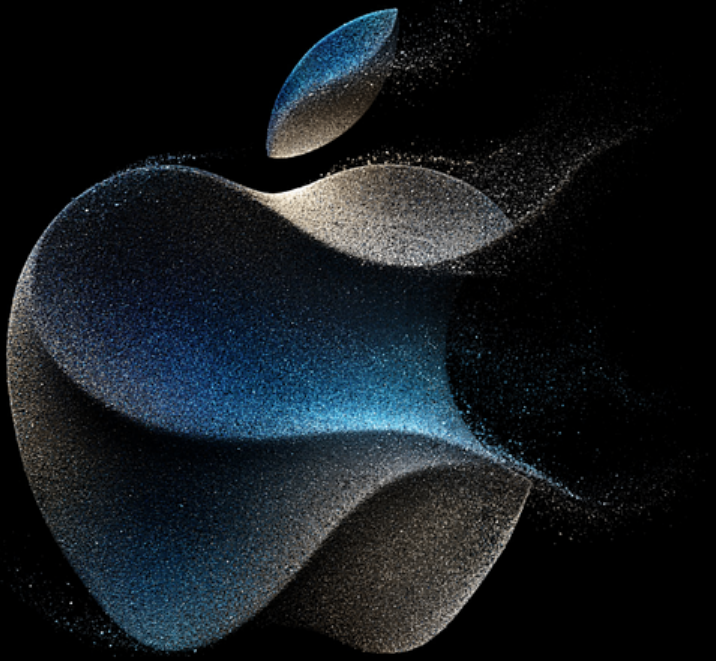
Apple Innovative Design



Gen Z

Team No. 70478S

Georgetown, TX

By: Tanish, Krishna, Sam, Sai, Naren

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Why Apple?

Apple played a pivotal role in transforming the smartphone industry by spearheading the shift from physical keyboards to intuitive touchscreens in Phones. Steve Jobs & Steve Wozniak shared an interest in technology and founded Apple in Job's garage 1976. Today, Apple is a key leader in the tech industry with innovation & advancements in many key product lines. Apple is a leading employer of highly skilled and knowledgeable workers in the STEM field and provides an opportunity for many. Our team was inclined to Apple's strong involvement in hardware and software, leading us to research the company's engineering process to improve our team's design process.

To better understand the industry's design process, we contacted Muralidhar Shammana who is an Engineer at Apple and set up an interview with him. We also researched using the Apple's career website and additional websites to understand Engineering Design Process and gain new insight.

Figure 1: Apple Headquarters
Source : Carles Rabada

Figure 2: Steve Jobs unveils the iPhone
Source : The Times Magazine

The Engineering Design Process

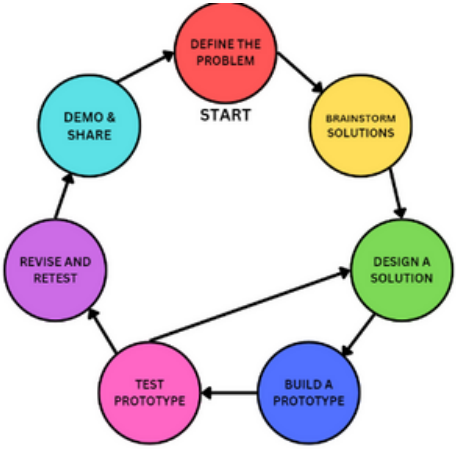


Figure 3: Industry Design Process

The purpose of the engineering design process is for a structured & systematic approach to solving problems. This process helps guide engineers to innovative solutions by breaking up big problems into small manageable steps. Mr. Shammana told us that using a design process to accomplish requirements and goals helps meet deadlines and increases collaboration. According to Designorate website, "the Apple's New Product Process is a document that describes the process in detail in its different stages" (Dr. Rafiq Elmansy).

Figure 4: Our engineering design process.

OUR PROCESS

Our team has also employed the Engineering Design Process to streamline our robot design, build and software development.

STEP 1: Define the Problem

The first step in the engineering design process is to clearly define & identify the problem & meet any requirements. As in the case of STEM companies, the problem at hand might come from a client or be an internal problem such as improving or developing a product. Jobs sought to match the customers' needs and wanted "a way to differentiate his company's products from the PCs of the day" (Daniel Turner).

Our team first identifies the task that needs to be accomplished by our robot and then we identify any requirements & criteria we need to follow.

Do we have the parts?	Shooting power	Complexity? (higher = easy)
Accuracy	How fast can you shoot	

Figure 5: Our decision matrix for the catapult

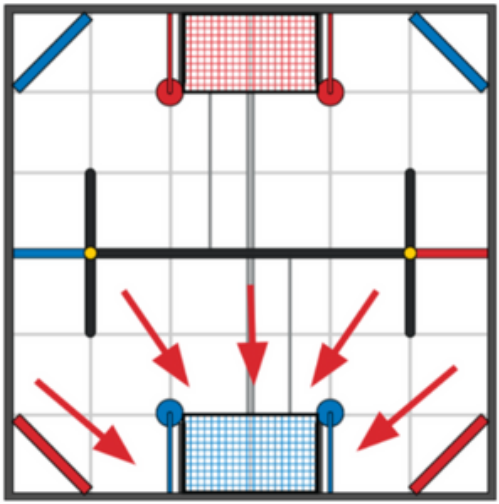


Figure 6: Problem: Be able to shoot triballs over the middle bar and into the goal

STEP 2: Brainstorming Solutions & Design

Mr. Shammana highlighted that brainstorming and checking existing solutions is an important step to tackle problems. Identifying existing solutions can be done through market studies in which key features and limitations would be identified. Our team researches existing robot mechanisms through robot reveals videos & the web. According to Designorate website, Apple has team brainstorming meetings to "fuel creative ideas" (Elmansy). Our team also has brainstorming sessions to share and improve upon robot ideas. After brainstorming, we would use the Decision Matrix to rank possible solutions given the requirements. Mr. Shammana said ranking solutions based on their advantages and limitation is important to choose the best solution without bias.

Type of Launcher	Do we have the parts?	Shooting power	Complexity? (higher = easy) (1-5)	Accuracy (1-3)	How fast can you shoot (1-3)	Overall: (out of 11)
Slip gear puncher	Yes, but would need to shave down gears	Very powerful based on rubber bands	3	2	2	7
Flywheel	Yes	Depends on RPM	2	1	1	4
Slip gear catapult	Yes, but would need to shave down gears	Very powerful based on rubber bands	4	3	3	10

Figure 7: Decision matrix of launchers to decide what kind of catapult/launcher we should use.

STEP 3: Build & Test Prototype

Mr. Shammana said that testing prototypes in virtual simulations is ideal if possible before producing small mockups to save time & money. Apple goes above and beyond to ensure a high-quality prototype as Jobs encouraged a “zero-draft molding method” despite it “costing more” (Turner). In Apple’s building process, they create a “pixel-perfect prototype” (Elmansy) which takes a long time but “develops a visual for the product” (Elmansy).

Our team also builds prototypes with high-quality and precision so that we can create a strong visual of our mechanisms. We would also create small implementations of a designs to pre-test before implementing it on the robot. This would help us understand the concept before applying it to the robot and prevent any build errors. We also use CAD to design & test our mechanisms to improve building efficiency.

Figure 8: Prototype Catapult to Launch

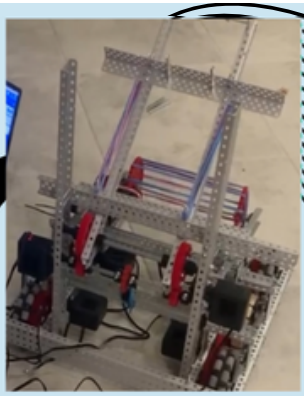


Figure 9: Testing Catapult ability to throw triballs

STEP 4: Refine & Retest

Mr. Shammana highlighted that a company would go through multiple iterations of a product before pushing it to the market. Product testing would happen “again and again in order to reach high-quality standards” & meet any criteria (Elmansy). In our team, we would perform robot mechanism tests to ensure reliability, functionality, safety, and limitations. We would then tweak our design & keep testing until we achieve our requirements. We would continue repeating this cycle until we are satisfied.

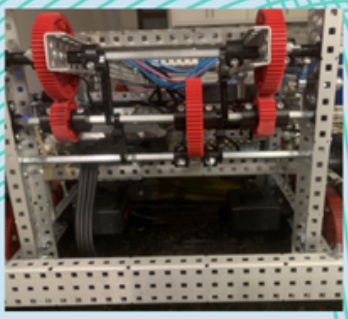
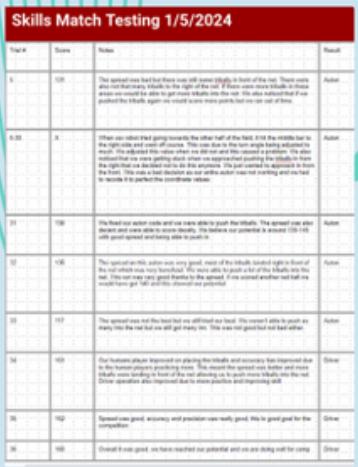


Figure 10: Refining the gear ratio of the catapult to increase speed



Skills Match Testing 1/5/2024

Trial #	Score	Notes	Result
1	120	The spread was bad but there was still some triballs in front of the net. There were also not that many triballs to the right of the net. If there were more triballs in those areas we would be able to get more triballs into the net. We also realized that if we pushed the triballs again we would score more points but we ran out of time.	Auton
6-30	X	When our robot tried going towards the other half of the field, it hit the middle bar to the right side and went off course. This was due to the turn angle being adjusted to much. We adjusted this value when we did not and this caused a problem. We also realized that our more getting stuck when we approached pushing the triballs in from the right that we decided not to do this anymore. We just wanted to approach in from the front. This was a bad decision as our antiks auton was not working and we had to recode it to perfect the coordinate values.	Auton
31	130	We fixed our auton code and we were able to push the triballs. The spread was also decent and were able to score double. We believe our potential is around 130-140 with good spread and being able to push in	Auton
32	130	The spread on this auton was very good, most of the triballs landed right in front of the net which was very beneficial. We were able to push a lot of the triballs into the net. This run was very good thanks to the spread. If one scored another net ball we would have got 140 and this showed our potential	Auton
33	117	The spread was not the best but we still had our load. We weren't able to push as many into the net but we still got many ten. This was not good but not bad either.	Auton
34	100	Our humans player improved on placing the triballs and accuracy has improved due to the human players practicing more. This meant the spread was better and more triballs were landing in front of the net allowing us to push more triballs into the net. Driver operation also improved due to more practice and improving skill.	Driver
35	152	Spread was good, accuracy and precision was really good, this is good goal for the competition	Driver
36	100	Overall it was good, we have reached our potential and we are doing well for comp	Driver

Figure 12: Stress testing robot

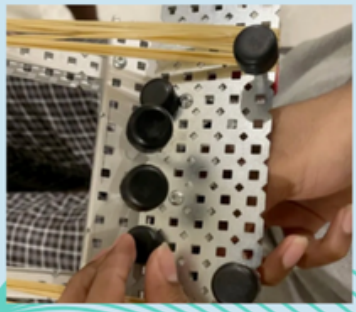


Figure 11: Testing a slapper mechanism

The Evolution of iPhones vs Catapult

Figure 13: An image shows the evolution of different iPhones and changes in the design over the years

Figure 16: image of us testing the catapult that we initially built

Image Credit: CNBC
Figure 14: Apple Testing CPU

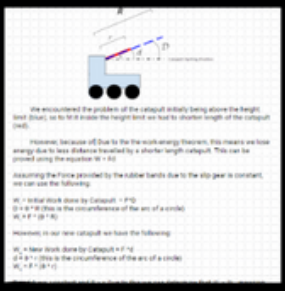


Figure 17: Design modifications to the catapult

Image Credit: CNBC
Figure 15: Testing CPU Temperature

Figure 18: New design of catapult after lots of testing and many iterations

STEP 5:
Demo & Share

Mr. Shammana said that after designing & testing , the next step is to release the product to the market through hosting events. Customer feedback is valuable for the next iteration of the product. For our robotics team, the demo & share phase is showcasing & participating at competitions. During competition, we would gain new insight into our robot which helps us make improvements for next competition.

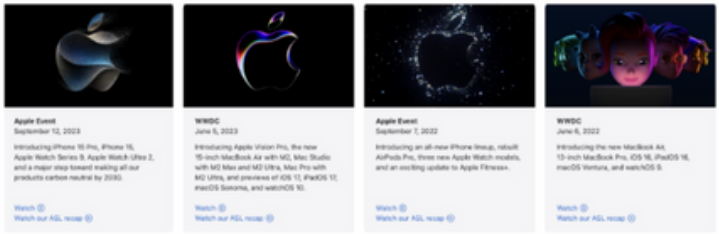


Figure 19: Apple online events to showcase products

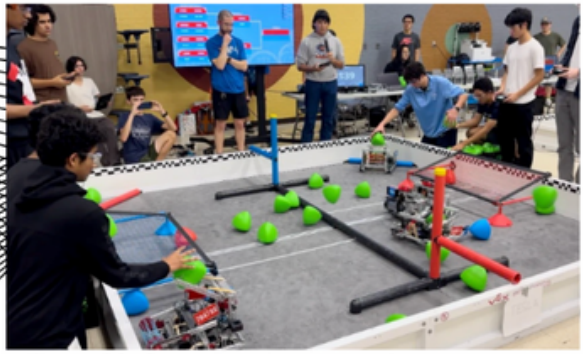


Figure 20: Our robot demonstration at competition

Figure 21: Presenting our robot at competition

Why Vex Robotics?

Our team believes that VEX robotics provides kids who are interested in STEM an opportunity to learn, design and implement ideas from scratch and a place to showcase their growth. Vex gives students the opportunity to build and code a robot that can perform various tasks and it's the students responsibility to try their best at accomplishing this goal. This is similar to tasks engineers complete in the industry. VEX robotics gives students the opportunity to learn technical skills needed in the workforce like collaboration, problem solving, time management, teamwork and brainstorming. These skills are crucial in the industry as they are the backbone of a company's workforce. Lastly, VEX robotics is a fun way for kids from all backgrounds to connect and explore engineering together.

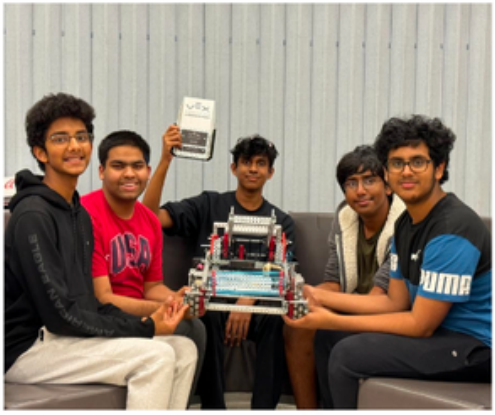


Figure 22: Our Team at competition

Figure 23: Using teamwork to fix robot

Thanks To: Muralidhar Shammana

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