph, Kyle, Rebekah, Daniel, Cecil
- Came up with three design options each including a component from the sorters of both teams
- Discussed and determined the design which would work best for the task
- Began building and completed the chosen design

3/27/16 - Present Members: Lauren, Joseph, Kyle, Margo, Rebekah, Daniel
- Tested sorter once again to double check correct execution of the task
- Made last minute changes to the sorter

3/31/16 - Present Members: Lauren, Leilani, Joseph, Kyle, Margo
- Brainstormed ideas for barcode reader
    - Move motor over barcode
    - Move barcode
- Built mechanism to move barcode
- Brainstormed overall project
    - Use pools of sorted pellets before reading barcode
    - Separate by size and read color and dispenses into pellets needed/pellets not needed

4/4/16 - Present Members: Lauren, Joseph, Kyle, Margo, Rebekah, Daniel, Cecil
- Brainstormed new design ideas
    - Divide pellets by size first, then color
    - Discussed possible platform ideas for sorter
- Began building possible sorter additions

4/7/16 - Present Members: Lauren, Leilani, Joseph, Kyle, Margo, Rebekah, Daniel, Cecil
- Constructing size sorter and tracks
- Worked on barcode reading component of sorter

4/11/16 - Present Members: Lauren, Leilani, Joseph, Kyle, Margo, Daniel
- Sketched design for sorter
- Finished the barcode reader

4/12/16 - Present Members: Lauren, Leilani, Joseph, Kyle, Margo, Rebekah
- Discussed specific details of sorter and how it would all come together
- Began placement of components onto sorter platform and testing

4/13/16 - Present Members: Lauren, Leilani, Joseph, Kyle, Margo, Rebekah, Daniel, Cecil
- Tested trial and error to determine best placements of size sorter, tubing, etc.

4/14/16 - Present Members: Lauren, Joseph, Margo, Rebekah, Daniel, Cecil
- Put finishing touches on pellet sorter

4/21/16 - Present Members: Lauren, Leilani, Joseph, Kyle, Margo, Rebekah, Daniel
- Developed new idea
- Began building size sorter

4/23/16 - Present Members: Leilani, Joseph, Kyle, Daniel, Cecil
- Redeveloped OPAAT
- Began building separation of steel

4/24/16 - Present Members: Lauren, Leilani, Joseph, Kyle, Margo, Rebekah, Daniel, Cecil

- Finished OPAAT
- Worked on code
- Finished steel separator

4/26/16 - Present Members: Lauren, Leilani, Joseph, Kyle, Margo, Rebekah, Daniel, Cecil

- Worked on code for barcode reader to completion

4/27/16 - Present Members: Lauren, Leilani, Joseph, Kyle, Margo, Rebekah, Daniel, Cecil

- Continued structure development of POS
- Tweaked code and fixed minor problems

4/28/16 - Present Members: Lauren, Leilani, Joseph, Kyle, Margo, Rebekah, Daniel, Cecil

- Put finishing touches on POS

Design Process Worksheet

List the Stakeholders

Users/Direct Beneficiaries

-People who use wells/waterholes

-WHO(World Health Organization)

Funding/Production/Shipping Stakeholders

-Small companies creating the product

Indirect Stakeholders

-The environment

Customer's Project Goals

What are the customers' high-level goals for this project? (Not your academic goals)

Create a prototype for an antiviral delivery system that will deliver a specified number of pellets into a well at regular intervals to improve the water quality based on instructions from a series of barcodes.

Why is the project important to the customer? (This is *not your motivation* for the project.). It is the customer's motivation for the project. If you understand your customer's wants, and goals, it is easier to meet them.

The airborne transmission mode of the disease requires that health workers wear full isolation suits when working with patients, which is impractical due to the high temperatures and poor access to the rural areas. The prototype will allow for an attack on the virus without needing to expose the health workers to the airborne transmission of the disease or wear the full isolation suits..

Operating Conditions

The conditions under which your produce is used can have a significant impact on its design

Where will your product be operated/used?

Local wells

Who will operate your product?

A WHO operative that is working with antiviral dispensary

When will they use your product?

When there is an outbreak of Ebola in an area.
How will they use your product?

Set it down, give it a code, and let it follow the pre-programmed instructions.

Preliminary Problem Statement

Using the information above, write a preliminary problem statement. As you write the problem statement only consider what the design has to do. Make sure that you do not include any solutions in your problem statement.

The robot must be easy to use, and follow preprogrammed codes to dispense the correct combination of pellets at set time intervals.

Customer Wants Worksheet

Input Wants
What inputs into your prototype does the customer list? Label each constraint as "Must", "Should", or "Preferred".

1. Barcode — Type: MUST
2. Dispense pellets — Type: MUST
3. Pre-programmed Instructions — Type: MUST

Output Wants
What outputs from your prototype does the customer want? Label each constraint as "Must", "Should", or "Preferred".

1. Correct mix of pellets — Type: MUST
2. Audio — Type: MUST
3. Discard unnecessary pellets — Type: MUST

Customer's Wants
What does the customer want the design to achieve (Be as concise as possible.) Label each constraint as "Must", "Should", or "Preferred".

1. Energy efficient — Type: MUST
2. Read barcodes — Type: MUST
3. Deliver correct mix of pellets — Type: MUST
4. If insufficient pellets, no pellets dispensed and alarm sounds — Type: MUST
5. Check pellets and discard chemical stabilization pellets — Type: MUST

Operating Environment
What "wants" do these environmental factors place on the project (For example, a piece of equipment operated by experts in a laboratory will have different needs than a piece of equipment operated by the same experts underwater or in a jungle. Be as concise as possible) Label each constraint as "Must", "Should", or "Preferred".

1. Areas with Ebola outbreak — Type: MUST

Constraints Worksheet
Using the lists that you prepared for the customers "wants", identify the actual "needs" of the design. These needs should be written in the form of a series of "Design Specifications" or "Design Constraints." You ***must*** meet all of these specifications. They are not optional and *are not* subject to alteration by your design team, but are required as written. Convert these constraints into full engineering specifications (i.e. what are the target values? What units do these values have?)

Design Input/Output Constraints
Design I/O constraints are often interfaces between your design and another team's design. For example, a design for a solar heater might need to interface with a solar tracker. Therefore, the tracker will need to attach to the heater. Your team might not be creating both designs. Be as concise as possible.

1.	*Has to be coded for EV3	Target:	Units:
2.	*Has to use EV3	Target:	Units:
3.	*Similar brick design(for coding use)	Target:	Units:

Engineering Constraints
What performance constraints are placed on your design?

1.	*Time	Target:	Units:
2.	*Ease of use	Target:	Units:
3.	*Parts to create robot	Target:	Units:
4.	*Not knowing exactly what environment will be	Target:	Units:
5.	Making it do what it is supposed to	Target: Yes	Units: Yes/No
6.	*Size	Target: ??	Units: Inches
7.	Has to run off of EV3 materials/Code	Target: Yes	Units: Yes/No
8.	Battery life	Target: 2	Units: Hours
9.	Doesn't harm environment	Target: Yes	Units: Yes/No
10.	Should be inexpensive (<$40)	Target: <=$40	Units: USD
11.	Should be light	Target: <30	Units: Pounds
12.	sorts effectively	Target: Yes	Units: Yes/No
13.	Doesn't kill people	Target: Yes	Units: Yes/No

Place an asterisk by the items on the lists, where there is insufficient information to create an engineering specification. You will need to determine the exact specifications as you move through the project

Brainstorming Worksheet
Complete this worksheet as part of your brainstorming efforts. You should come up with *at least five solutions* for every function. Make as many copies as needed to address all of the functions

Function : Scan and analyze data to determine the best route to the target

Methods for Achieving Desired Function

1. Use a water bottle
2. Use a funnel
3. Use paper
4. Use cardboard
5. Be sturdy

Define Solution

Due to time constraints we went with the cardboard because it was readily available. We soon found out that the cardboard wasn't too good at creating the smaller end of the funnel so we started to use a can.

Subtask 1

Rankings:

Team	Consistency	No Blockage	Receiving Pellets	Path to Dispenser	Dispensing Mechanism	Supporting Pellets
17	7	4	10	6	9	8
18	7	7	7	6	6	8
Subtask 2	8	3	9	9	9	10

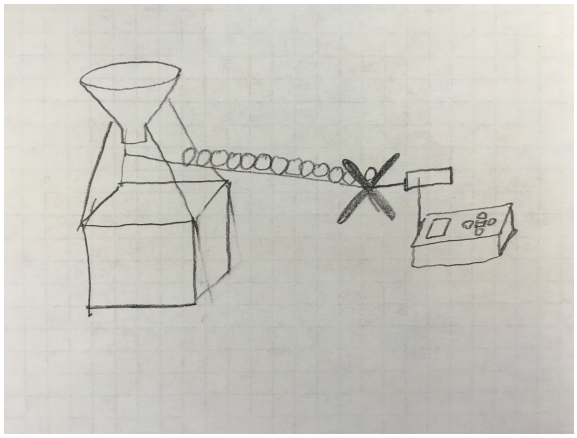
*10 = excellent; 5 = needs improvement; 1 = terrible

Ranking Method

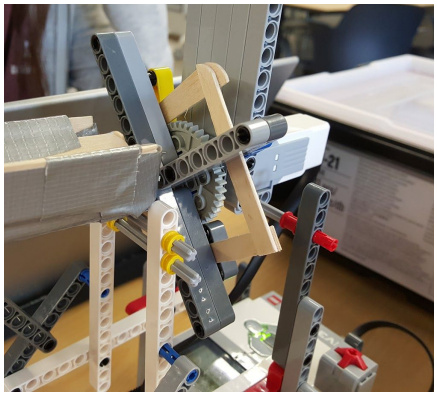
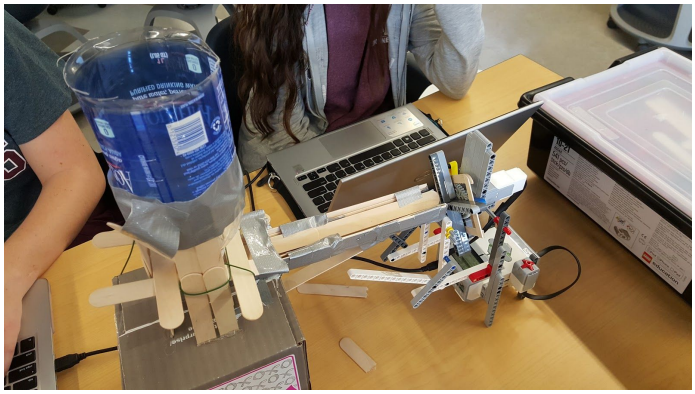
The prototypes are ranked based on a 1-10 scale, one being the worst and ten being the best. Rankings were given to the prototypes based on six categories: consistency, no blockage, receiving pellets, path to dispenser, dispensing mechanism, and supporting pellets. Observations of the robots were obtained and used to rank them.

Team 17

original sketch:



final

Team 18

Performance

Team 17

This prototype performed fairly well. The main issue was with the initial reception of the pellets. When the 75 pellets were poured into the container, many of them became jammed with each other, causing no pellets to be released onto the track. The pellets that did make it on the track (excluding a few) slid down the incline and to the OPAAT (One Pellet at a Time). The OPAAT took the pellets one by one and dispensed them into a cup a controlled time period apart. Overall this prototype was successful despite the jamming of pellets and pellets getting stuck on the track or OPAAT.

Team 18

The prototype functioned as it should have with the exception that many of the pellets got stuck in the tube that transferred the pellets from the holding container to the end to be dispensed. Once the pellets were able to pass through the jam, the prototype did as it was supposed to. Each pellet was dispensed one at a time. A different container with smoother edges could have solved the jamming problem. A sturdier tube also could have prevented some of the pellets from getting jammed due to the flexible nature of the tube that was actually used.

Subtask 2

Our prototype for Subtask 2 was an improvement over both team's prototypes. We were able to make a sturdy structure to hold up to 75 pellets and we had a path to our dispensing mechanism. However, we came across a problem when one of the pellets used for testing happened to be too large to fit our path. This problem will be resolved by increasing the tolerance of the current path. Also, there were a few instances in which more than one pellet got dispensed at once. We plan to make this system more consistent by making the structure more stable and replacing the weaker components of the prototype with stronger materials. Also, for the next prototype, the barcode reader and the component for separating the pellets by size and color will also be implemented.

Subtask 2

Moving Forward from Subtask 1

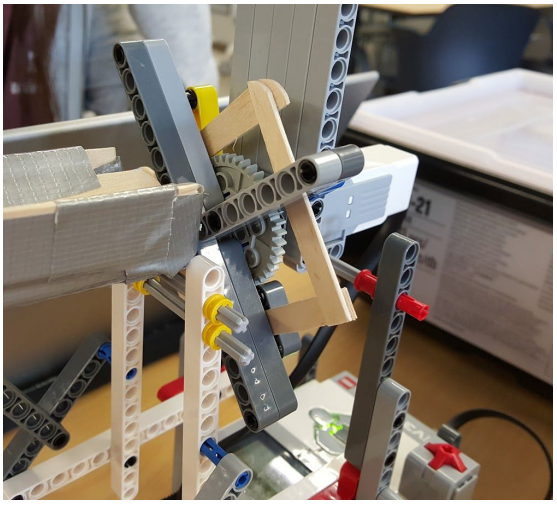
The taskforce decided to do a combination of both mechanisms. The top half of Team 18's machine (the tube design for input) would be used, and the lower half of Team 17's (the dispensing system) would be used. Since both teams' machines were built out of materials that weren't super sturdy, we decided to fully rebuild the contraption with PVC and duct tape. The idea of an OPAAT (One Pellet At A Time) to dispense only one pellet at a time will still be employed since both teams used a wheel design for that portion of the contraption. That is one of the few pieces that won't go through much change; however, the ramp leading to the wheel and the actual container will be changed to a sturdier material.

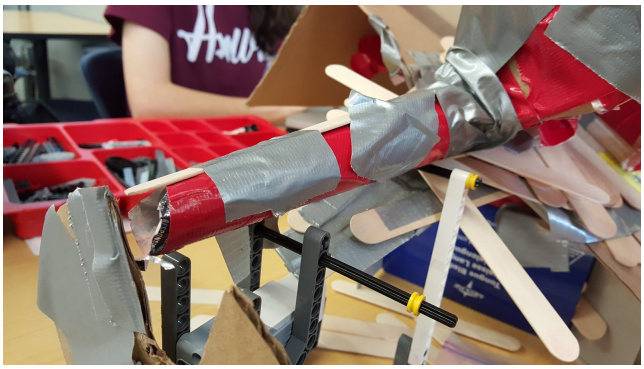
The first idea we had was to simply combine Team 18's container shaker with Team 17's container and OPAAT. This would be a simple addition to Team 17's POS, but the fear of it breaking down over time was a huge factor in moving onto more brainstorming. The ramp to the OPAAT could be replaced with a PVC pipe for sturdiness, and the pellet container could be made out of some form of sturdy material. We ended up scrapping the idea fully since we didn't want to restrain ourselves to a system that only partially worked, the shaker from Team 18's POS.

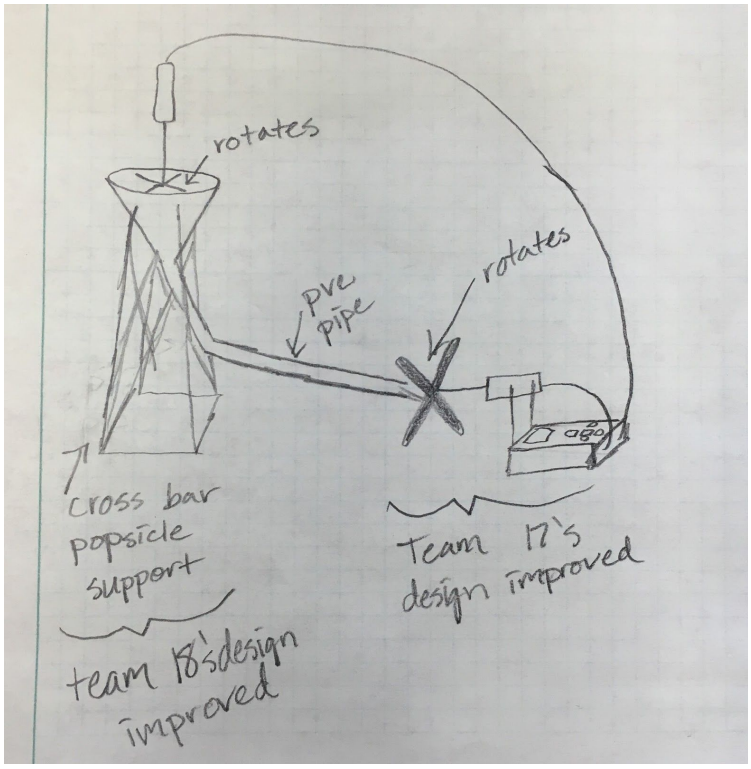
Another was to use a blender-like mechanism (PAS) inside of the pellet container to help stir up pellets that got stuck. This idea would involve placing a medium motor above the container and having it stir an axle near the bottom of the container near the hole of the funnel. In theory this idea works better at stirring up the pellets inside the container over the container shaker from Team 18. Within this design we also plan to use funnels to contain the bulk of the pellets, so that there is more sloping to the design. On top of that, we will also start using PVC pipes for the ramp since they could fit one pellet at a time and reduce the risk of multiple pellets coming out at once.

Upon development of the POS with implementation of the ideas previously explained, a problem was encountered when attempting to add the POS that had been decided on. The cable lengths available were all too short to reach the funnel from where the brick was placed with respect to the entire mechanism, and the axles available were too short to reach the bottom of the funnel in order to thoroughly fix all pellet jams. A poking mechanism that poked the pellets when they became stuck to add necessary force to make them liberate, more similar to Team 18's shaker than the blender-like mechanism, was used instead in the final design of the prototype.

Propeller from Team 17 + tube design for transport from Team 18 + new blender idea





= 

(Pellet Operating System)

Memorandum

DATE: 3/28/16

TO: Engineering Design Teams

FROM: Margo Hood, Team 17
Rebekah LeBlanc, Team 17
Daniel Matas, Team 17
Cecil Sabu, Team 17
Lauren Alexander, Team 18
Joseph Gerules, Team 18
Kyle Gustafson, Team 18
Leilani Horlander-Cruz, Team 18

SUBJECT: WORLD HEALTH ORGANIZATION CONTRACT

This project involves developing a prototype that delivers antivirals into wells according to barcodes that are determined from analysis of water quality. Through this device, many of the current issues of medication delivery in highly contagious situations will be solved. This idea emerged from the new Ebola strain that now has the ability to be transmitted through air. Rather than nurses having to deliver medication in isolated suits, this device would allow for faster and safer delivery through an autonomous system.

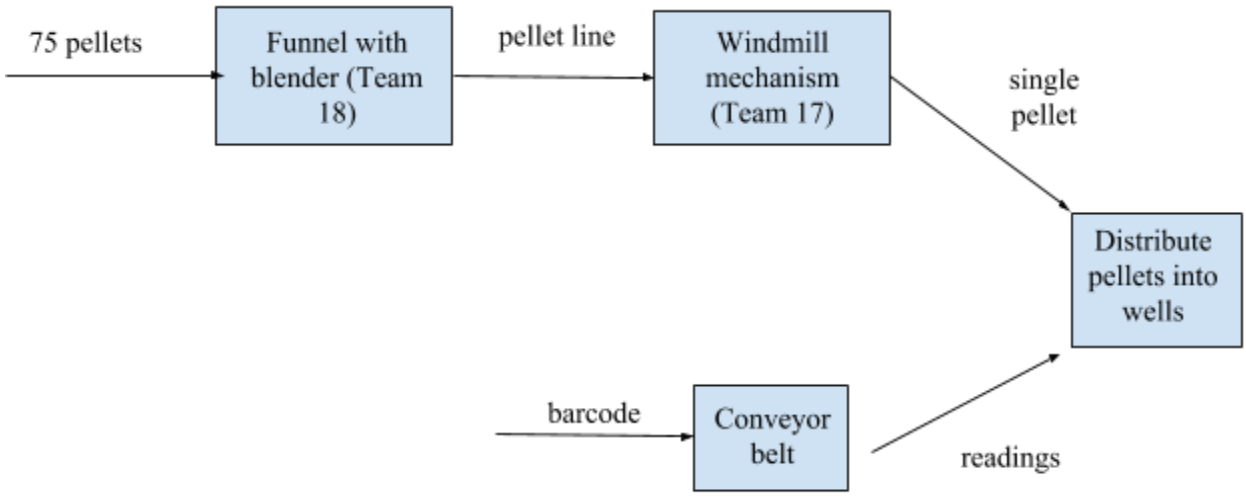
The final prototype of our antiviral delivery system will perform many functions. However the current prototype has 4 main features:

- Pellet holder - Our prototype is able to store an amount of pellets which will allow there to be enough pellets to replenish the well for a few days.
- Holder Shaker - There will be a contraption that creates motion to allow the pellets to leave the holder without clogging.
- Path - The pellets will exit the holder and travel in a line to the dispenser.
- Dispensing Fan - There will be a fan at the end of the path which constantly rotates and dispenses the pellets into the wells one at a time.

For the final prototype there will also be:

- Barcode Scanner - The final product will have the ability to detect what kind of pellets the well needs.
- Pellet Separator - This component will allow the system to differentiate between the pellets by their size and color.

- Functional block diagram:



Currently, the prototype includes a pellet dispenser where 75 pellets are placed into a funnel then directed down a tube to a windmill type mechanism where the pellets are dispensed individually at a constant rate of 2 pellets per second. The next step is to develop a barcode reader and separate the pellets into different wells based on the barcode reading. Our current plan is to use a conveyor belt to read the barcodes and use a similar windmill mechanism to distribute the pellets into their respective wells.

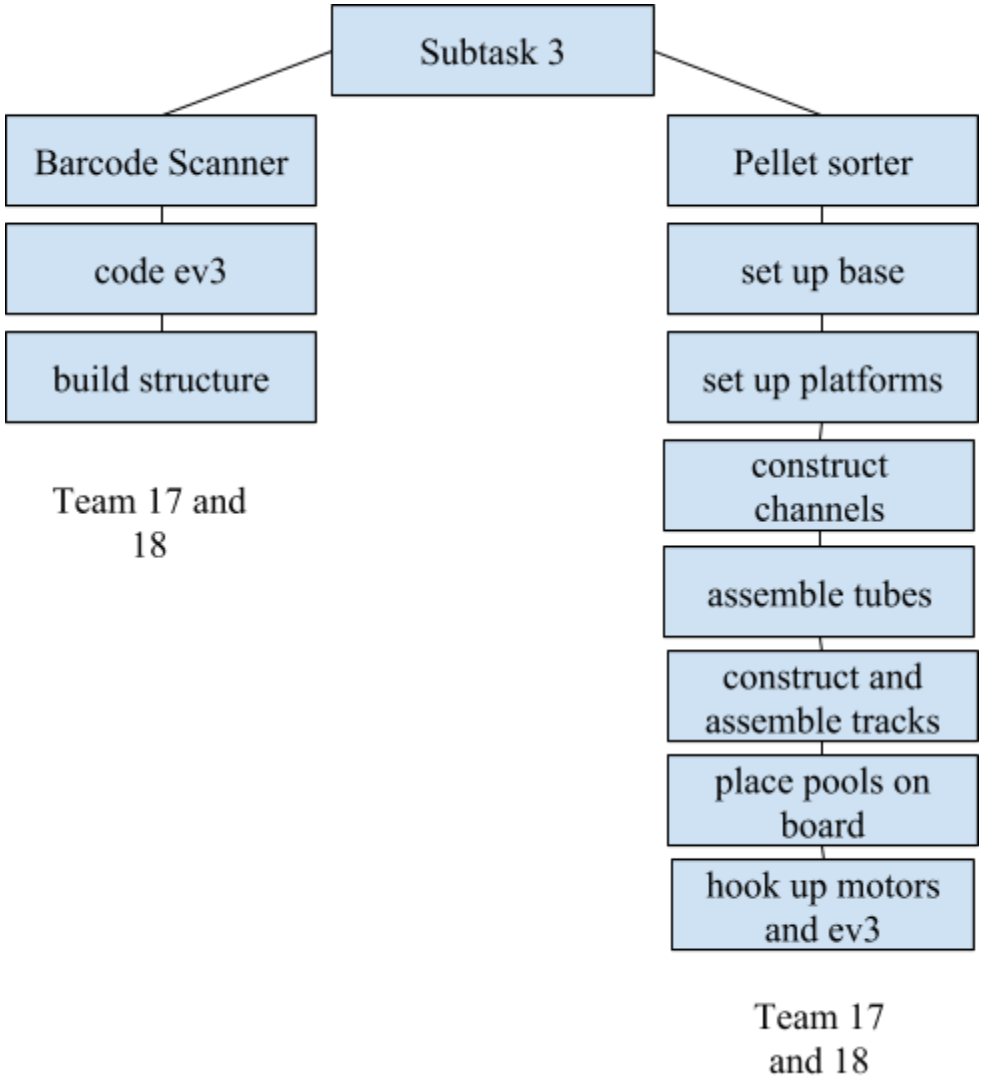
Appendix

Our current plan to sort the pellets is to first separate the pellets by size and then by color. We plan on sorting the pellets by the smaller and bigger sizes by having a slit at the bottom of our current path which will allow the smaller pellets to fall onto a separate path. Then both the paths of the large and small pellets will be met with a color sensor which will detect the color of the pellets. From there the pellets will be led to a storage compartment if it is needed for the well, and thrown in a trash pile if it is not needed. Once the system recognizes that all the needed pellets are in the storage compartment, all the pellets will be released into the correct well.

Subtask 3

Task 1

1. Work Breakdown Structure



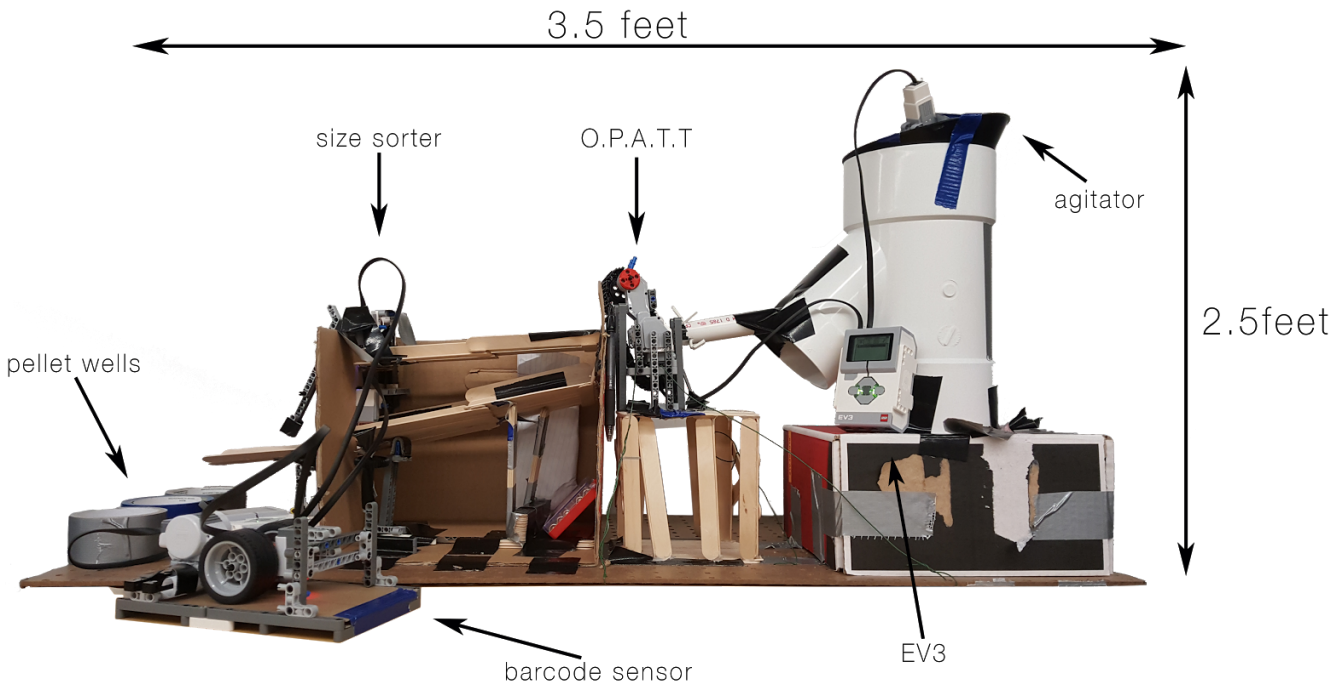
2. The teams exchanged information and sample pellets by using GroupMe and by meeting all together in person each work day. Both aspects of the subtask were completed by both teams equally.

Results

Demonstrating subtask 3 revealed that the barcode needs to be adjusted to accommodate a different material and also possibly different light values on the barcode. However, the use of tracks to separate sizing, conveyor belts to deliver a single pellet to a color sensor, and weight distribution to

separate similarly colored pellets was successful. Moving on, the code for the barcode reader will be adjusted and tracks to distribute the separated marbles will be added. Also, code will be made to deliver the correct assortment of pellets into a well from their respective path.

Final Demo



Results

The prototype performed fairly well during the final demo. A malfunction occurred, however, that caused one barcode to be stored twice. This caused the dispenser to output one set of pellets twice so there were too many pellets dispensed. This problem could be caused by resetting the program and also tweaking the code to prevent this from happening. Another problem that came up was that the color sensor read blue as green which caused viable pellets to be thrown in the toxic bin. This could be prevented by providing a better light source in the area where the pellets are being identified by the color sensor so less errors will be made. Other than these two problems, the dispenser worked well. No jamming occurred while the test was being run due to the funnel used at the top of the prototype, the mixer in the funnel, and the OPAAT which prevented jams further down the track.

Moving Forward

Moving forward, the prototype needs to have a way to recycle pellets back to the beginning in order to recycled unused, viable pellets. This would be a more cost-efficient process in the long run. Another way to improve the prototype would be implementing a system to tally how many pellets have been put into the prototype to assure there are enough pellets to complete the dosage. An alarm should

also sound if there are not enough pellets in the system. To further prevent an incomplete dosage from being dispensed, the system should not dispense if the proper dosage cannot be dispensed (example: not enough of a certain pellet in the given mix). The prototype could be further improved by using sturdier materials that would last longer (if given more time and money).