2019
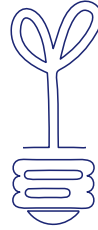
International Torrance Legacy Creativity Awards

Inventions

The Torrance Legacy Creativity Awards Competition for Inventions challenges young inventors to solve problems using the scientific method. Students from ages 8 to 18 years old create original products ranging from enjoyable activities (Arts and Leisure) to playful fun (Toys and Games) to helpful solutions (Science and Engineering). Young inventors attend public, private and/or home schools and submit applications from North America, Europe, Asia and Africa. They begin with a need, develop their concept and design a prototype with detailed instructions and three-dimensional graphic. Applicants select a Torrance Legacy Creative Award theme and submit a 300-500 word description with drawings or electronic images.

A team of qualified judges evaluate applications in each category with a rubric scoring problem-solving skill, real world application, and product presentation. In addition to Torrance Legacy Creative Invention Award recognition, previous invention award recipients have received an academic scholarship, patented an invention, and appeared in local news media.

Connie Phelps, Coordinator of Inventions, International Torrance Legacy Creativity Awards, Director of Gifted Education and Great Plains Center for Gifted Students, Emporia State University Emporia, Kansas.

Arts and Leisure

Ages 11-12

First Place

Emily Watkins
Capitol Heights, Maryland
Perfect Page Turner

Second Place

Claire W. Goodowens
Winter Park, Florida
Stick Together

Ages 13-14

First Place

Valencia Tan and Olivia Chiam Jia-rong
Singapore
Ropa de Fácil

Second Place

Mindy Zheng Yiqing and Michelle Che Ming
Xuan
Singapore
Project NOted

Third Place

Caitlin Cheah and Miyen Chua
Singapore
Cooking 101

First Place

Emily Watkins
Capitol Heights, Maryland
Perfect Page Turner

"THE PERFECT PAGE TURNER" is definitely something fun, new and exciting. It's something that everyone and anyone can enjoy and have fun exploring and utilizing. It serves a great purpose in protecting periodicals, and it also is fun to use, explore, take apart and put back together. This invention not only encourages reading, but it helps to learn about engineering. The product is highly useful regarding reading, studying, engineering and science.

What if, for some reason, a person has trouble turning pages of a book due to a sprained wrist, for example? How can children turn pages of a storybook without smudging or ripping the pages? The Perfect Page Turner can assist by making reading more engaging and enjoyable. Using the Perfect Page Turner, children can relax more and be encouraged to read more.

The original design for the project was meant to use levers to turn the page. With the initial design, levers wouldn't turn the page, so I altered the design to use wheels. Not much else was changed, except batteries. At first, size D batteries were used, but they turned the wheels too fast which would damage a book. Therefore, I used size double A batteries instead. Future models might be different; they might be digital, voice-activated or stand-alone with a foot pedal.

The silver case for the device is eye-catching, and aesthetically pleasing. The wheels which turn pages were originally for a toy car. Wires connect from the pack of two double-A batteries, and are split to travel to each motor. There's a motor connected to the back of each wheel. The wires run from each motor to a button and back to the batteries.

When the button is up, the combination of motors, batteries and wires is referred to as an "open circuit". When pressure is applied to the button, the wheels begin to turn as electricity travels through the wires. This process is referred to as a "closed circuit". So, as you can see, this project involves plenty of engineering knowledge, work and enthusiasm. This means that when others use it, they may find this interesting and want to learn more about engineering. That's where another positive result of this project comes in.

This project, "THE PERFECT PAGE TURNER", acts not only as an assistant, but as a teacher. People might use the project, and begin to wonder what makes the project work? How was the project put together? What is the main feature in the project? Et cetera, et cetera. These questions, especially with children, can bring up discussions on engineering in any household. So now, people are not only helped with reading, but they are also discovering new things! All due to one project:

THE PERFECT PAGE TURNER
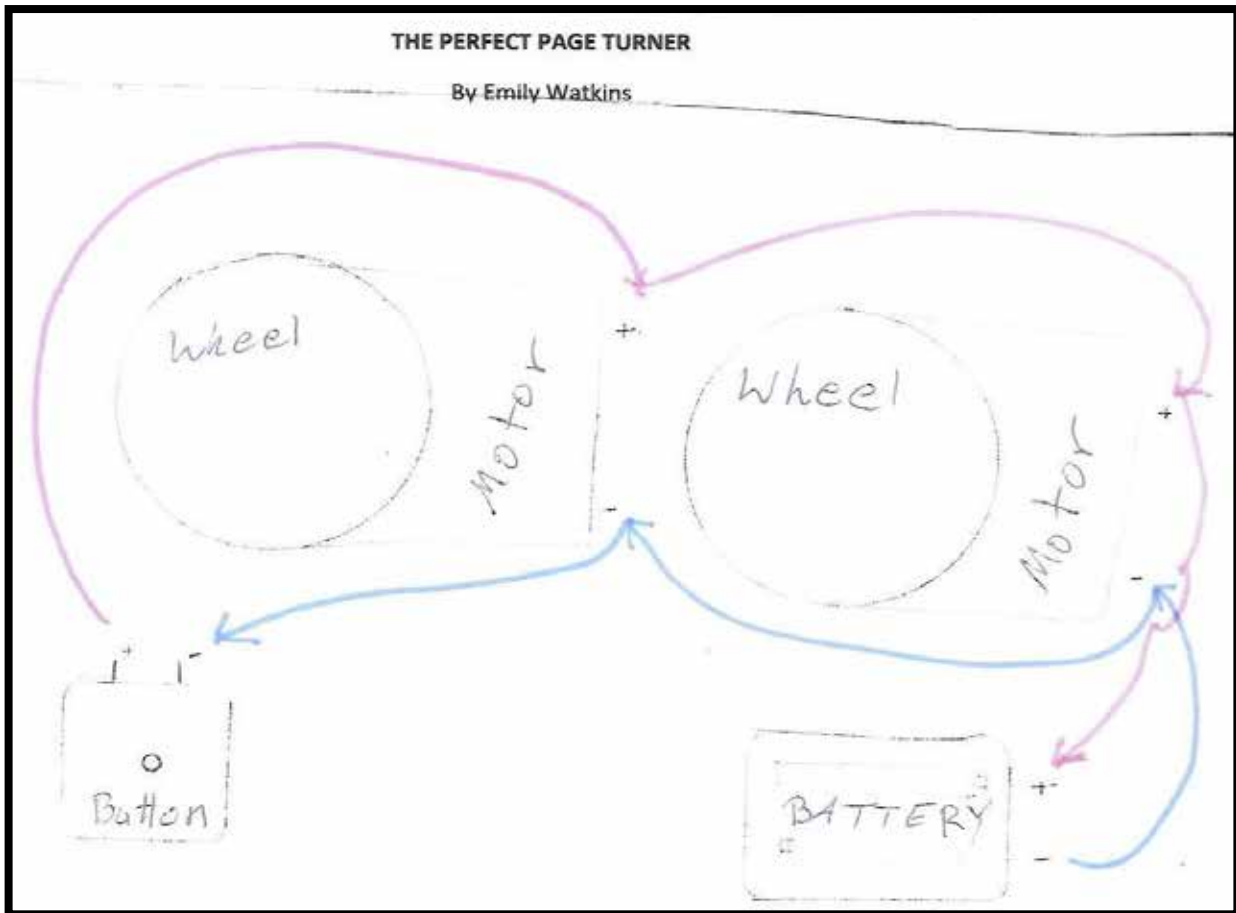
THE PERFECT PAGE TURNER

By Emily Watkins

Second Place

Claire W. Goodowens
Winter Park, Florida
Stick Together

STICK TOGETHER CHALLENGE

Please go to my website at:
WWW.STICKTOGETHERCHALLENGE.COM

Text from the web site:

542,000 CHILDRENWORLDWIDE HAVETYPE 1 DIABETES
1,978,300,000FINGER STICKS A YEAR

WHY STICK TOGETHER?
Many Type 1 Diabetics thrive in the face of their disease. People outside the diabetic community are seldom aware of how much these people have to overcome on a daily basis. We often only show the "facebook" version of ourselves: the results of the struggle but not the effort and the struggle itself. STICK TOGETHER is intended to promote early detection for Diabetes and raise the empathy level in this important issue. Experiencing firsthand the challenges associated with Diabetes management is essential for informed decision-making on issues related to pharmaceutical pricing and research funding. A finger stick, the first for many who will be participating, brings home the reality that ONE stick is literally a drop in the bucket over the lifetime of a diabetic. Even those who are afraid to participate in this challenge because fear of a singular finger stick stands in their way of important personal health information, will still have a window into the daily challenges that Type 1 Diabetics face.

THE CHALLENGE:
It's simple!
- Post a video of you testing your blood glucose and tag #STICKTOGETHERCHALLENGE
- Pledge at least 10¢ for each point to JDRF or BEYOND TYPE 1
- Tag 3 people you care about so you can all STICKTOGETHER!

MY STORY
My name is Claire and I'm one of 542,000children who have Type 1 Diabetes. I was diagnosed on March 1, 2018. The scariest thing that happened to me that day was realizing that I would have to stick my finger at least 10 times every day for the rest of my life! EVERY. DAY. FOREVER.
On the 1 year anniversary of my diagnosis, I felt inspired to create this challenge in the hopes of promoting Diabetes awareness and good diagnostic habits. I decided to turn the very thing that scared me the most into something that could help save other people from getting Diabetes! Whether Type 1 or Type 2, testing your blood glucose levels is a great tool for diabetic indicators and can be your first line of defense to prevent or prolong a full diabetic diagnosis.
If there's anything I've learned this past year, it's that the T1 community is strong and if we all STICK TOGETHER there's nothing we can't cure!

542,000 CHILDREN WORLDWIDE HAVE TYPE 1 DIABETES

## 1,978,300,000

FINGER STICKS A YEAR

StickTogetherchallenge

First Place

Valencia Tan and Olivia Chiam Jia-rong
Singapore
Ropa de Fácil

Ropa de Fácil

The clock struck 6 o'clock and the taxi driver was beginning to tap his feet on the ground. "Grandma!! Why are you so slow?" She hustled out of the room hastily, pulling on a rosy cardigan and heaved a sigh, "These days, it takes a lot more effort for me to put on my clothes... Sorry ah girl, I didn't mean to make us late." Agitated, I stared at the ground and kept silent until we reached the diner, where I eventually cooled down over a cup of iced coffee. Was it really that hard for her to put on her clothes quicker? I whipped out my phone and searched "Why do elderly put on clothes so slowly?"
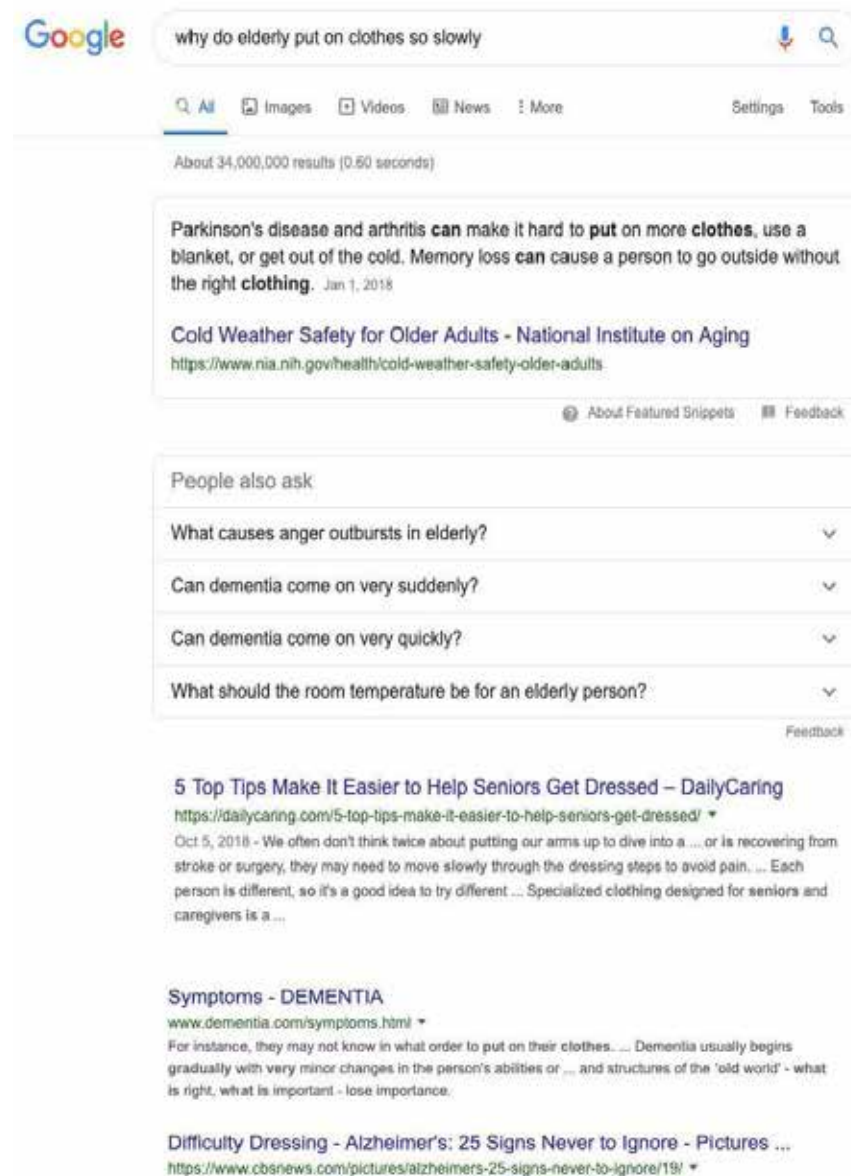
Oh. My. Gosh. I can't let Grandma deal with this problem on a daily basis!

I was determined to find a solution to help my grandma, and all the other elderlies/slightly disabled who have trouble putting on and taking off their clothes.

Ropa de fácil means "easy clothes" in Spanish. In other words, our invention is a set of clothes (top and bottom) that is easy to wear. We aim to help the elderly and slightly disabled to wear and put on clothes easily. A majority of the elderly have complained about the difficulties they face in putting on and taking out their clothes. (e.g. grandparents) The elderly and disabled have weaker muscles and find it more strenuous to stretch their arms or legs when putting on and removing clothes. Clothing is a part of each and every person's daily lifestyle, thus, we want to find a way to allow those who struggle with flexibility to go through this part of their day more easily. We hope to enable the elderly all around the world their own independence in their day-to-day lifestyle.

1. Slip the top over the head as shown in the picture and adjust so that the zip is facing the front
2. Grab both corners of the shirt (will be hanging at the back of the shirt), bring it forward to the front, and attach them to the velcros at the front.

The shirt is done!

These are the steps for taking of the top:

(photos and descriptions)

1. Detach the front part of the shirt

2. Pull the zip at the front of the shirt down to widen the neck hole
3. Pull the whole shirt down

Our pants do not have pant legs, therefore the user need not raise up their legs or bend down to their legs through the pant legs, , like what people usually need to do when they put on normal pants. This makes it less strenuous and easier for the user to put on the pants. These are the steps for putting on the pants: (photos and descriptions)
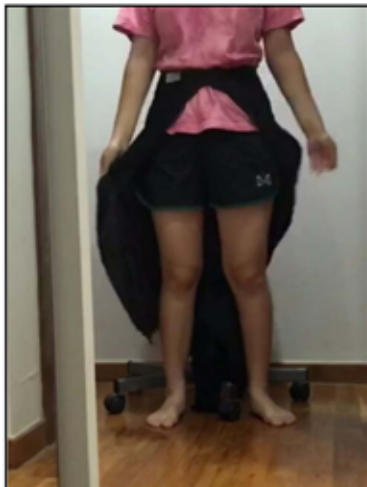
1. Wrap the pants around the waist and attach it using velcro. (image above)
2. Sit down

3. Grab the cloth from between the legs and stand up again (image above)
4. Attach the velcro to both sides of the waist to complete the pants! (image below)

Done!

Well, you may wonder, what is so special and unique about our solution? The user does not need to stretch his/her body in any way! This is a feature that other existing products and normal clothes do not have. Our invention is an all-inclusive invention, as everyone can use our products. Normal people can also wear these clothes, even if they do not have trouble putting on clothes.

I hope that we have **found a solution** to successfully solved the problem that my grandma and other elderly people face, and this set of clothes will make it easier and less strenuous for them to put on and take off their clothes. Now, grandma will be able to dress more quickly and easily!

Second Place

Mindy Zheng Yiqing and Michelle Che Ming Xuan
Singapore
Project NOted

Have you ever been given so many notebooks or bought so many in cheap bundles, 3hat you don't know how you're going to finish *using* them? Or worse, most of them are half-used because of many different reasons?

Fret not, for you are not alone! May students in our school face the same problem. The half-used notebooks cluttering your house will only produce paper wastage when you clear them out, and that is a waste of good notebook and good paper! It is also detrimental to the environment as more trees would be cut down and more resources used to make new notebooks. As such, we have decided to make an invention to solve this problem.
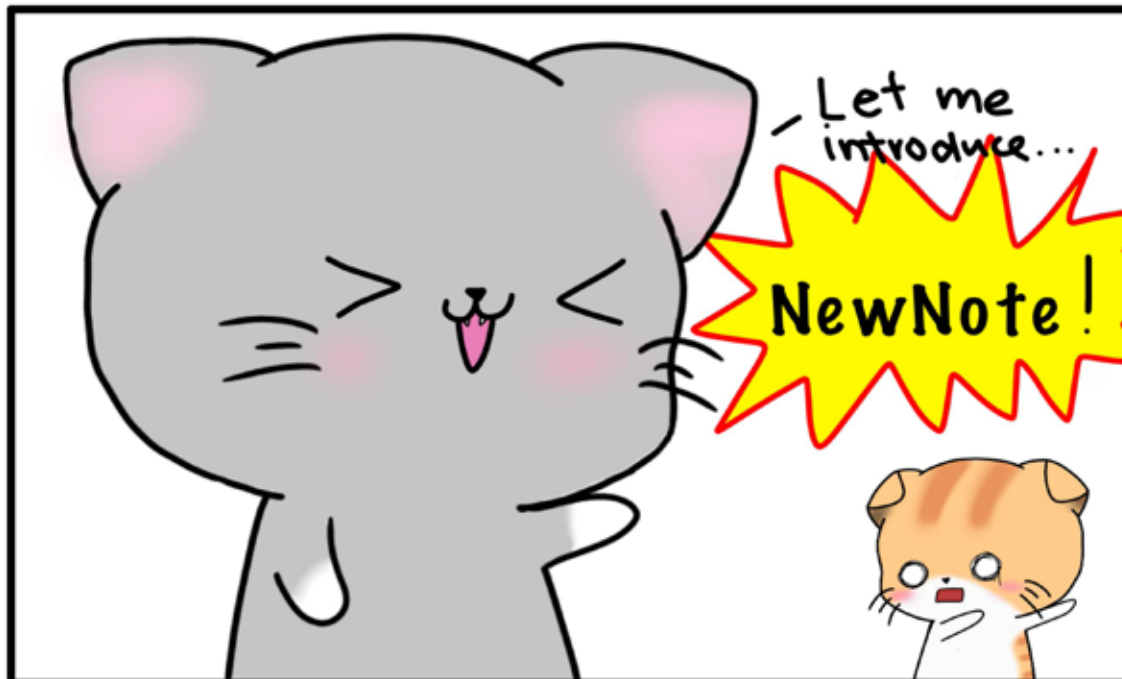
You must be wondering, what NewNote? And how does it work?

Cardboard

To make the paper less flimsy

Band

To hold any access string down

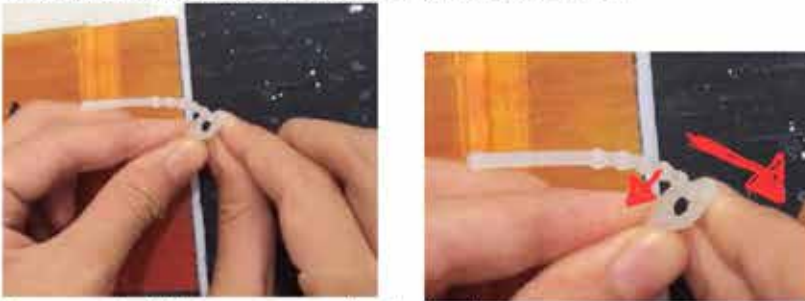**Tape Section**

To bind the paper, can be adjusted

Stopper

To adjust and hold the spine in place

This is how NewNote works:
1. Unclip the tape section

2. Unplug the stopper and remove the tape section

3. Remove/add the cover and notebook pages

4. Pull the stopper along the tape section until the desired width is reached. Clip down the tape section.

5. Clip down any excess with a strap.

5. Clip down any excess with a strap.

NewNote allows users to take the unused paper from half-used notebooks and bind them into a next-to-new notebook that is sturdy, adjustable and personalized! If they finish using the pages or have new pages that they want to add, they can simply punch holes and put the new pages into the binder. NewNote is portable too, as it is quite small and not made up of many components. The cover can be drawn on, making it unique and special. NewNote reduces the need for users to buy new notebooks and allows them to make a whole new notebook decorated by themselves!

So, still wondering about your half-used notebooks at home? Tell your parents not to throw them out the next time you're cleaning your room. You never know, NewNote may just be able to help you find the true worth of those abandoned notebooks!

More Videos:
https://tinyurl.com/NewNoteVideos

Third Place

Caitlin Cheah and Miyen Chua
Singapore
Cooking 101

Theme: A Change of Heart

"I hate cauliflowers."

"Ew, throw them away! They're disgusting!"

Miyen and I rolled our eyes. There they went again…

We have two friends, Ellie and Maddison. Other than being the most annoying duo in the history of duos, the two girls shared another irritating characteristic; they *hated* fruits and vegetables. *Hated.*

At first, we didn't really mind. We would just turn a blind eye to their distaste towards the leafy greens and juicy fruits. However, we became increasingly worried and bothered when we saw the amount of produce they wasted every day.

And Geography class certainly didn't help quell our worries.

"Every year, approximately 1.3 billion tonnes of food is wasted. That amounts to a staggering US$ 680 billion worth of money lost. However, this is not the only problem. The *freshwater, land, electricity, labour* etc. that is put into cultivating the food is all wasted! When the wasted food decomposes, it also releases methane gas, which traps 30 times more heat than carbon dioxide, contributing further to global warming!"

Miyen and I shared a look. The devastating effects of food wastage was just too great to ignore anymore.

Hence, Operation *Cooking 101* was commenced. We were going to change some hearts.

We shared new cheap and easy-to-follow recipes with the food vendors, where vegetables were cooked to taste flavourful and salty like their favourite snacks, chips and instant noodles. It also included adding vegetables to other "more palatable" food, in the hopes that the conbination appealed to them. Not to forget fruits! To make fruits taste sweeter, we froze them. Who doesn't enjoy a cold fruit in Singapore?

Toys and Games

Ages 8-10

First Place

Emma Knight and Sage Powers
Lebanon, Tennessee
The Adventure

Second Place

Mohamed Adel Jaafar
Manama, Bahrain
Catch Me

Third Place

Hannah Ferrell & Shelby Neely
Lebanon, Tennessee
Math Mania

Ages 11-12

First Place

Claire W. Goodowens
Winter Park, Florida
TOOTH RUSH

Second Place

Jake Anderson, James Dyal, and Laine Thorne
Lebanon, Tennessee
Hit the Egg

Third Place

Tameem Ahmed Isa
Manama, Bahrain
Balance Board

Ages 13-14

First Place

Celeste Tan and Danielle Leow
Singapore
FlexEat

Second Place

Regina Ng
Singapore
Water Are You Waiting For?

Third Place

Lilia Leyan Zhou and Grace Chenxi Yu
Singapore
Understanding Disabilities

First Place

Emma Knight and Sage Powers
Lebanon, Tennessee
The Adventure

The Adventure

An original game by Emma Knight and Sage Powers

Our invention is a game called *The Adventure!* It is a game about teamwork, strategy, and bravery. The object of the game is to work together as a team, in order to get to the castle and save Princess Alena and beat the evil Lord Stone.

There are two teams, Team Red and Team Blue. There are six players maximum, consisting of three players for each team, and two players minimum. First, you choose a playing piece for the game. Next, you pick a trivia card and answer it, to determine which team goes first. The trivia cards are different categories such as History, fantasy, and entertainment. A sample question in the fantasy category would be *Do unicorns fly?* In the entertainment category, there would be questions like *What year was the first "Indiana Jones" movie made?* If you get the answer wrong, then it becomes the other team's turn. Only one person may go at a time on your team.

We got the idea for The Adventure from *Mario* and *Mario Brothers*, combined with our love for trivia games. We loved how he had to fight monsters, such as the Koopa Troopa, Bowser, and Goomba, and how he had Luigi as his team mate. In our game, there are different monsters and you have an entire team to help you! This game is meant for anyone ages 8 and up.

To start the game, each person on the team starts with 10 gems of each type, and you have the opportunity to earn gems along the way, throughout the game. If you make it to the castle and come to Lord Stone, then you must pay 50 of each kind of gem in order to destroy him. If you get stuck then you can combine your gems with another person on your team. There are power cards and the power cards allow you to decrease the power of the game's mythical creatures, in battle. Reducing their power will allow you to move farther than any other cards. During the course of the game, in order to save the Princess, you must fight mythical creatures, by answering questions, to win additional gems.

To make our game, we used pens, paint, cardboard, paper, and gems. The gems were simply fake jewels purchased at Walmart. In all, our game construction cost about $23.51. The majority of our money was spent in paint and on the gems. If we were to sell our game, we would sell it for approximately $30.00.
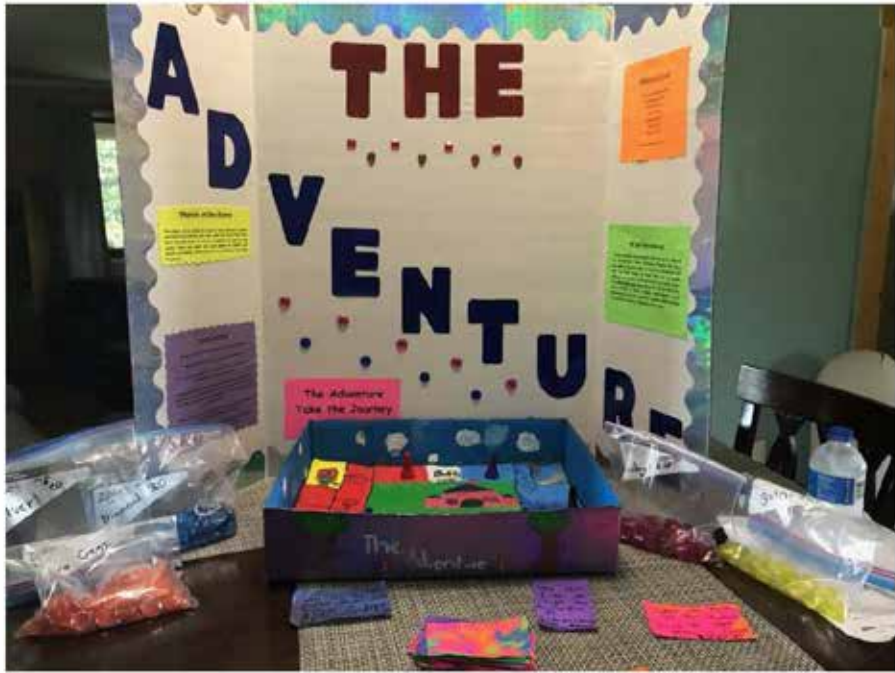
Second Place
Mohamed Adel Jaafar
Manama, Bahrain
Catch Me

Category: Toys and Games

Title: - Catch me - game

Boosting a child's memory capacity is one of the greatest gifts you can afford your children. Studies reveal that increased memory capacity also improves self-awareness, communication skills, social skills and self-confidence. Improvements in concentration also aid future learning.

I am sharing a fun shapes memory game that is perfect for helping children to s-t-r-e-t-c-h their brain!

This game require them to focus, think, plan and remember, and these are all great skills that we all need to use every single day. It can be use with kids in the years of primary/elementary school.

How it works:

Using VEX IQ robot kit and robot c programming language I invented this shape memory game using 7 VEX IQ motors attached with 7 cards and 7 different shapes (2 star – 1 heart – 2 square – 2 triangle) , I made 3 programming levels : Easy – Medium – Hard and I changed the speed to make it more hard .

This is sample of the robot C programs:

```
//  easy
2  repeat ( forever ) {
3      setTouchLEDColor ( led ▾ , colorRed ▾ );
4      if ( getTouchLEDValue(led) ▾  == ▾  1 ) {
5          displayText ( line2 ▾ ,    );
6          displayText ( line3 ▾ ,    );
7          displayText ( line4 ▾ ,    );
8          displayText ( line5 ▾ ,    );
9          displayText ( line1 ▾ , Round one );
10         moveMotor ( motor7 ▾ , 60 , degrees ▾ , -40 );
11         moveMotor ( motor7 ▾ , 60 , degrees ▾ , 40 );
12         moveMotor ( motor1 ▾ , 60 , degrees ▾ , -40 );
13         moveMotor ( motor1 ▾ , 60 , degrees ▾ , 40 );
14         wait ( 4 , seconds ▾ );
15         displayText ( line1 ▾ , Round Two );
16         moveMotor ( motor2 ▾ , 60 , degrees ▾ , 40 );
17         moveMotor ( motor2 ▾ , 60 , degrees ▾ , -40 );
18         moveMotor ( motor4 ▾ , 60 , degrees ▾ , 40 );
```

```
19         moveMotor ( motor4 ▾ , 60 , degrees ▾ , -40 );
20         moveMotor ( motor9 ▾ , 60 , degrees ▾ , 40 );
21         moveMotor ( motor9 ▾ , 60 , degrees ▾ , -40 );
22         wait ( 5 , seconds ▾ );
23         displayText ( line1 ▾ , Round Three );
24         moveMotor ( motor3 ▾ , 60 , degrees ▾ , -40 );
25         moveMotor ( motor3 ▾ , 60 , degrees ▾ , 40 );
26         moveMotor ( motor8 ▾ , 60 , degrees ▾ , -40 );
27         moveMotor ( motor8 ▾ , 60 , degrees ▾ , 40 );
28         moveMotor ( motor7 ▾ , 60 , degrees ▾ , -40 );
29         moveMotor ( motor7 ▾ , 60 , degrees ▾ , 40 );
30         moveMotor ( motor1 ▾ , 60 , degrees ▾ , -40 );
31         moveMotor ( motor1 ▾ , 60 , degrees ▾ , 40 );
```

```
32  wait ( 6 , seconds ▼ );
33  displayText ( line1 ▼ , Round Four );
34  moveMotor ( motor2 ▼ , 60 , degrees ▼ , 40 );
35  moveMotor ( motor2 ▼ , 60 , degrees ▼ , -40 );
36  moveMotor ( motor4 ▼ , 60 , degrees ▼ , 40 );
37  moveMotor ( motor4 ▼ , 60 , degrees ▼ , -40 );
38  moveMotor ( motor9 ▼ , 60 , degrees ▼ , 40 );
39  moveMotor ( motor9 ▼ , 60 , degrees ▼ , -40 );
40  moveMotor ( motor3 ▼ , 60 , degrees ▼ , -40 );
41  moveMotor ( motor3 ▼ , 60 , degrees ▼ , 40 );
42  moveMotor ( motor8 ▼ , 60 , degrees ▼ , -40 );
43  moveMotor ( motor8 ▼ , 60 , degrees ▼ , 40 );
44  wait ( 7 , seconds ▼ );
45  displayText ( line1 ▼ , Round Five );
46  moveMotor ( motor1 ▼ , 60 , degrees ▼ , -40 );
47  moveMotor ( motor1 ▼ , 60 , degrees ▼ , 40 );
48  moveMotor ( motor7 ▼ , 60 , degrees ▼ , -40 );
49  moveMotor ( motor7 ▼ , 60 , degrees ▼ , 40 );
50  moveMotor ( motor2 ▼ , 60 , degrees ▼ , 40 );
51  moveMotor ( motor2 ▼ , 60 , degrees ▼ , -40 );
52  moveMotor ( motor4 ▼ , 60 , degrees ▼ , 40 );
53  moveMotor ( motor4 ▼ , 60 , degrees ▼ , -40 );
54  moveMotor ( motor9 ▼ , 60 , degrees ▼ , 40 );
55  moveMotor ( motor9 ▼ , 60 , degrees ▼ , -40 );
56  moveMotor ( motor3 ▼ , 60 , degrees ▼ , -40 );
57  moveMotor ( motor3 ▼ , 60 , degrees ▼ , 40 );
58  wait ( 8 , seconds ▼ );
59  displayText ( line1 ▼ , Round six );
60  moveMotor ( motor8 ▼ , 60 , degrees ▼ , -40 );
61  moveMotor ( motor8 ▼ , 60 , degrees ▼ , 40 );
62  moveMotor ( motor7 ▼ , 60 , degrees ▼ , -40 );
63  moveMotor ( motor7 ▼ , 60 , degrees ▼ , 40 );
64  moveMotor ( motor4 ▼ , 60 , degrees ▼ , 40 );
65  moveMotor ( motor4 ▼ , 60 , degrees ▼ , -40 );
66  moveMotor ( motor3 ▼ , 60 , degrees ▼ , -40 );
67  moveMotor ( motor3 ▼ , 60 , degrees ▼ , 40 );
```

```
68  moveMotor ( motor1 ▼ , 60 , degrees ▼ , -40 );
69  moveMotor ( motor1 ▼ , 60 , degrees ▼ , 40 );
70  moveMotor ( motor2 ▼ , 60 , degrees ▼ , 40 );
71  moveMotor ( motor2 ▼ , 60 , degrees ▼ , -40 );
72  moveMotor ( motor9 ▼ , 60 , degrees ▼ , 40 );
73  moveMotor ( motor9 ▼ , 60 , degrees ▼ , -40 );
74  wait ( 6 , seconds ▼ );
75  repeatUntil ( getTouchLEDValue(led) ▼  == ▼  true ) {
76      displayText ( line1 ▼ , R1:Ci+Tr R2:Re+H+sq );
77      displayText ( line2 ▼ , R3:cy+st+ci+tr );
78      displayText ( line3 ▼ , R4:Rec+H+Sq+Cy+St );
79      displayText ( line4 ▼ , R5:All except star );
80      displayText ( line5 ▼ , R6:All );
81  }
82  }
83  setTouchLEDColor ( led ▼ , colorGreen ▼ );
84  }
```

The game pictures: Displaying Numbers from(1-9) and Shapes
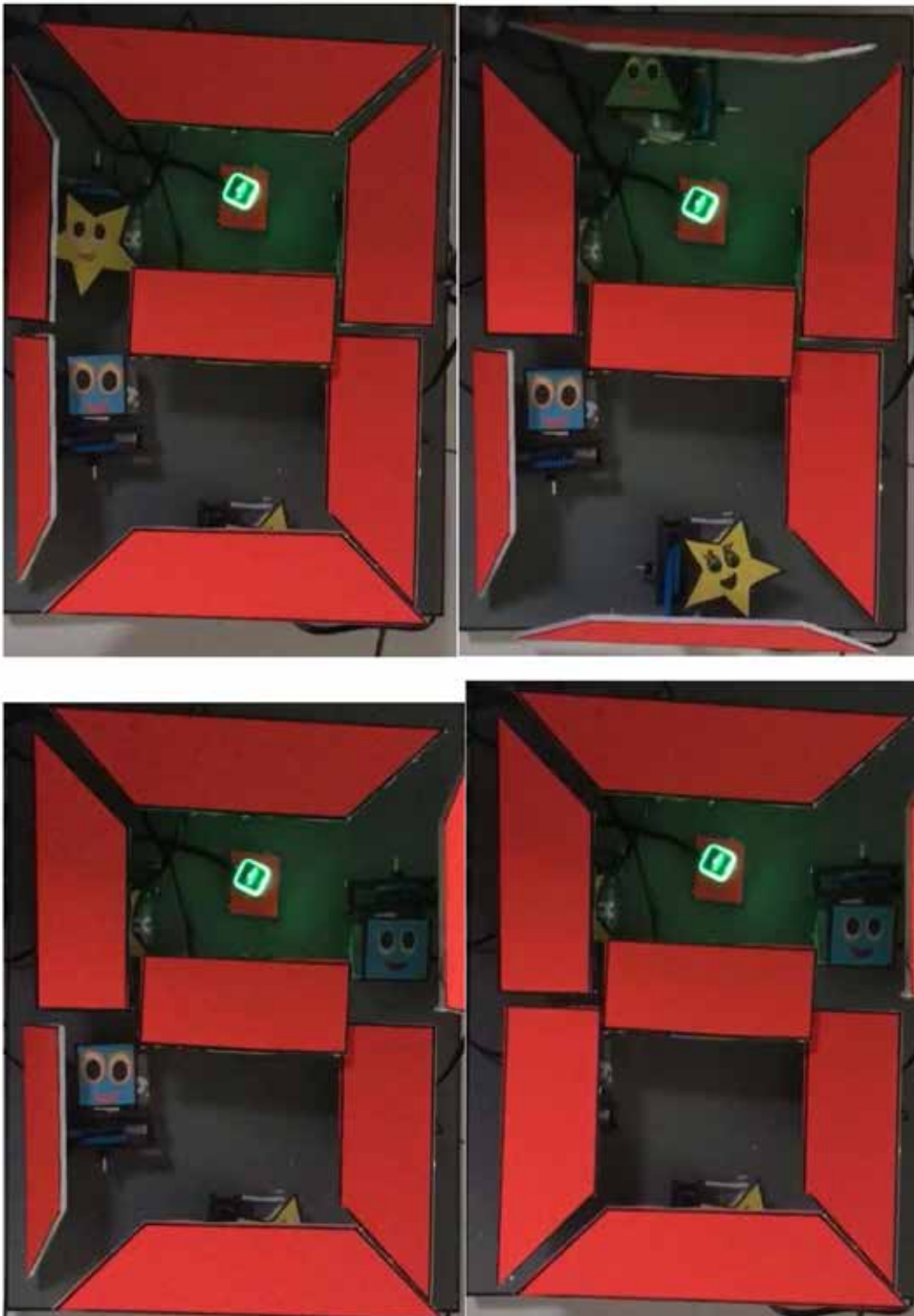
Scoring sheet for the child when playing the game:

You have 6 rounds and you have time between each round, the object of the game to put check mark on the shapes that you will see in each round .

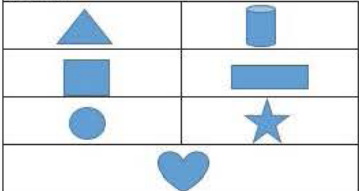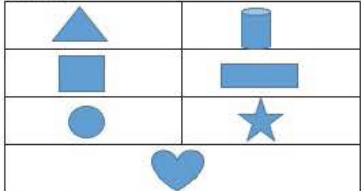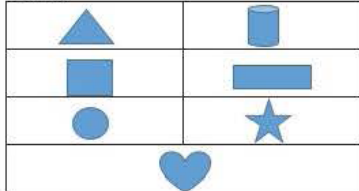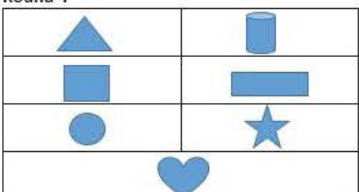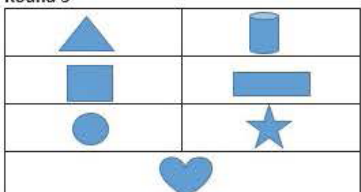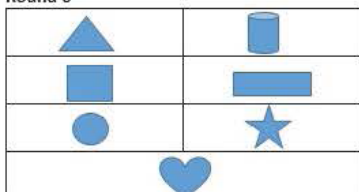you have three trails to get the highest score (each correct shape one point)

Easy game : You have more seconds between the shapes – slow changing the shapes

Midum game : You have medium seconds between the shapes – medium changing the shapes

Hard game : You have less time between the shapes - Fast changing the shapes

Name: ———————————— Age: ————————————

School: ———————————— country: ————————————

	score	Trail 1	Trail 2	Trail 3
Round 1	1			
Round 2	1			
Round 3	1			
Round 4	1			
Round 5	1			
Round 6	1			
Total score	6			

The answer sheet :

	easy	Midium	difficult
R1	7-1 Circle +Triangle	2-4 Rectangle + Heart	3-9 Cylinder + Square
R2	2-4-9 Rectangle +Heart +Square	7-1-3 Circle + Triangle + Cylinder	7-4-1 Circle + Heart + Triangle
R3	3-8-7-1 Cylinder +Star +Circle + Triangle	9-7-8-1 Square + Circle +Star+ Triangle	2-7-8-1 Rectangle + Circle +Star+ Triangle
R4	2-4-9-3-8 Rectangle + Heart + Square + Cylinder + Star	4-9-2-3-1 Heart + Square + Rectangle + Cylinder + Triangle	4-9-2-3-1 Heart + Square + Rectangle + Cylinder + Triangle
R5	1-7-2-4-9-3 All except star	7-8-2-4-9-3 All except Triangle	7-8-2-4-9-3 All except Triangle
R6	All	All	All

The game diagram:
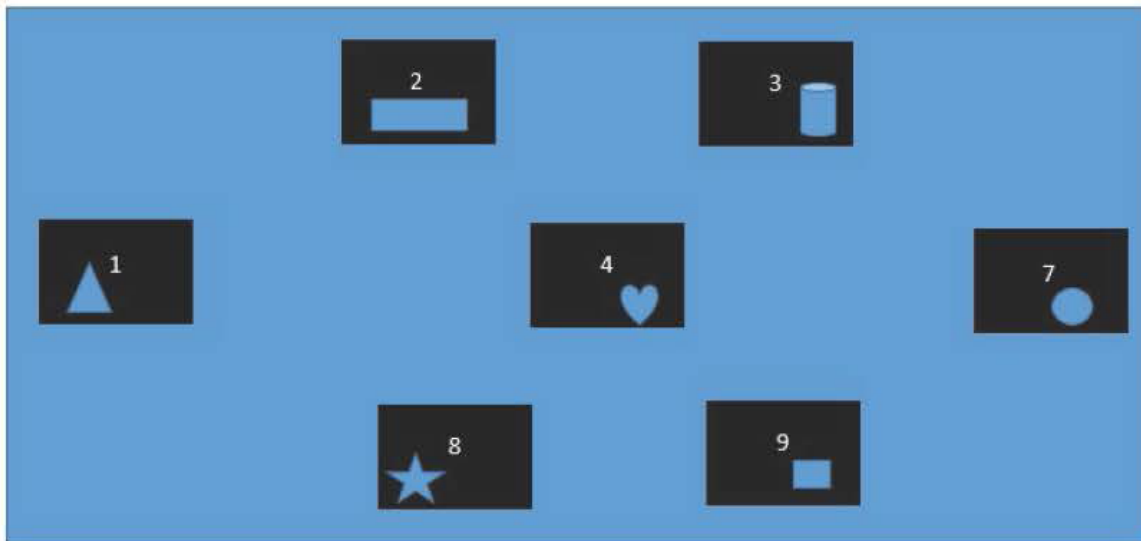
Third Place

Hannah Ferrell & Shelby Neely
Lebanon, Tennessee
Math Mania

A math game by Hannah Ferrell

My invention is a game called Math Mania. The motto for the game is, "Math Mania! A fun way to learn!" I wanted to make a math game that was not boring, was interactive, and could stand out in a crowd. It is a fun math game for students in 3rd-5th grade who want to make learning fun, and are excited about making education fun.

To play In this game players will answer math problems to get to the Math Master's castle, in order to win. Students will answer problems math fact problems in areas such as multiplication, division, addition, and subtraction. It is a game that can improve your addition, subtraction, division and multiplication skills and abilities.

I got the idea of this game from the game Candyland. The rules are very simple. First, everyone playing must roll the dice to decide who gets to go first, and whoever rolls the highest number goes first. Then, they roll the die and whoever gets the highest number, moves up the number of spaces on the they got on the dice. Example- If you roll a 5, you move 5 spaces. If they get it right, they will stay where they are, but if they get it wrong they will skip a turn. Once someone reaches the math castle they will have to

answer a more complex math problem. When someone completes the complex problem, at the end of the game, they will become the math master!

The materials we used are a pizza box ($0.50), acrylic paint ($6.00), construction paper ($2.00), sticker paper ($1.00), and game pieces($0.30). I spent a total of $10.10. Remember education can always be fun. Never let anyone take away the fun in learning and anyone around you, as this game is beneficial to everyone. It will improve math fact knowledge and understanding.

First Place

Claire W. Goodowens
Winter Park, Florida
TOOTH RUSH

The Problem:
The Dental inequity in the US is far reaching. The rate of heart disease, diabetes, HIV in poor communities is disproportionately greater and all are linked to poor dental hygiene. Poor dental care even effects employment mobility. Additionally, Alzheimer's is directly related to tooth decay and Americans alone spend $277 billion dollars a year on patients which reinforces that good dental hygiene is more important than ever.

The Solution:
People need to do a better job of brushing their teeth and at as young an age as possible to create lifelong habits. Games engender authentic particpation and emotional connection, so obviously the solution is to make it a game! TOOTH RUSH is a game that can be played at home or expanded to play with anyone anywhere at any time!

Description:
TOOTH RUSH is a FREE game that only requires a bluetooth toothbrush. The TOOTH RUSH app links every family member and converts brushing time (the brush knows) and good habits into points and access to additional online mini games. You will only be able to get credit for THREE 2-minute brushing sessions per day and they must be at least 2hrs apart. Even without pursuing the online mini-games, you can still be "the best brusher in your house".
If you choose to engage online, you can earn up to 300 gold coins and be awarded up to 5 gems for your daily hygiene. These can be used to play mini games online or an app. In the mini game universe you can play and also change your avatar's appearance including the style of the toothbrush you yield. Mini games allow you to earn silver coins and different gems but you must have the gold coins earned from brushing to play them. You can play the mini games privately, within a family group or publicly.

Sample Mini Games
BRUSH RUSH – You have to use your specialty toothbrush (upgradable with gems) to brush the dirty teeth that appear among clean teeth. The dirty and clean teeth will keep appearing faster and faster until you brush a clean tooth or you run out of time (based on silver coins you spend).

TEETHTRIS – This is identical to tetris but the shapes are toothbrush, floss, molars and toothpaste.

SMILE MILE – You are on a toothbrush floating down a stream of flowing toothpaste. You must avoid foods that are bad for your teeth that are floating in the stream while trying to collect healthy smiles that appear. You have 3 "health" lives per game but can use gems to get more health.

Benefits:
Nothing is more fun for a child than beating their parents or siblings at ...ANYTHING! But the real benefits can literally change society as we know it. Prevention is always cheaper than treatment. So what's the prevention for the medical issues that keep poor people poor? How do we stop the horrific spread of Alzheimer's and it's staggering emotional and economic costs? YOU BRUSH YOUR TEETH BETTER THAN YOUR PARENTS!!

SOURCE CITATIONS:

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Income, & Poverty: Where We Are & What Could Help | Health Affairs*, 4 Oct. 2018,
www.healthaffairs.org/do/10.1377/hpb20180817.901935/full/.

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Health.com, 24 Jan. 2019, www.health.com/alzheimers/alzheimers-gum-disease.

Second Place

Jake Anderson, James Dyal, and Laine Thorne
Lebanon, Tennessee
Hit the Egg

A game created by:

Jake Anderson, James Dyal, and Laine Thorne

Purpose:

Our game is called *Hit The Egg*. *Hit The Egg* is a fun game to play and to make. It is based on the game *Angry Birds*. The ball we used is a Nerf Rival bullet. The game was created to help younger children learn math, and have a good time playing, which means they will learn and have fun at the same time. The math questions are a combination of addition, subtraction, multiplication, and division. The objective of the game is to be the first to score 100 to 500 points by hitting eggs and getting the math question right.

How to play:

The directions are to pull slingshot back and try to hit the egg, hit the egg and grab the card with the amount of points on the egg. Then, if you miss the egg your turn is over. If you hit the egg, look at the number on the egg and answer the question on the note card. Once someone answers the question, look at the answer key. If it is right, you get the amount of points on the egg. If you knock the egg over, replace

it with another one, with the number facing away, and set the old one to the side.

Once you are done with a card, put it in a separate pile.

The rules:

1. Don't use the slingshot to throw the ball at anyone or pull the slingshot back all

the way, as injuries may occur.

2. 2-4 players can play at a time.

3. After you answer a question, see if it is right on the answer key.

4. No cheating and have fun!

Additional Information:

This game was very hard to build because we messed up so many times. When you

don't mess up it should only take a few hours, but we messed up alot.

Materials used:

We used to build it was a wooden board, Solo cups, a Styrofoam ball, plastic

Easter eggs, and a slingshot. It costed about $24 in all. If we were to sell the game,

we would sell it for $44.

Improvements for the future:

If we made another prototype, we would make the playing board longer. We would also make it where it could be taken apart and stored.
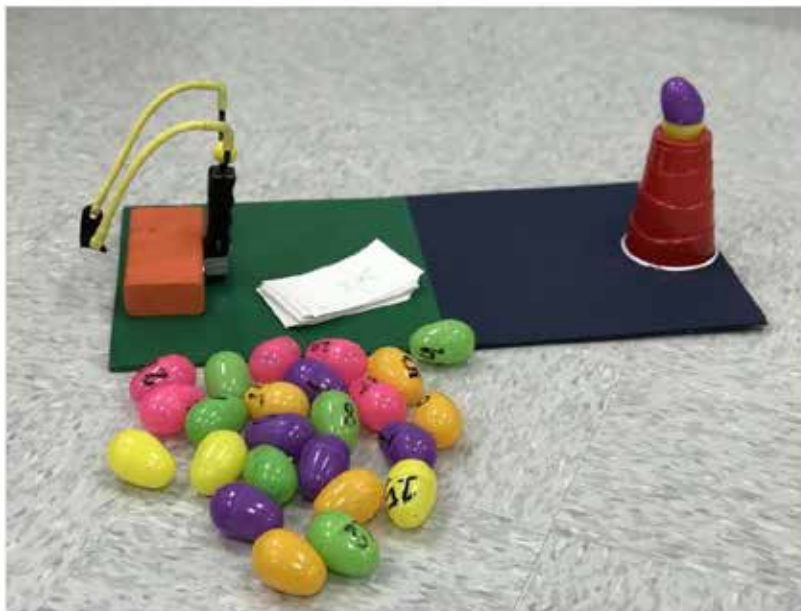
Third Place

Tameem Ahmed Isa
Manama, Bahrain
Balance Board

Balance board is a fun and active toy kids can enjoy both in and out of the house but more than that, these boards help kids development important skills. Physical skills like spatial awareness, balance and coordination are developed and practiced with the use of a balance board. Studies have even shown regular use of a balance board can increase attention span and focus in children.

Balance board exercises are being used by physiotherapists, school physical education teachers, sports coaches, and parents across the globe **to help children to develop rhythm, sequencing, coordination and spatial awareness skills**. But they are also proving beneficial in the acquisition of visual and auditory processing skills and even in cognitive development.

How it works:

Using VEX IQ robot kit and robot C programming language I invented this balance board using 10 VEX IQ motors attached 5 motors and 5 Omni wheals in each side to allow the balance plate to move in all directions, I made programming for the balance plate for the VEX IQ controller to control **our balance plate**.

The balance plate can carry until 20 kg and I am working to make it carry more.

I used the VEX IQ brain to connect all the cables in the brain ports, we have 10 cables and 12 ports in the VEX IQ brain .
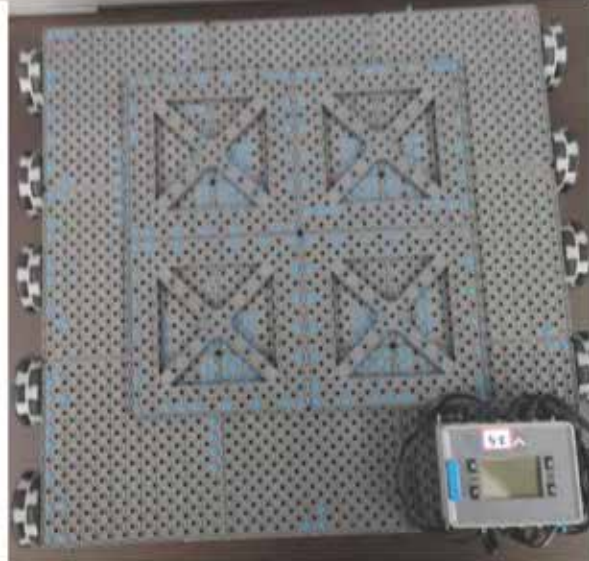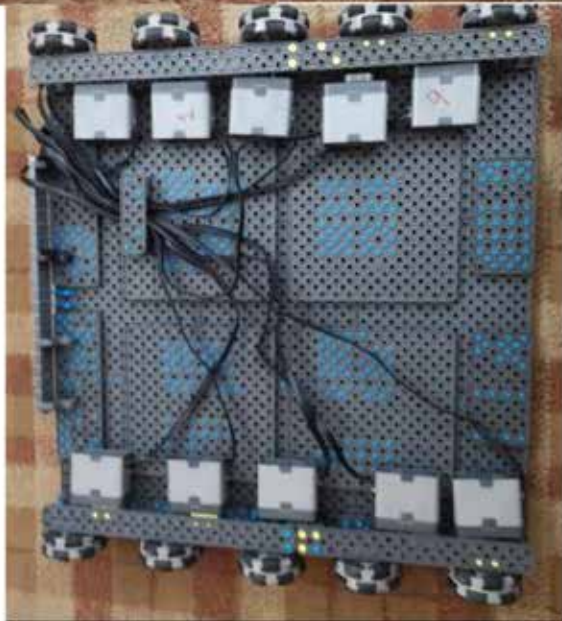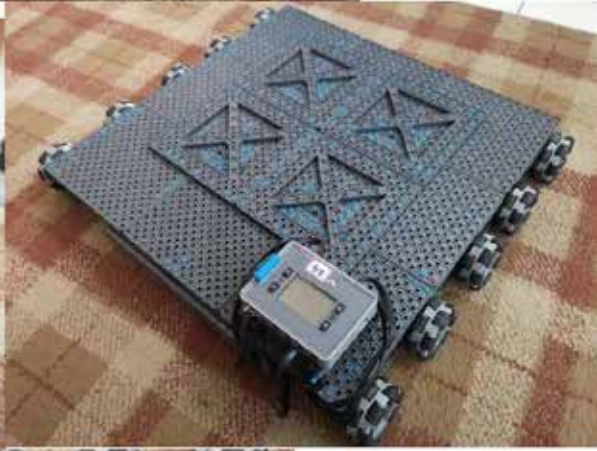
First Place

Celeste Tan and Danielle Leow
Singapore
FlexEat

FlexEat

It is a product that is convenient for everyone, fun for those who use the app and at the same time benefits the ocean! Out product is made of two parts - the takeaway container and the accompanying app, kills two birds with one stone as it solves your problem and the ocean's problem too.

You have no friends. Add some now!

Leaderboard
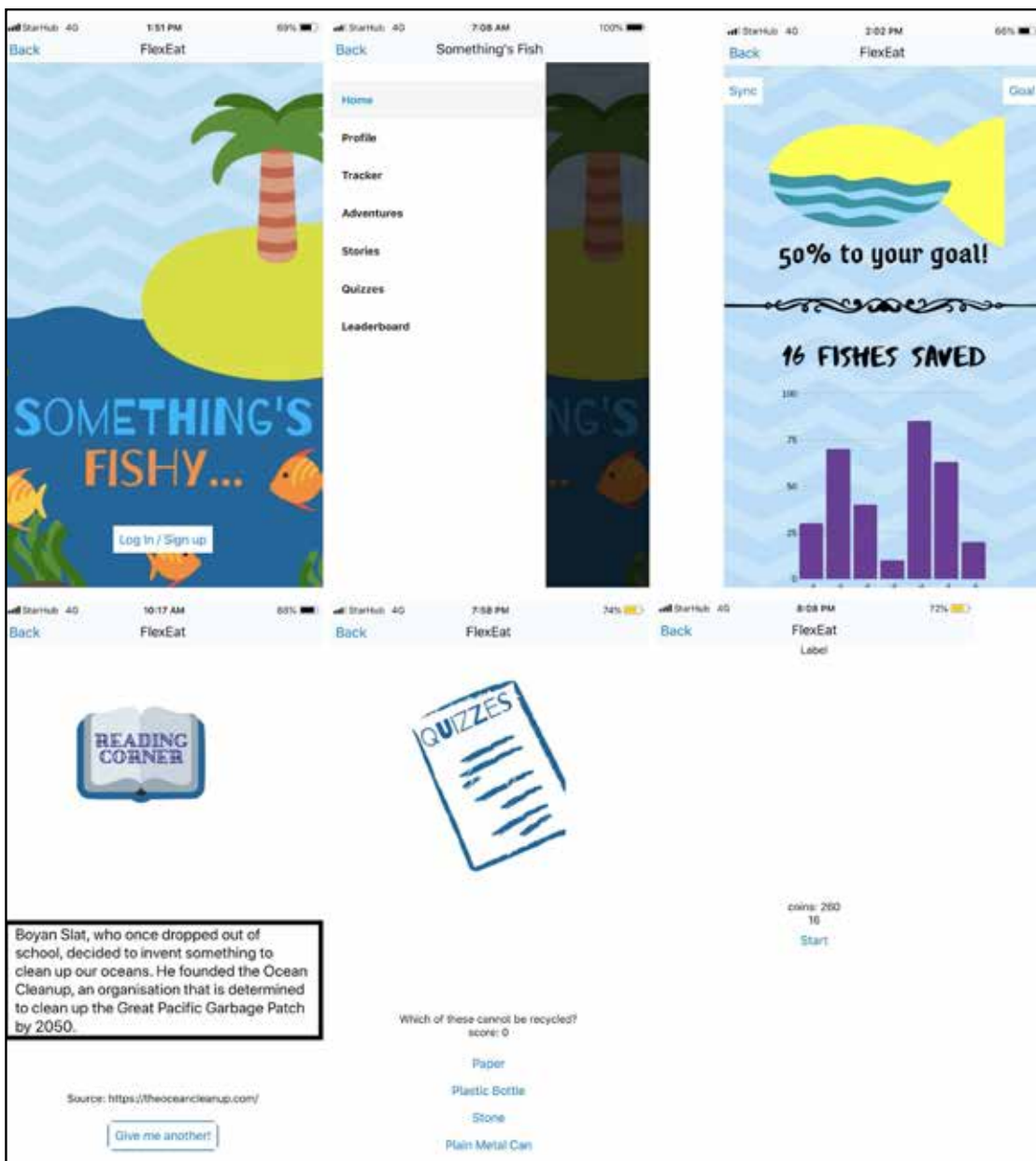
Firstly, the takeaway container can be shrunk and put in your pocket. It is FLEXible and will bend in the direction of your pocket, when you sit down, to ensure comfort. This product is so useful that you can also FLEX it on others. It can contain any kinds of food, even hot soup! The material that we use, PUL is non-toxic and BPA free, making it more user friendly. The base is sturdy enough to to eat food from, yet is also soft and flexible enough to give you a sense of comfort, and even if you accidentally sit down on it, you would not notice a thing! It is made up of silicone, which is also a safe material to eat from. Next, you can customise the size. You can roll and unroll it to customise the height (see fig. 1), depending on what you are eating or putting in to takeaway. And if you are taking your food away, you can roll up the top of it and buckle the buckle and it will form a handle that also acts as a seal. (see fig.3) You can hold it just like a handbag or like a normal takeaway container. It is so convenient you can just unzip, roll and eat! Next when you want to keep it after eating or when you want to bring it out, just zip it, push it into the base and buckle it up. The food particles, sauce, gravy or food leftovers will not leak out as it is sealed, by the airtight zip, in the bag.

Next, this is the part that encourages you and help you understand why you need to save the ocean - the app. It encourages you to use our product and use less plastics. If you did not know that plastics harm the ocean, you can learn fun facts and do quizzes! Once you have completed them, you can move on to playing games. You can earn coins while playing the games to unlock more games and to buy avatars. The app that accompanies it can track its usage too. There is a leaderboard where you can add friends using their username. You can compete with your friends who uses the takeaway container more and if you are the top 3, you get coins too! You can also input your goal and if you reach your goal, more coins can be earned. It also has an in-app timer that ensures that you do not spend too much time playing games and will warn you

when you have 5 minutes left in the app. It will kick you out once your time is up. It is addictive yet not too addictive as it will kick you out of the app and not allow you to enter the app until the next day.

PURPOSE OF INVENTION
We wish to challenge ourselves to save the ocean by making a product that appeals to humans. Our ultimate goal is to save the ocean by tackling the root cause - humans who use too many 1 time use disposables, in particular, plastic containers.

What do you want to accomplish? Why is this project important?
We want to achieve our goal and save the ocean and the animals in it. Everything links back to humans. We might not realise it but we are eating the plastics that we use and throw away. This happens because if not disposed properly, the plastics end up in oceans, eaten by wild animals, if not broken down into micro plastics and then finally getting ingested by these animals. Who eats these animals? Us! While eating the seafood, we also eat the plastic in them, and these plastics come from us. We are the ones causing animals to die, and even ourselves, as these plastics are toxic and bad for our health. We need to address this urgent issue.

What is the problem statement that captures what really needs to be addressed?
To reduce the amount of plastic waste that enters the ocean due to human inconsideration and laziness. We want to make it convenient for people to reduce usage of a one time use plastic that are thrown away, and not recycled.

Who will play with the toy or game?
Children ages 5-16, or whoever deems themselves fit to use our game app and takeaway container. However, children ages 5 to 16 will mainly use the lunchbox, as we want to create something that encourages children to reduce their plastic waste, and it can become a habit of theirs when they grow older, and if they have children, this habit may be passed down, or our product can be used to cultivate this habit.

ILLUSTRATIONS
The link for the app: https://x.thunkable.com/copy/0a74c13bcee8657ec8f809ba0cb96a60
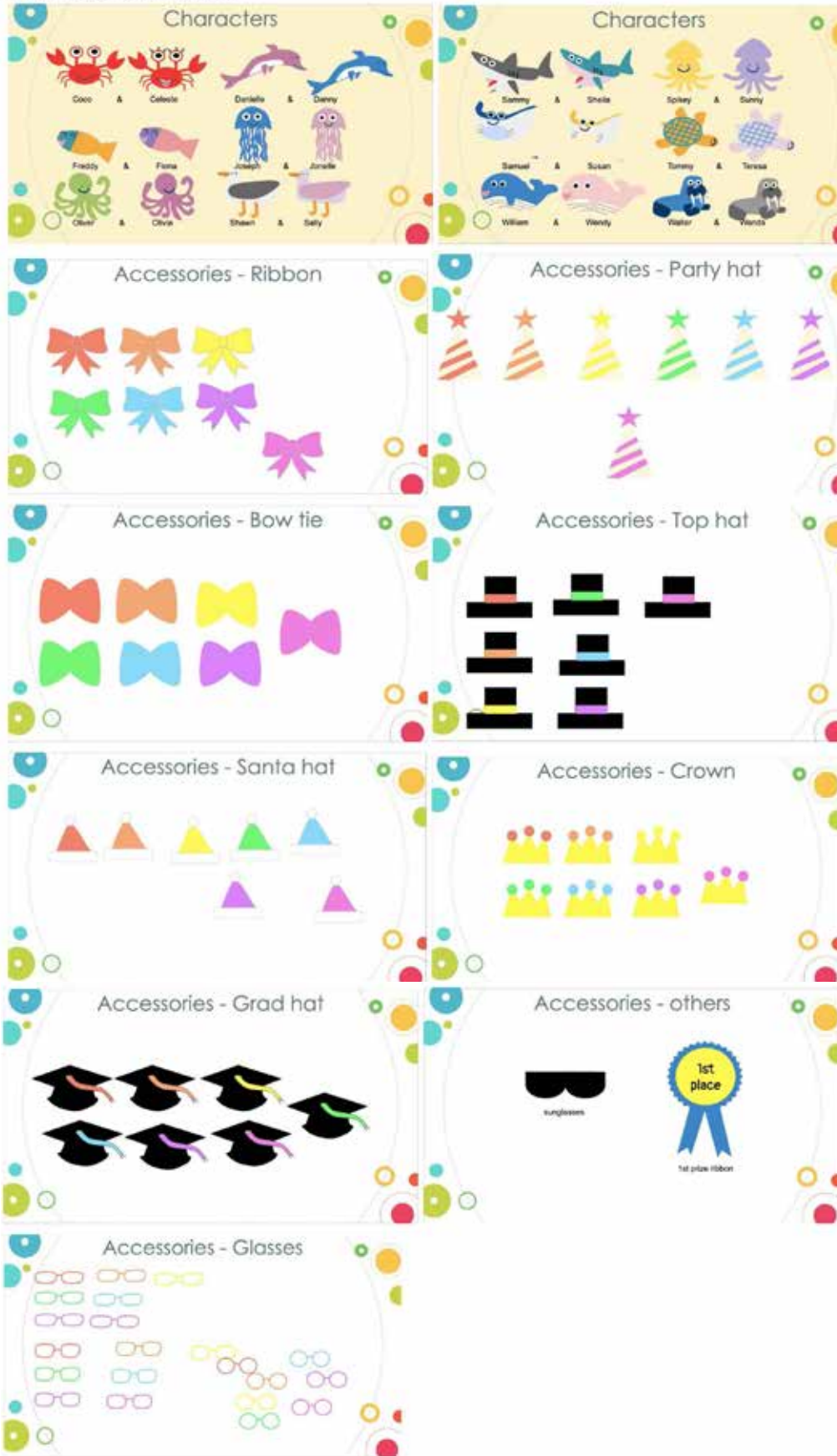

Fig. 1

Fig. 2

<u>KEY FEATURES OF INVENTION</u>

1. It has an app that is synced with it, tracking your plastic saving efforts
2. There is a leaderboard for users to compete against family and friends - this encourages them to save even more as there will be rewards the higher in the ranks you get
3. It can be folded three ways - one, roll it down. (see fig. 1) two, fold it down. (see fig. 2) three, buckle it! (see fig. 3)
   a. The first allows ease of eating, as you can customise the height of the lunchbox
   b. The second allows you to fit it in your pocket before and after you're done eating
   c. The third allows you to carry it around, sealed, with the buckle forming a natural handle
4. It is pocket-sized when there is no food inside
5. It has a hard base, unlike the other existing solutions like pockeat or vi.

Theme: Transcending Limits

Again and again, humanity has killed off so many animals.

Avatars and accessories:

Characters

Characters

Accessories - Ribbon

Accessories - Party hat

Accessories - Bow tie

Accessories - Top hat

Accessories - Santa hat

Accessories - Crown

Accessories - Grad hat

Accessories - others

Accessories - Glasses

Second Place

Regina Ng
Singapore
Water Are You Waiting For?

Water You Waiting For

Children are our future. In the blink of an eye they will be the ones leading our future. They cannot possibly be ignorant about the severity of water wastage! How could they not know about the large amounts of water being wasted every minute? This is possibly because they do not usually wash dishes at home. Their parents are often overprotective, thinking that they will hurt themselves by breaking a dish, or they may already have a helper at home, hence kids have no experience in doing the dishes. Based on our research and a survey conducted, an estimate of 90 litres of water is wasted everyday merely on washing dishes. Why is such a huge amount of water wasted? Many people are unaware of methods to save water. Hence, we created a kit to teach young children aged 4 to 12 more on how to save water while washing dishes. We believe that by doing so we can provide children with an opportunity to learn about the severity of the water wastage problem by providing them with the data and ways they can help tackle this problem. Through this kit, the children will grow up being conscious of the water they waste in their daily activities, a good practice to take with them in life. The kit will be a box in the shape of a cloud so as to appeal more to children. It is comprised of three compartments. The first compartment is to scrub off the food residue using a sponge, it has a detachable base to allow for the disposal to be easier. The second compartment is to be filled with hot soapy water for dirty cutlery and dishes to soak in before being scrubbed down. Here, natural dishwashing soap will be provided as it is more gentle on the skin and has a lower chance of causing irritation or damage as compared to commercial soap which contains many harmful chemicals. The third compartment is to be filled with clean water. The user will hold the soaped dish over the second compartment and scoop clean water from the third compartment and pour it over the dish to rinse it. The contaminated soapy water will be collected in the second compartment so as to not contaminate the clean water in the third compartment. When the soapy water gets diluted, the user can just add more dishwashing soap. Additionally, there will be a removable cork stopper at the bottom of the second and third compartment to allow for the water to be drained easily after use. It is also planned to

include a reward system like a music player or sweet dispenser to entice children to be less dependent on others to wash up after them and wash their own dishes, making it less of a chore and more of an engaging activity. By implementing this into children's lives, we would provide an educational playground for children to learn about saving water and cultivate a good habit.

Word Count: 499

ILLUSTRATIONS/PICTURES
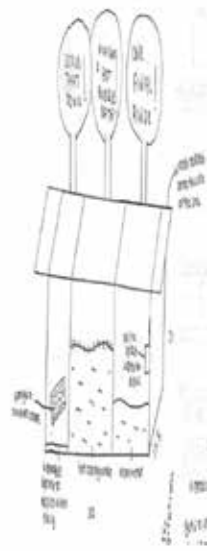
Third Place

Lilia Leyan Zhou and Grace Chenxi Yu
Singapore
Understanding Disabilities

Purpose of Project: To Change the mindset and educate students aged 10-16 on various disabilities.

(Oops!)

"What do you think about disabilities?"
This is a question that we unconsciously answer when we interact with people in their daily lives. For teenagers, the concept of "disability" is something that is rather foreign to them. With this game, we hope to change their mindset about the issue, and hopefully facilitate meaningful discussion about what it means to have a disability in Singapore in today's day and age. Not knowing how to interact with the disabled also cause unnecessary awkwardness. Which nobody wants!

1. KEY INSIGHTS ABOUT PROBLEM

When we looked at our data, the main conclusion we got was that Singaporean students understand the present stigmatisation and the discrimination the disabled have to face, yet due to the lack of education on such a matter, they do not know and do not understand many of the issues that the disabled face and is hence indifferent to what is going on in their communities. Thus, we are literally "changing" the hearts of the people around us by educating them by giving them new knowledge.

2. KEY FEATURES OF PROPOSED SOLUTION & HOW IT IS DIFFERENT

We are creating a board game that will teach students on disabilities in Singapore. Our hope is that through this game, we can deliver more facts and concepts about particular disabilities, as well as to dispel misconceptions and to evoke discussions.

We are making this game so that it fits our typical Singaporean contexts. Laws and facilities are different in different cultures and different countries, and we want to make the game as Singaporean as possible so that it may be more relatable to our audience

3. ILLUSTRATIONS

How to play
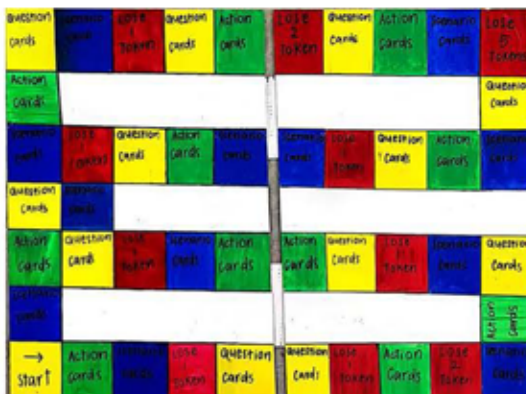
Players can play individually or form teams of 2-3 players. Player(s) will then roll a dice, take the number on the dice and move the player(s)'s character the respective number of steps. If the character lands on a square that says "Question Cards", the player(s) will then draw a question card (Fig. 1).
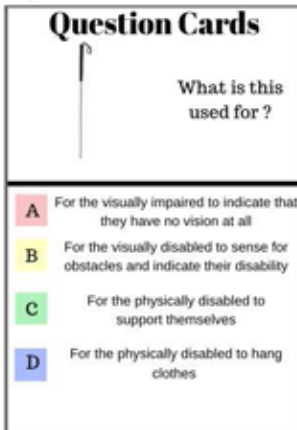
Fig. 1

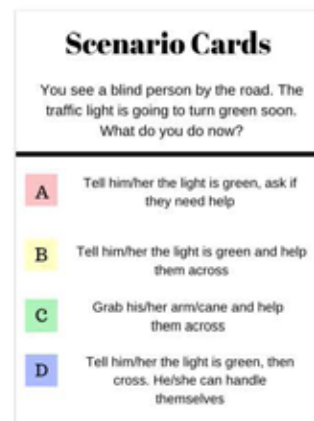**Question Cards**

What is this used for?

A	For the visually impaired to indicate that they have no vision at all
B	For the visually disabled to sense for obstacles and indicate their disability
C	For the physically disabled to support themselves
D	For the physically disabled to hang clothes

Fig. 2

A

B

C

D

The player(s) will show the card to everyone else, rendering the question open to the floor. Each player will then have to choose among the four options and indicate their choice with the option cards (Fig. 2) If the player(s) answer it correctly, they will be allowed to take a token (Fig. 3) and move one square forward and the next player rolls the dice. Likewise, if the player(s) lands on a square that says "Scenario Cards", the player(s) will draw a Scenario Card (Fig. 4) and do as stated above.

Fig. 3

1

Fig. 4

Scenario Cards

You see a blind person by the road. The traffic light is going to turn green soon. What do you do now?

A	Tell him/her the light is green, ask if they need help
B	Tell him/her the light is green and help them across
C	Grab his/her arm/cane and help them across
D	Tell him/her the light is green, then cross. He/she can handle themselves

The game ends when one of the players manage to earn 15 tokens. All the players will then sign a pledge (Fig. 6) to use the knowledge they have learnt to help the less abled in the community.

With this, students are able to learn about how to interact with the disabled. What a change of heart, right?

Science and Engineering

Ages 8-10

First Place

Jamie Adams and Bryce Johnson
Lebanon, Tennessee
The Mobile Bat Rack

Callie Rae Pendley
Dalton, Georgia
The Neon Book Light

Second Place

Hudson Guzman
Norwood, New Jersey
The Carbonator

Third Place

Lily Read
Lebanon, Tennessee
The Invisible Glove

Ages 11-12

First Place

Callum Wyer
Houston, Texas
Methylene Blue Blister Pack for Food Safety

Second Place

Rylee Buehler, Morgan Garton, and Sara Scott
Lebanon, Tennessee
The Super School Stool

Ages 13-14

First Place

Glenda Tan
Singapore
Computer Vision (object tracking) robotic car for ADHD children

Second Place

Jonelle Tan Wen Qi and Jen Ho
Singapore
Fruit Scoot

Third Place

Sanjuana Jensine Dharmaraj and Athi Ramesh Athirah
Singapore
Med Botch

Ages 15-18

First Place

E Wen Wong
Christchurch, New Zealand
BIRD: Biomimicry Identification Robot Device

Second Place

Salwa Raed Almajed,
Zain Khamis Al-noaimi,
Mariam Tariq Mohamed, and
Mariam Mahmoud Sharif
Isa Town, Bahrain
Silent Ring

Third Place

Winston Chen and Aditya Santosh Kondepudi
St. Louis, Missouri
Interconnected Balloons

Dora Ivkovich
Okemos, Michigan
Mcaps

First Place

Jamie Adams and Bryce Johnson
Lebanon, Tennessee
The Mobile Bat Rack

"Hang it, Rack it, Smack it"
An invention by Jamie Adams and Bryce Johnson

Our invention is a mobile bat rack. This would be useful for baseball and softball. We recommend this device for people ages 6 and older. We used a couple of materials to build it. The materials we used were 2 pieces of wood, screws, toilet paper holders, and hooks. The total cost of everything combined was $11.00. The wood was $6.00, the screws were $1.50, the hooks were $1.50, and the toilet paper holders were $2.00. You could customize it, by putting stickers or even paint on it. You would not have to sand the wood, as it is made of cedar. It is very lightweight, so it packs easily and is easy to carry. If we were to sell our bat rack, we would sell it for approximately $30.

You don't have to buy a bat rack that is not portable or really expensive. We would sell our mobile bat rack for $29.99. You can take it everywhere you want; you could take it to school or you could keep it at your house. You can hang your sports hats and gloves on it, and up to 3 bats on it, too. We got the idea when one of the inventors was playing baseball and there were no more spots to hang the bat, so he laid it on the ground, in the dust. When it was his turn, he picked up his bat and it almost slipped out of his hands, because the dust from the ground made it slippery.

If we were to make improvements to our bat rack, one of them would be to put clamps on it so it could collapse and fit in your bag. Our current prototype does not collapse. The Mobile Bat Rack is super simple to use, you hook it on a fence, and put your baseball bats, hats, and gloves on it. This invention is a good solution for not having a place to hang bats, whether you are playing backyard baseball with your friends or competitive baseball with a team. The mobile bat rack is amazing and would allow baseball players to take it and use it just about anywhere. Once you buy it, make sure to hang it, rack it, then smack it.
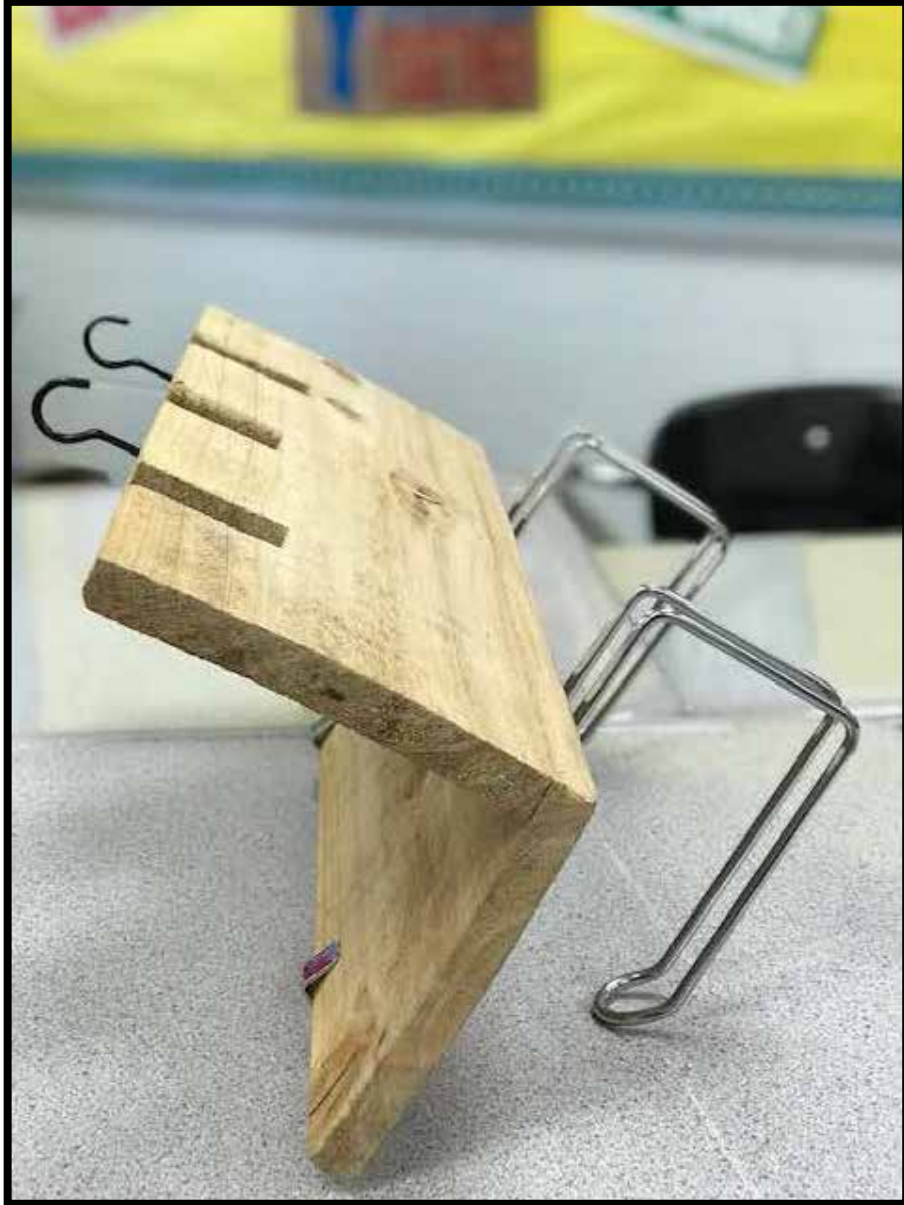
First Place

Callie Rae Pendley
Dalton, Georgia
The Neon Book Light

One night I was reading and I couldn't see the words to my book. I thought about getting a regular clip on book light, but they can fall off very easily. I looked online to see if there were any book lights that weren't so big and wouldn't fall off. There were none. So, I decided to invent one. I wondered, how might I create a non-clip on book light that would be easy for anyone to use?

I originally thought I could put the LED lights inside the front and back of a lightweight book cover and that the lights would be strong enough to show through the pages. After testing the idea, I realized that would not work. I worked through several prototypes, moving the lights around and changing the cover until I was able to find the perfect solution.

I created a lightweight book cover out of a water-resistant foam material. On the front, there is an on/off button. On the back, there is a battery pack that provides the power for LED lights. Inside the cover, you will see a strip of strong LED lights. This strip can be inserted in each page as you are reading, much like a bookmark. When you push the on/off button, the LED lights will turn on. When you are ready to turn it off, you just push the same button to turn it off.

When you are reading at night or any time when you do not have enough light to read, the LED lights will shed enough light so you can read anytime, anywhere. The Neon Book Light can be used by anyone. It comes in a variety of sizes and colors that can fit all books. The lightweight cover and LED strip make it easy to use instead of having to attach a large clip on book light. If you love to read, this invention is for you!

Strip
of LED
← lights
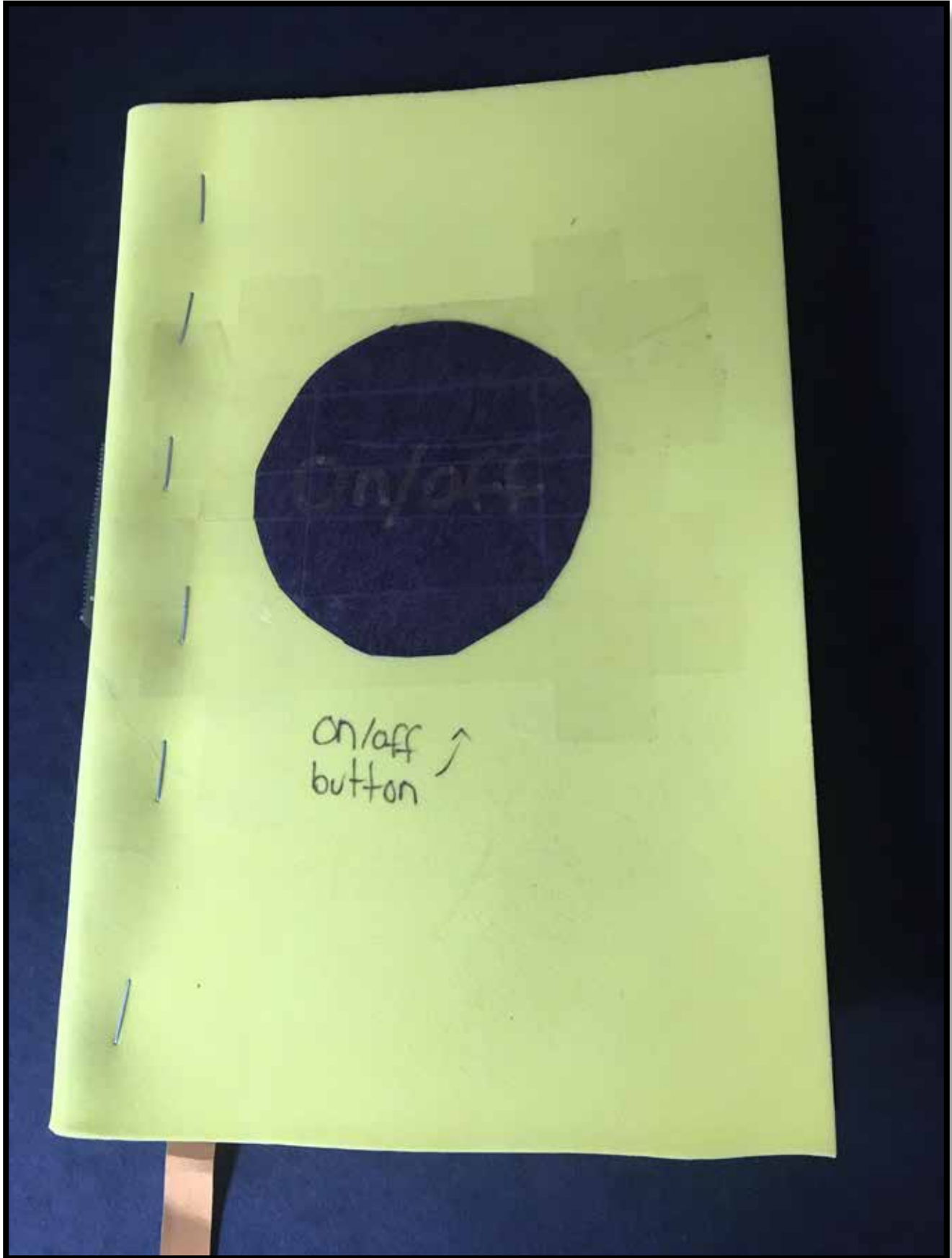
1. How might I create a for reading book light?

I need water

2. I can put a button on the front of a book and LED lights in the cover and done!
No that won't work!

LED lights | button on front

3. Maybe I can make it a book cover and still have the LED lights on the inside of the cover and a button on the front!
No. Still needs more work!

Neon book cover

4. How will the LED lights work? I know I can put a battery pack on the back!

5. How will the LED lights go through all those pages? I know! I can put the LED lights on a little strip!

Neon book cover

6. There, that's it! You can slip a book under the strip! The battery pack still runs it and the button on the front still turns it on and off!

Neon book cover

Second Place

Hudson Guzman
Norwood, New Jersey
The Carbonator

The greenhouse effect occurs when carbon dioxide in the atmosphere traps in heat from the sun, heating the earth. When there is too much carbon dioxide in the atmosphere, the globe gets too hot, making all life forms die. Global warming is disastrous. It will make the earth join those other millions of uninhabitable planets.

My invention will use global warming and carbon dioxide in the atmosphere to its advantage. My machine will take in carbon dioxide from the atmosphere by using high volume air filters. The air filters will be solar powered and will absorb carbon dioxide from the air and trap it into a room with windows and pools of water. The area shall be covered with a greenhouse type ceiling, to allow heat from sunlight to come in. Since there are high amounts of carbon dioxide in the pool area, the heat will be trapped inside the tunnel and heat the water, creating a build up of steam. The intense amount of steam will power a turbine that will power millions of homes across the globe. Another source of energy in the pool tunnels will be the heat itself, using RTGs (radioisotope thermoelectric generators) to generate electricity.

The project will be about the size of three football fields. The reason is because to get enough steam from water to power the turbines, there needs to be large amounts of water to begin with.

The high level of carbon dioxide in the earth's atmosphere is causing natural disasters and will make all life forms die. My machine will use this harmful effect to its advantage by making use of the carbon dioxide. My machine will also help remove carbon dioxide from the

atmosphere. If my machine were to be built all over the globe, humanity would have an alternate

power source than fossil fuels, and Mother Nature will continue to thrive.

KEY:

→ = carbon

= filter

= water

= RTG

= turbine
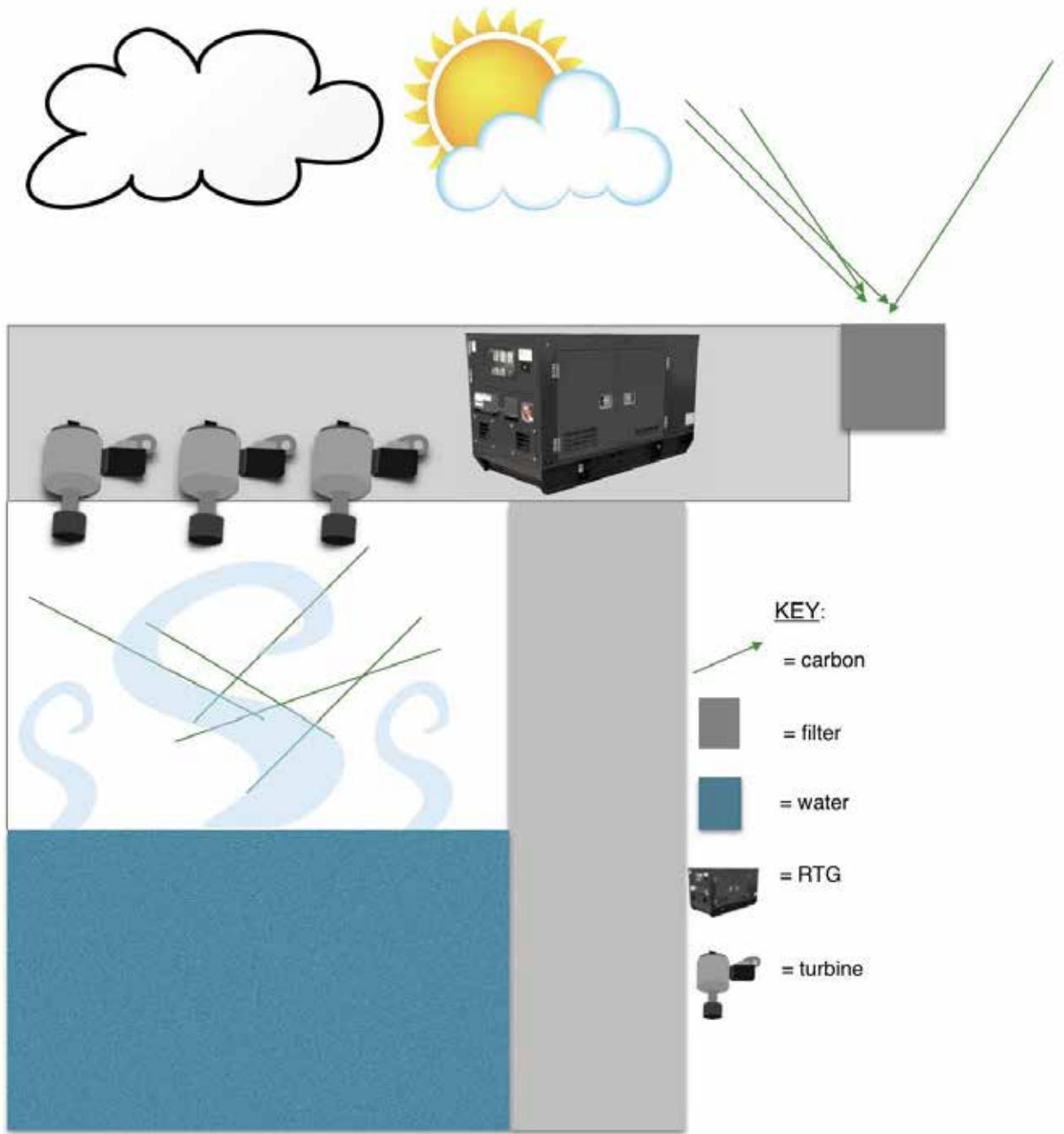
Third Place

Lily Read
Lebanon, Tennessee
The Invisible Glove

"You'll love the glove that snakes can't see!"

An Original Invention by Lily Read

My invention is the Invisible Glove. I call it the Invisible Glove because snakes can't sense the heat from your hand, when it is inside the glove. My invention is a regular leather glove, covering in mylar, and used for feeding my sister's pet snake. Mylar is a material that reflects 80% of heat signals. Snakes cannot sense the heat, inside the mylar covered glove, because the mylar reflects the heat signals. This heat reflection would keep snake owners from being bitten by their pet snake.

My younger sister has a snake named Cocoa and when she was feeding him one time, he bit her. We later figured out that Cocoa had bitten her because he had sensed the heat from her hand, and thought her hand was the rat, that she was feeding him. I used mylar for my invention, because when Cocoa was being fed, he wouldn't be able to sense her heat at all. This invention is geared to people ages 9 and up. Please make sure to supervise children, while in use.

To make the Invisible Glove I used a single leather glove ($5.33), a tube of dazzle tac glue ($7.89), and a mylar emergency blanket ($2.99). It

cost $16.21 to make. I would sell it for about $25.50. I made this so my sister can feed her snake and still stay safe. My slogan is "You'll love the glove that snakes can't see!".

My sister has used this twice since I invented it, because the snake only eats once a month. My younger sister's snake is a ball python, but you can use it for all types of snakes. If I could make any improvements to it, I would like to find a way to not have it make a crinkle sound, while in use.

First Place

Callum Wyer
Houston, Texas
Methylene Blue Blister Pack for Food Safety

The news is filled with reports of food recalls due to contamination of dangerous microbes such as *e.coli* and *listeria*. Meat, in particular, can spoil or rot due to bacteria, oxidative rancidity, and mold [1]. It's easy to see mold, but you cannot see microscopic bacteria with the naked eye. Is there a way to help consumers know if their packaged meat has been contaminated, and therefore, is not fit to eat?

Bacteria are unicellular microorganisms that need oxygen (O_2) to survive. All cells use oxygen during cellular respiration where sugars and oxygen are used to by the cell to make energy (ATP). The formula for cellular respiration is: $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + ATP$ (energy molecule). Oxidative rancidity occurs when fats in meat react with oxygen molecules. What both have in common is that oxygen (O_2) is used or consumed.

My thought experiment: Once meat has been packaged, what if there is something that would alert the consumer that the meat is possibly contaminated due to either bacterial growth or oxidative rancidity?

Methylene blue ($C_{16}H_{18}ClN_3S$) is a blue-colored chemical that is widely used for staining cells on microscope slides. However, it can also be used to indicate the presence (or absence of) of oxygen (O_2).

Methylene blue was once used to test pasteurized milk. If oxygen was removed from the milk, the blue color of the methylene blue would disappear, indicating that bacteria or other oxidizing agents had contaminated the milk [2].

What if we could design a food-safe color-changing technology for packed meat that would alert the consumer of possible bacterial contamination or oxidative rancidity? That is when I thought of creating a Methylene Blue Blister Pack for Food Safety.

My design is a simple transparent Methylene Blue Blister Pack that would be placed in the package with the meat. The transparent blister pack would be filled with a methylene blue gel suspension. In order to prevent the methylene blue from seeping out into the package or into the meat, a one-way semi-permeable polymeric membrane would be used, similar to those of one-way membranes designed for transdermal drug delivery systems [3, 4]. The membrane would allow oxygen in but keep the methylene blue gel from leaking out.

The consumer could look at the blister pack to see if the gel is dark blue or has lost its color. If the blister pack is dark blue, then it would indicate there has been no loss of oxygen through either bacterial growth or oxidation, meaning the meat is good. If the blister pack is pale blue or clear in color, it would indicate possible contamination of the meat.

Example of a Methylene Blue Blister Pack for Food Safety

← **Left** *Methylene Blue Blister Pack*

Right→
One-way semi-permeable polymeric membrane

References

1. Hummel, Calla. What Causes Meat to Spoil? Leaf.tv, 2019, https://www.leaf.tv/artciles/what-causes-meat-to-spoil. Accessed 01 May 2019.

2. "Chlorine Compound of the Month: Methylene Blue, Part 2: The Chemist's Indicator." The American Chemistry Council. Dec. 2006. https://chlorine.americanchemistry.com/Science-Center/Chlorine-Compound-of-the-Month-Library/Methylene-Blue-Part-2-The-Chemists-Indicator/. Accessed 01 May 2019.

3. Soon Hong Yuk, Seung Jin Lee, Teruo Okano, Bret Berner, and Sung Wan Kim. *One-way membrane for transdermal drug delivery systems. I. Membrane preparation and characterization.* International Journal of Pharmaceutics, Vol. 77, Issues 2–3, 15 November 1991. Pages 221-229.

4. Soon Hong Yuk, Seung Jin Lee, Teruo Okano, Bret Berner, and Sung Wan Kim. *One-way membrane for transdermal drug delivery systems. II. System optimization.* International Journal of Pharmaceutics, Vol. 77, Issues 2–3, 15 November 1991. Pages 231-237.

Second Place

Rylee Buehler, Morgan Garton, and Sara Scott
Lebanon, Tennessee
The Super School Stool

"All is well with the Super School Stool!"

How we got the idea:

The name of our invention is the Super School Stool. We got the idea of the Super School Stool because one of the inventors is not tall enough for her legs to reach the floor. When she sits in her desk, she sits on her legs in class. With her feet dangling in the air, after class, they are always asleep or cramping very badly. She needed something to rest her feet on. This is when we thought of a stool.

However, we needed a way to keep it under and attached to the desk. We realized that it would be easier to use if it was portable because of transitioning classes. That is when we thought of *The Super School Stool*!

Materials used:

The materials we used to make *The Super School Stool* were an collapsible bathroom stepping stool, which cost $15.98 and bungee cords which cost $2.49 each. This added up to approximately $21.00. If we were to sell our invention, we would sell it for approximately $35.00.

How it works:

The way the Super School Stool makes life easier is that it supports peoples' legs, when their legs are not long enough to reach the floor, while sitting in a seat. When your legs are short, they dangle above the floor. This makes you experience pain in your feet, and sometimes in your thighs, because your thighs are holding up all of the weight of your legs. Therefore, your feet just go to sleep because they are not being supported by the floor.

To set up the Super School Stool, hook the bungee cords to the front of your desk, whether that be the legs of your desk or a ledge under the desk. This product can be used on tables, chairs, or desks.

Once you connect the cords to the desk, and put your feet on the stool, you can feel the pain disappear into thin air!

First Place

Glenda Tan
Singapore
Computer Vision (object tracking) robotic car for ADHD children

12 June 2019

Dear Diary

Poor Cousin Tom! His teacher had scolded him for daydreaming. Feeling misunderstood, he stood up and walked around his classroom aimlessly, disrupting the lesson.

At home, Tom was tapping his fingers non-stop on the table. Aunt Mary gave him fidget spinners to calm him down. But, he was not interested.

The Cons of a Fidget Spinner

Stops spinning after a while

Distracting

Choking hazard for young children
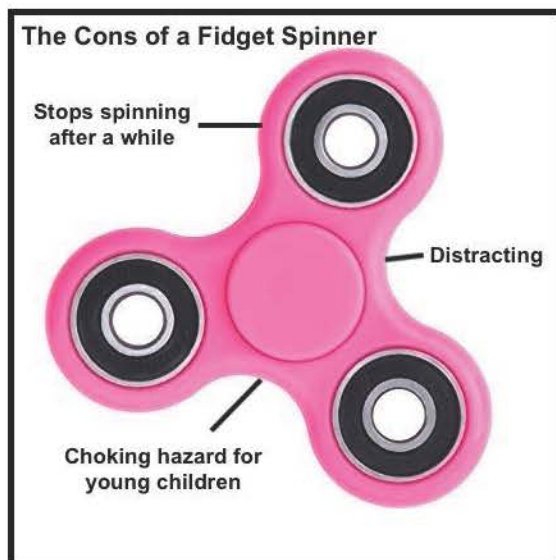
Source:
https://www.google.com/search?q=fidget+spinner&rlz=1C5CHFA_enSG741SG741&source=lnms&tbm=isch&sa=X&ved=0ah
UKEwjL3cL-p4fjAhUY14SKHe0LAYkQ_AUIECgB&biw=1440&bih=788#imgrc=EGRmc1aNJhoHgM:

Next, he flung his Chewelry onto the floor, shouting "I'm not a baby!"

The Cons of Chewelry

Does not help ADHD children who fidget with their hands

A bit embarrassing

Need to wash
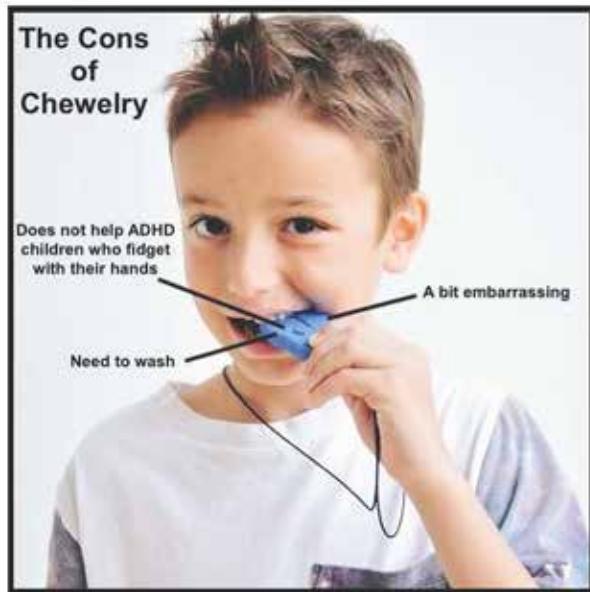
Source:
https://www.google.com/search?q=chewelry&rlz=1C5CHFA_enSG741SG741&source=lnms&tbm=isch&sa=X&ved=0ahUKEwi5_eKbqIfjAhXLso8KHTZRAVEQ_AUIECgB&biw=1440&bih=788#imgrc=K_ZePEkTHLMhaM:

Even his favourite toy car suffered the same fate. "Useless car! Can never respond to me!"

The Cons of Toy Cars

Not autonomous

You get bored easily

Stop after you push them for a while

Unable to interact with you

Source:
https://www.google.com/search?q=toy+car&rlz=1C5CHFA_enSG741SG741&source=lnms&tbm=isch&sa=X&ved=0ahUKEwj9jcivqIfjAhXKpY8KHQXrBQAQ_AUIECgB&biw=1440&bih=788#imgrc=9DbRIDu7apB1PM:

My heart broke! Why can't others accept that he has attention-deficit hyperactive disorder (ADHD), which makes it difficult for him to stay focused and control his emotions?

According to the Academy of Medicine Singapore:

Although the prevalence of ADHD In Singapore has been estimated to be less than 5%, ADHD is the fourth-highest contributor to disease burden (as measured in disability-adjusted life years) in children aged 14 and below. This chronic condition often continues into adulthood. While treatment (involving medications and behavioural interventions) won't cure ADHD, it can help to deal with symptoms.

Source: https://ams.edu.sg/view-pdf.aspx?file=media%5C2014_fi_176.pdf&ofile=ADHD+CPG_Booklet.pdf

I worry for Tom... when he grows up, he may struggle with a combination of persistent problems (eg. difficulty sustaining attention, hyperactivity and impulsive behaviour).

What an uphill challenge for Tom to find his path! I wish I could help him...

13 June 2019

Dear Diary

I've got an idea! Since Tom's hyperfocus (an area he is very interested in) is on cars, why not create a computer vision (object tracking) robotic car that he can control and interact with?
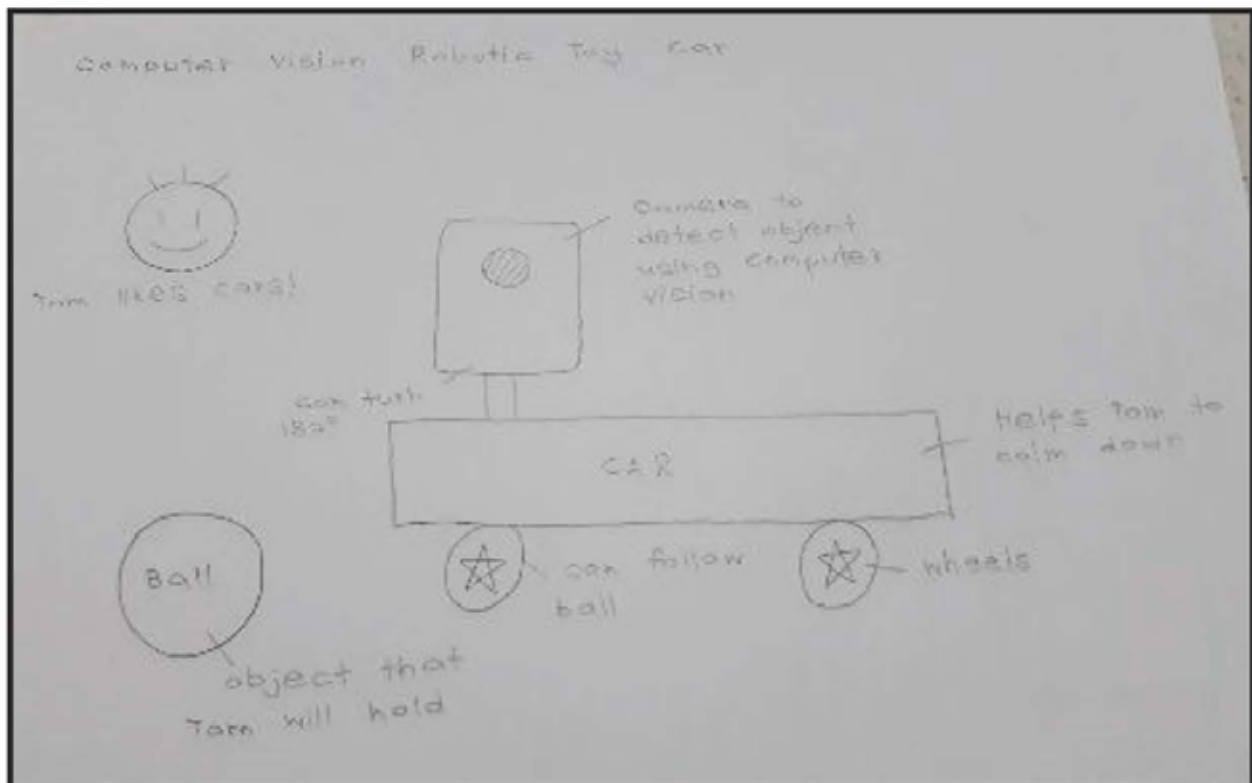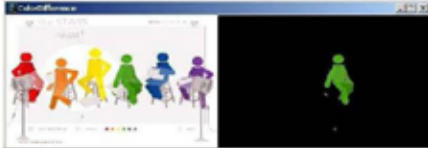
Time for more research...

How color detection works in computer vision:

Source: https://www.slideshare.net/jorgecardoso/computer-vision-for-computer-music

How the "find_blobs()" function detects binary large objects (blobs):

```
image.find_blobs(thresholds[, invert=False[, roi[, x_stride=2[, y_stride=1[, area_threshold=10[, pixels_threshold=10[, merge=False[, margin=0[, threshold_cb=None[, merge_cb=None[, x_hist_bins_max=0[, y_hist_bins_max=0]]]]]]]]]]]]])
```

Finds all blobs (connected pixel regions that pass a threshold test) in the image and returns a list of `image.blob` objects which describe each blob. Please see the `image.blob` object more more information.

`thresholds` must be a list of tuples `[(lo, hi), (lo, hi), ..., (lo, hi)]` defining the ranges of color you want to track. You may pass up to 32 threshold tuples in one call. For grayscale images each tuple needs to contain two values - a min grayscale value and a max grayscale value. Only pixel regions that fall between these thresholds will be considered. For RGB565 images each tuple needs to have six values (l_lo, l_hi, a_lo, a_hi, b_lo, b_hi) - which are minimums and maximums for the LAB L, A, and B channels respectively. For easy usage this function will automatically fix swapped min and max values. Additionally, if a tuple is larger than six values the rest are ignored. Conversely, if the tuple is too short the rest of the thresholds are assumed to be at maximum range.

Source: https://docs.openmv.io/library/omv.image.html?highlight=blob#image.image.find_blobs

16 June 2019

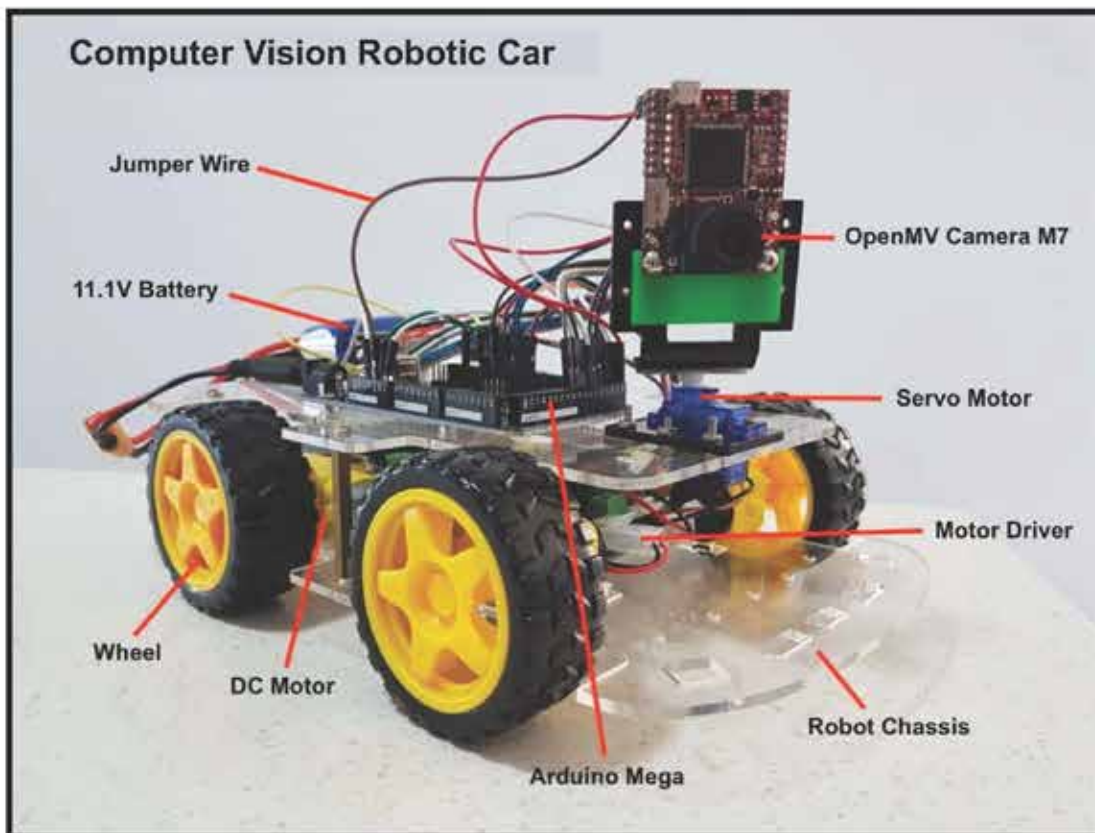Dear Diary

I've identified the components for the robotic car.

No.	Component	Image
1	Robotic car chassis (2 acrylic plates), 4 DC motors, 4 wheels. 6 spacers and M3 screws	
2	Arduino Mega Microcontroller	
3	50 Ampere Dual-channel H-bridge Motor Driver

Amplifies signal to drive DC motors | |
| 4 | OpenMV Camera M7

Detects blobs with computer vision algorithm | |

5	Servo Motor Allows camera to turn 180° for a wider field of view	
6	Turnigy 800 mAh 11.1V Battery	
7	Jumper wires	
8	Breadboard	

Circuit diagram that I've drawn:
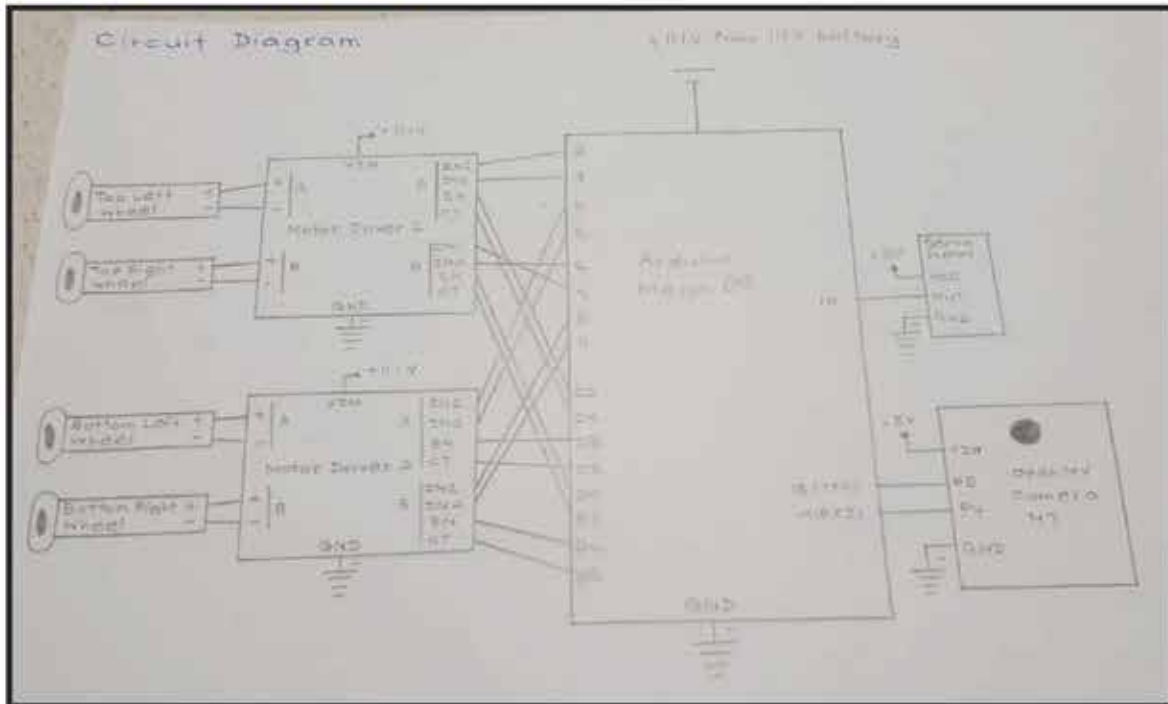
Then I assembled and wired the parts. The hardware is done!

Computer Vision Robotic Car

- Jumper Wire
- OpenMV Camera M7
- 11.1V Battery
- Servo Motor
- Wheel
- Motor Driver
- DC Motor
- Arduino Mega
- Robot Chassis

17 June 2019

Dear Diary

As Tom's favourite colour is red, I programmed the openMV camera to track red objects (eg. red ball).

Code that I wrote using MicroPython for the OpenMV camera:

```python
# IMPORTS
import sensor, image, time, pyb, ustruct
from pyb import UART

# SERIAL INITIALISATION
uart = UART(3, 9600, timeout_char=1000)
uart.init(9600, bits=8, parity=None, stop=1, timeout_char=1000)

# THRESHOLDS - My robot tracks a red ball
thresholds = [(30, 100, 40, 80, 15, 127),   # red
              (30, 100, -64, -8, -32, 32),   # green
              (0, 30, 0, 64, -128, 0)]        # blue

# CAMERA SETUP
sensor.reset()
sensor.set_pixformat(sensor.RGB565)
sensor.set_framesize(sensor.QVGA)
sensor.skip_frames(time = 2000)
sensor.set_auto_gain(False)
sensor.set_auto_whitebal(False)
clock = time.clock()

# LOOP
while(True):
    clock.tick()
    img = sensor.snapshot() # gets image taken by the camera

    # finds binary large objects (blobs) that are red in colour
    blobs = img.find_blobs([thresholds[0]], pixels_threshold=200, area_threshold=200, merge=True)

    for blob in blobs:
        img.draw_rectangle(blob.rect()) # draws rectangle around every blob
        img.draw_cross(blob.cx(), blob.cy()) # draws cross around every blob

    if blobs != [ ]:  # if there is a blob found
        sorted_blobs = sorted(blobs, key=lambda blobb: blobb.area()) # sort blobs by size
        biggest_blob = sorted_blobs[len(sorted_blobs) - 1] # find the biggest blob (red ball)

        # concatenates the x-coordinate, y-coordinate and area of the ball
        text = "x" + str(biggest_blob.cx())
                + ",y" + str(biggest_blob.cy())
                + ",a" + str(biggest_blob.area()) + "\n"

        print(text) # prints string to serial terminal
        uart.write(text) # sends data to Arduino using Serial

    else: # no blobs are found - no ball
        text = "x999,y999,a-1\n" # camera sends a random string to Arduinos
        print(text)
        uart.write(text)
```

Initially, the camera detected the wrong shade of red (my hand instead of the ball).
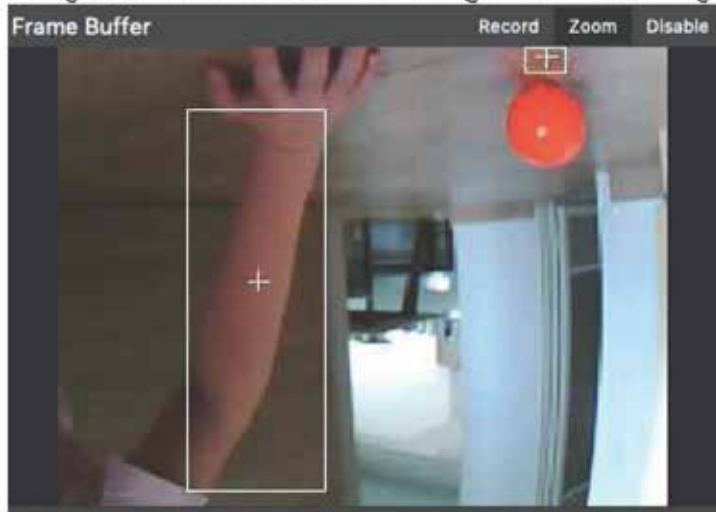
I persevered and continued troubleshooting. Finally, I fixed the issue by modifying the threshold values.
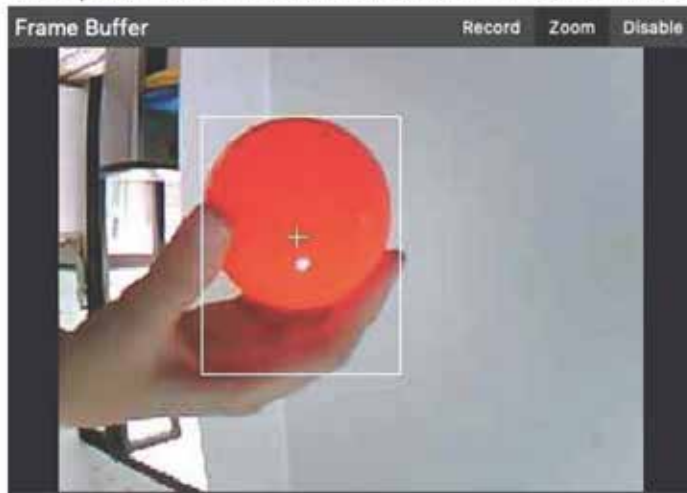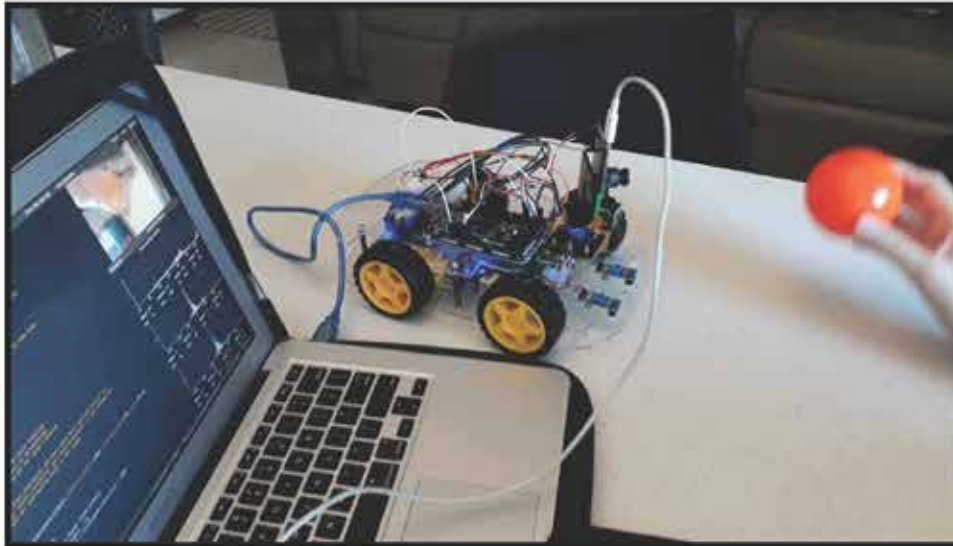
Before:

```
# THRESHOLDS - My robot tracks a red ball
thresholds = [(30, 100, 10, 50, 15, 127),   # red
              (30, 100, -64, -8, -32, 32),   # green
              (0, 30, 0, 64, -128, 0)]       # blue
```

After:

```
# THRESHOLDS - My robot tracks a red ball
thresholds = [(30, 100, 40, 80, 15, 127),   # red
              (30, 100, -64, -8, -32, 32),   # green
              (0, 30, 0, 64, -128, 0)]       # blue
```

The OpenMV Camera could now detect the red ball instead of my hand!

Click this link to watch video: https://tinyurl.com/testing-camera

Output when the ball is detected:


```
Serial Terminal
x115,y106,a9990

x114,y105,a9701

x115,y106,a9768

x115,y104,a9701

x116,y104,a9701

x121,y101,a9345
```

Displays x-coordinate, y-coordinate and area of ball when a ball is detected


```
Serial Terminal
x999,y999,a999

x999,y999,a999

x999,y999,a999

x999,y999,a999

x999,y999,a999

x999,y999,a999
```

Displays 999 (impossible value when no ball is found)

19 June 2019

Dear Diary,

I programmed the Arduino Mega to control the motors according to the coordinates and number of pixels of the red ball sent from the camera. This allows the robotic car to detect and go after it!

Code that I wrote for the Arduino:

```
// LIBRARIES
#include <Servo.h>
#include <SoftwareSerial.h>

Servo servo; // servo motor

// GLOBAL VARIABLES
int pos = 90;           // position of the servo motor
int difference = 0;     // error of the ball's x-coordinate from frame's centre
String data = "";       // string sent from OpenMV camera
int accumulator = 0;    // PID controller accumulator

void move (byte RPWM, byte LPWM, byte DIS, byte EN, int motorspeed) {
  digitalWrite(EN, HIGH);
  digitalWrite(DIS, LOW);

  if (motorspeed > 255) {
    motorspeed = 255; // ensures that the maximum speed is 255
  }

  else if (motorspeed < -255) {
    motorspeed = -255;  // ensures that the maximum speed is 255
  }

  if (motorspeed >= 0) {
    analogWrite(RPWM, motorspeed);  // motor moves in the positive direction
    analogWrite(LPWM, 0);
  }

  else {
    analogWrite(RPWM, 0);
    analogWrite(LPWM, abs(motorspeed)); // motor moves in the negative direction
  }
}

void setup() {
  Serial.begin(19200);   // Arduino's serial
  Serial1.begin(9600);   // OpenMV's serial
  servo.attach(10);      // servo motor uses pin 10
  servo.write(pos);      // servo faces the centre first

  // top left wheel
  pinMode(2, OUTPUT);    // IN1
  pinMode(3, OUTPUT);    // IN2
  pinMode(22, OUTPUT);   // EN
  pinMode(24, OUTPUT);   // CT

  // bottom left wheel
  pinMode(4, OUTPUT);    // IN1
  pinMode(5, OUTPUT);    // IN2
  pinMode(26, OUTPUT);   // EN
  pinMode(28, OUTPUT);   // CT

  // top right wheel
  pinMode(7, OUTPUT);    // IN1
  pinMode(6, OUTPUT);    // IN2
  pinMode(30, OUTPUT);   // EN
  pinMode(32, OUTPUT);   // CT

  // bottom right wheel
  pinMode(9, OUTPUT);    // IN1
  pinMode(8, OUTPUT);    // IN2
  pinMode(34, OUTPUT);   // EN
  pinMode(36, OUTPUT);   // CT
}

void loop() { // void loop is empty
}
```

```
void serialEvent1() {
  char temp = Serial1.read(); // character read in

  if (temp == 'x') {  // a new set of data
    data = "";        // clear old string
  }

  data += temp; // concatenate character to string

  if (temp == '\n') { // done with one set
    Serial.print(data);

    String x = "";  // x-coordinate of ball
    int index = 1;  // reads from second element as first element is 'x'

    while (data[index] != ',') {
      x += data[index]; // reads x-coordinate
      index ++;
    }

    index += 2; // skip the comma and 'y'

    String y = "";  // y-coordinate of ball
    while (data[index] != ',') {
      y += data[index]; // reads y-coordinate
      index ++;
    }

    index += 2; // skip the comma and 'a'

    String a = "";  // area of the ball
    while (data[index] != '\n') {
      a += data[index]; // reads area
      index ++;
    }

  int x_coordinate = x.toInt(); // convert x-coordinate to int
  int y_coordinate = y.toInt(); // convert y-coordinate to int
  int area = a.toInt();         // convert area to int

  // PART 1: Camera turns to face the ball with PID Controller
  if (x_coordinate == 999 && y_coordinate == 999) { // ball cannot be found
    move(3, 2, 24, 22, 0);  // stop
    move(4, 5, 28, 26, 0);
    move(6, 7, 32, 30, 0);
    move(9, 8, 36, 34, 0);
  }

  else {  // the ball is found
    difference = abs(x_coordinate - 160); // calculates error from centre of the frame (160 pixels)
    difference *= 0.06;                   // PID variable

    if (x_coordinate < 160) { // ball is on the right (left but camera is upside down)
      pos -= difference;      // turn right
      if (pos < 0) {
        pos = 0;              // minimum position is 0
      }
      servo.write(pos);       // camera turns to face the ball
    }

    else if (x_coordinate > 160) {  // ball is on the left (right but camera is upside down)
      pos += difference;      // turn left
      if (pos > 180) {
        pos = 180;            // maximum position is 180
      }
      servo.write(pos);       // camera turns to face the ball
    }
```

```
// PART 2: Motors turn to face the ball with PID Controller

int error = 90 - pos;                          // gets error for motors to turn
int p_correction = abs(error);                 // gets p correction
p_correction *= 2.5;                           // multiplies p correction by 2.5
accumulator += error;                          // adds error to accumulator
accumulator = constrain(accumulator, -100, 100);  // ensures that accumulator is within the range of -100 to 100

int i_correction = accumulator * 0.15;         // gets i correction
int correction = i_correction + p_correction;  // gets total correction

if (error < 0) {  // if ball is on the left,  turn left
  move(3, 2, 24, 22, correction);
  move(4, 5, 28, 26, -correction);
  move(6, 7, 32, 30, -correction);
  move(9, 8, 36, 34, correction);
}

else {  // if ball is on the right, turn right
  move(3, 2, 24, 22, -correction);
  move(4, 5, 28, 26, correction);
  move(6, 7, 32, 30, correction);
  move(9, 8, 36, 34, -correction);
}


    // PART 3: Moving forward and backward to follow the ball

    if (area < 4000) {  // if the ball is too far, move forward
      move(3, 2, 24, 22, 100);
      move(4, 5, 28, 26, 100);
      move(6, 7, 32, 30, 100);
      move(9, 8, 36, 34, 100);
    }

    else if (area > 30000) {  // if the ball is too near, move backward
      move(3, 2, 24, 22, -100);
      move(4, 5, 28, 26, -100);
      move(6, 7, 32, 30, -100);
      move(9, 8, 36, 34, -100);
    }
  }
 }
}
```

My robotic car is finally completed!

20 June 2019

Dear Diary

It's D-Day!!! Tom's eyes shone when he saw the robotic car.

when he held the ball in front of the camera and moved it to the left, the car sensed the ball, followed and turned left!
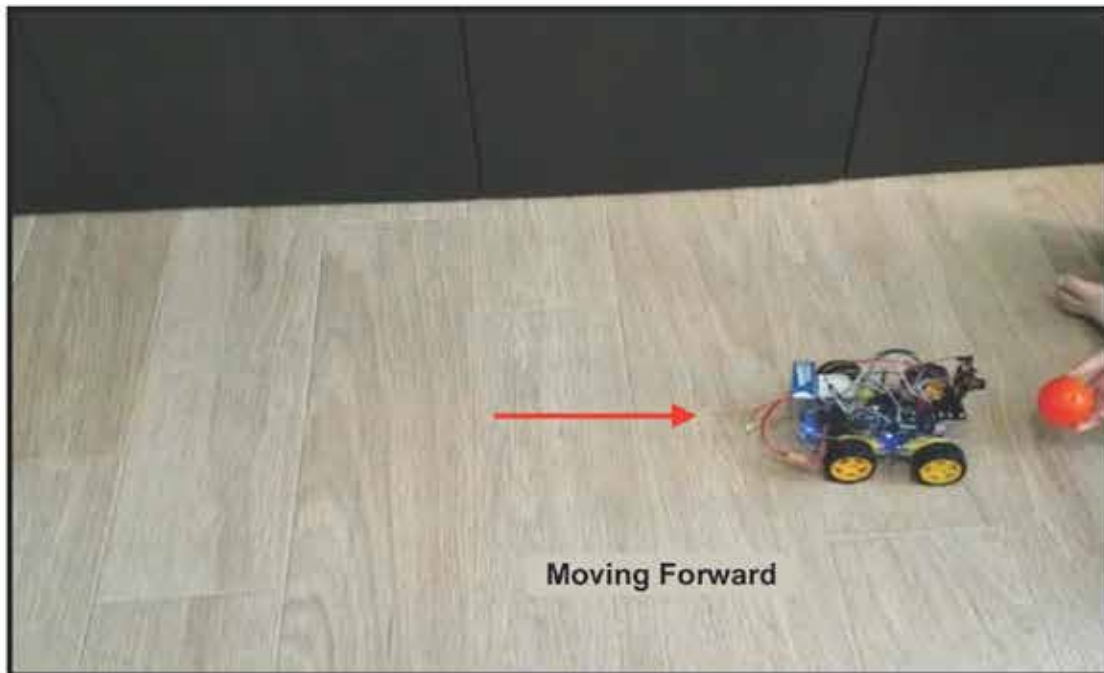

Ball is on the left

when he moved the ball to the right, the car turned right too.

Ball is on the right

Click this link to watch video: https://tinyurl.com/leftnright

When Tom placed the ball in front of the camera, the car moved forward!

Moving Forward

When he held the ball nearer to the robot car, it moved backwards.

Moving Backward

Click this link to watch video: https://tinyurl.com/forward-backward
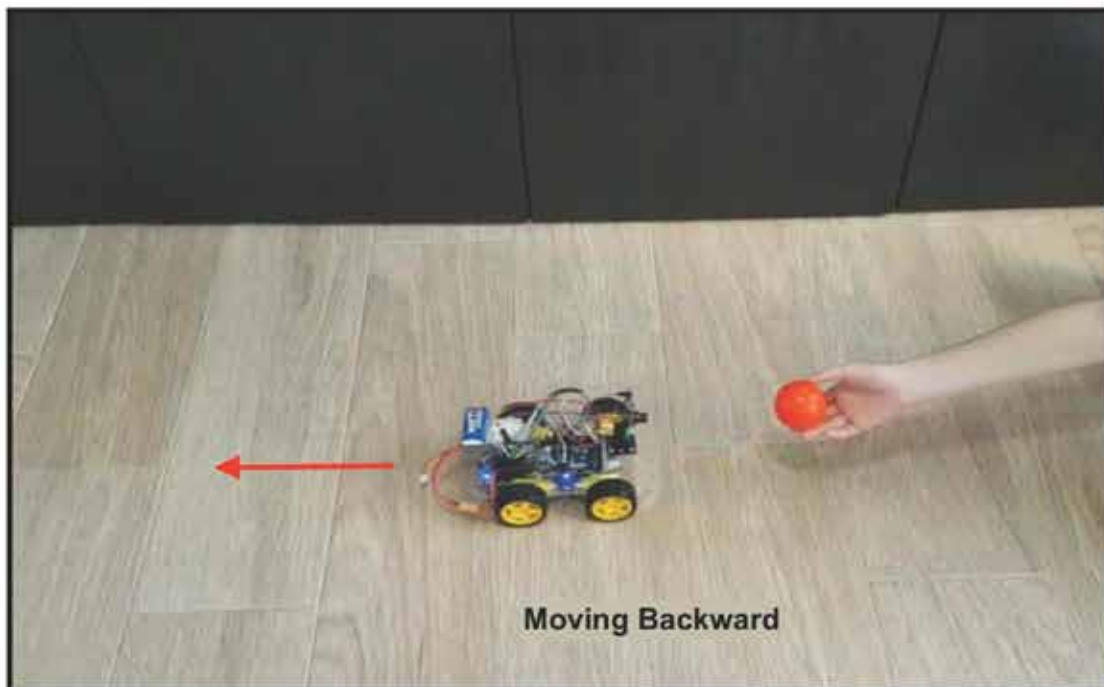
Tom was very captivated by the robotic car and spent a long time "interacting" with it. Unlike other devices, this car could track and respond to his movements!

Going after the ball!

Robot stops when

No ball is detected

Click this link to watch video: https://tinyurl.com/chasing-ball
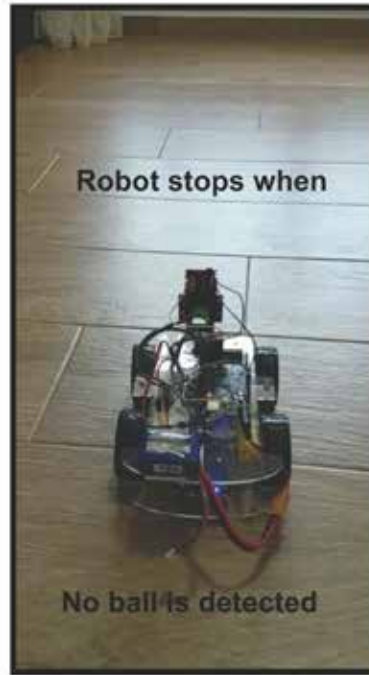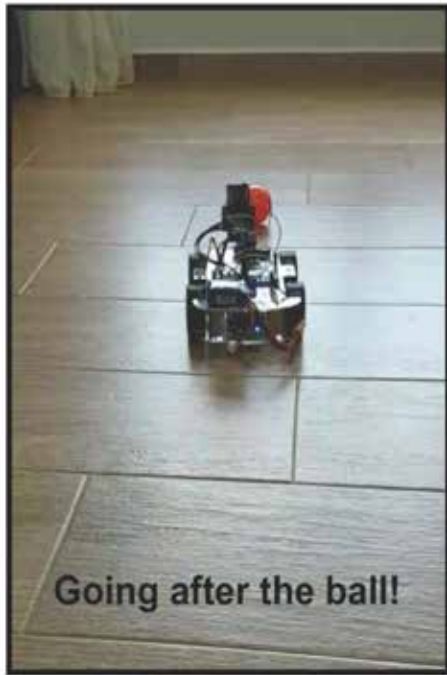
Interacting with the robotic car with object tracking capabilities not only helped to sustain Tom's attention, he also gained a greater sense of control when directing and controlling its movements.

Mission accomplished!

23 Jun 19

Dear Diary,

Guess what? Tom asked me how to programme the robotic car so that it could track other colours and perform other "tricks"!

I'm glad that the robotic car I created has sparked off a new interest in him.

Tom has found his path, his hyperfocus!

Second Place

Jonelle Tan Wen Qi and Jen Ho
Singapore
Fruit Scoot

Have you ever seen a rise in your water bills? Ever wondered why? Well, here's the reason. Convenience. People are too caught up in getting the work done to even notice this. How often does your water disappear down the drain just because you want to achieve efficiency? In fact, according to a study conducted by Public Utility Board, Singapore, 16% of water usage comes from the taps. 16% may not seem much, but it is the third most common usage area in households.

Something must be done. That was when we chanced upon this sight: A housewife washing her fruits under running water. We all know how precious water is to us, but sometimes, even we take it for granted. We should never underestimate how much saving water can do. With a goal in mind, we set off to combat this.

Of course, a survey was necessary to understand the severity of this situation. After careful research with a portion of our school population (in which you may access here), we have found out that many, 73.3% actually, do wash their fruits under running tap

water. This is evidence that water usage is high. We went on to question how the respondents would choose to use the water if they could reuse it and this is what we found:

If you could use your water used to wash vegetable and fruits again to save water, how would you use it?
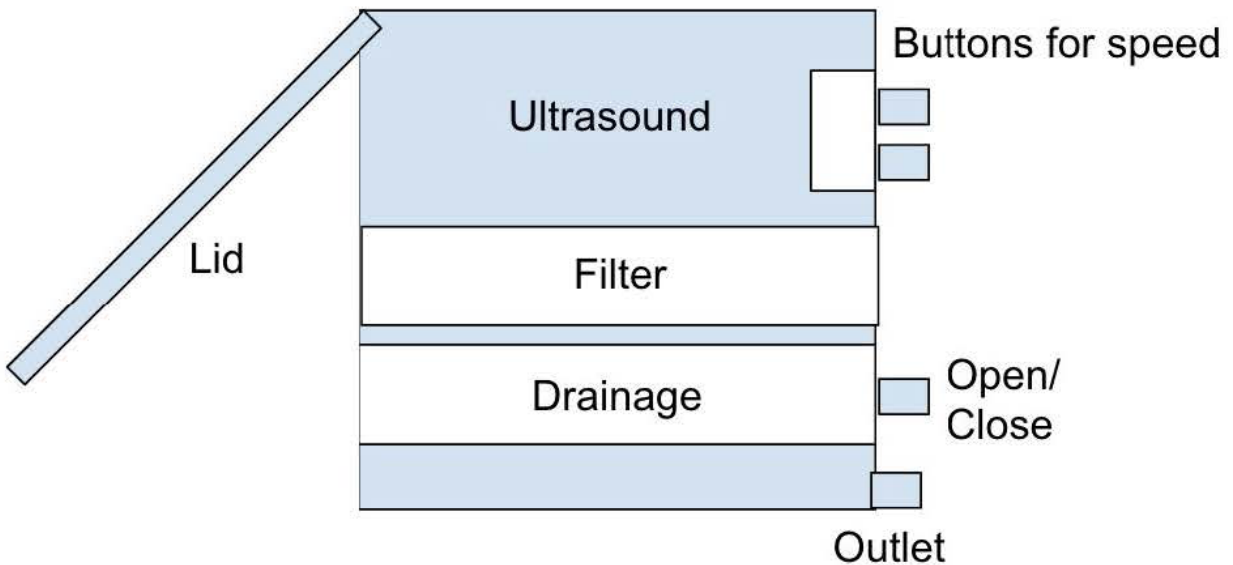
247 responses
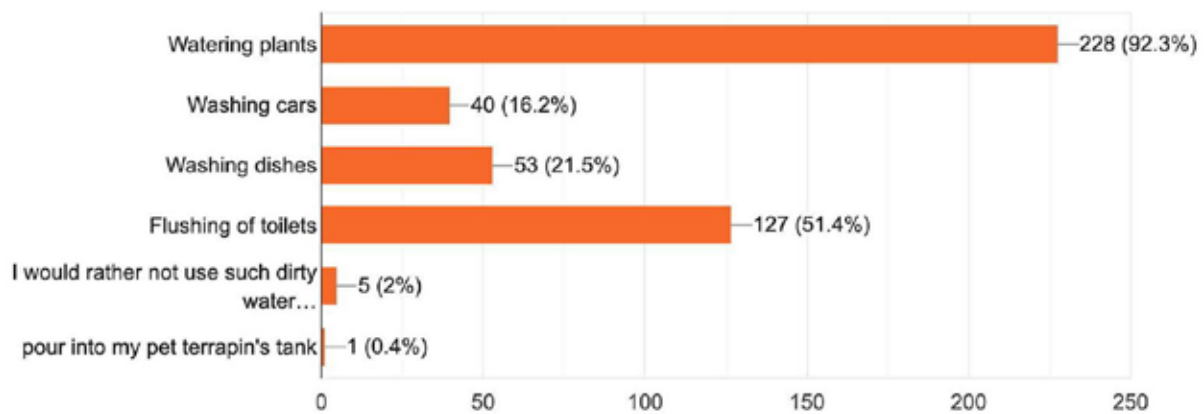
Watering plants? It turns out to be a very attractive option, hence we have set off to create our first prototype as shown below:
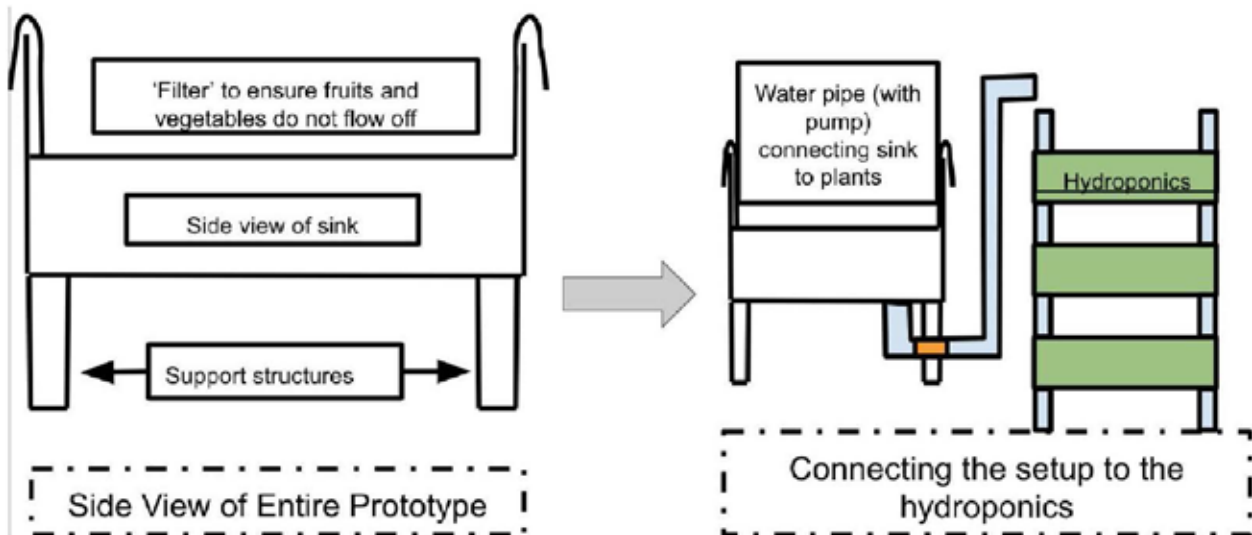
Our general intention was to allow for water to be reused for watering plants. Eventually, we decided to cater to as many needs of our consumers as possible to create this:

This prototype is more flexible as it allows for water to be reused for other purposes as the consumers wish to. (To find out more about how it works, you may access it here)

What makes it different from previous inventions then? Our invention is an improvement and kills two birds in one stone. It is automatic, for lazy users, and saves water, which is a solution to the diminishing resources on our planet.

Saving the world, one drop of water at a time!

Should the links not work:
- ❖ https://docs.google.com/spreadsheets/d/1Rd6mGV0vUlC34UPPx_zWPH3W-lrruwoUtoKZ6p1Wikw/edit#gid=529614024
- ❖ https://docs.google.com/presentation/d/1cdxCyvVcULlQoNqwGpPuRNhtegJ_zBCwcWH9TU-S2WM/edit#slide=id.g57af7c498d_1_336

🍉🍊🍋🍌🍍🍎🍏🍐🍑🍓🍉🍊🍋🍌🍍🍎🍏🍐🍑🍓🍉🍊🍋🍌🍍🍎🍏🍐🍑🍓🍉

Third Place

Sanjuana Jensine Dharmaraj and Athi Ramesh Athirah
Singapore
Med Botch

"Wait, did I take my medicine today?"

Sounds familiar? Well, this scenario is a daily recurrence in many households, specifically amongst the more aged members of the family. We have identified this as our problem to solve as we noticed many senior citizens do tend to forget when to take their medicine, or whether they have taken their medicines or not. This is a serious problem as it sometimes leads to people taking too much or too little of their medication, thus causing ineffective treatment of their illnesses. To combat this problem, we have come up with a solution after much toil and effort, and after many failed ideas.

Picture this. You see an elderly at a restaurant wearing an extremely cool watch and then suddenly there's a ringing noise, though you don't know where it is from. You see the eldery's watch flickering and it says "Time to take your pills!". It also shows this awesome pill design, which the elderly perks up at and takes out a box with pills inside. The elderly gulps them down with a glass of water. Watching this makes you wonder, why did that watch suddenly ring?

Our goal is to help elderly take the correct medicines at the right time with the right dosage. In order to achieve better healthy living, we wish for elderly to be more independent and to be able to take care of themselves without needing a helper. Statistics we have collected prove that many elderly are dependant on others to remember when to take their medicine and this is worrying as without them undesirable negative side effects to the elderly's health can be caused.

What do you want to accomplish? Why is this project important?

We want to help support the elderly and also achieve our goal which is to help them remember when and which medicines to take. In the end, we really want our product to help seniors and embrace them so that they do not feel too dependent on their caregiver or family members. Moreover, it also gives courage for eldlery to step out of their comfort zones as our product enables them to take their pills anytime and anywhere and they don't have to worry about forgetting to take the right medication or not taking it at the correct time. This project is important as from what we heard from an elderly we interviewed, he shared how he wants seniors to be more included in society and to not be left out. He shared how elderly actually can and want to do things independently and the elderly we interviewed was also definitely someone with confidence. Thus, this product will achieve the goal make the elderly feel more independent and empowered having confidence in themselves, enabling them to transcend what they once thought were their limits, of staying at home, and be more self-dependant.

Who will use the product?
Anybody, usually senior citizens, who needs help remembering when and which medications to take.

ILLUSTRATIONS

Fig 1. Final Pill box and Watch

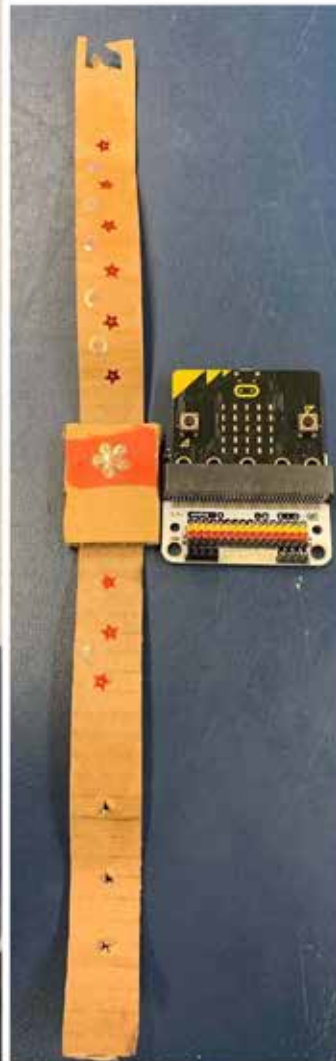**Fig 2.** Watch's actual size before attaching micro:bit

Fig 3. How the prototype would look like when prototype the chip is smaller and hidden from sight.

Fig 4. An earlier version of the Pill box
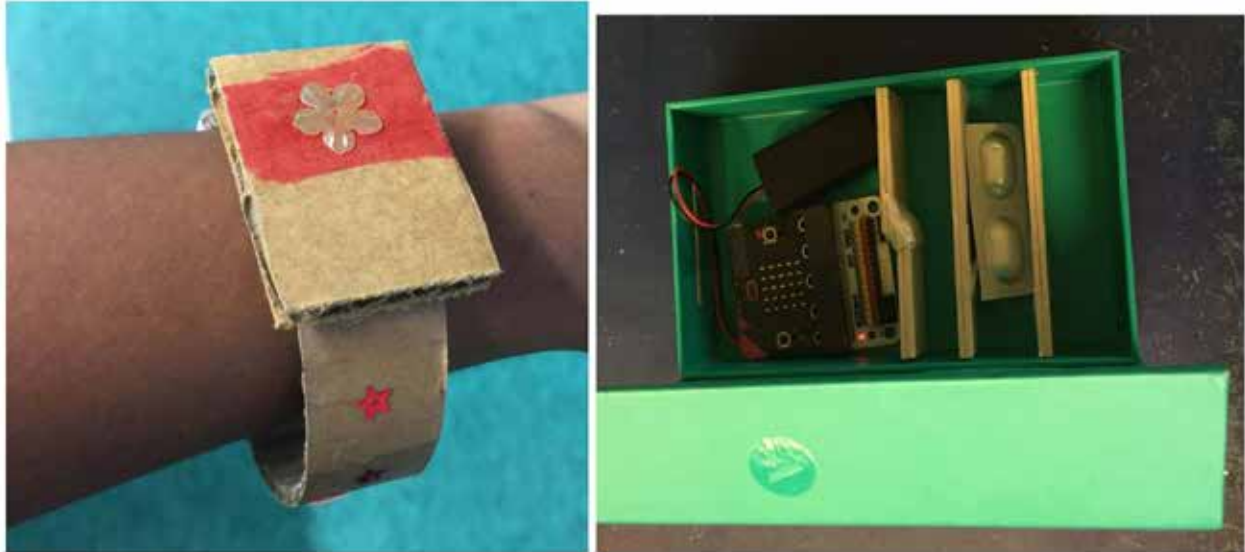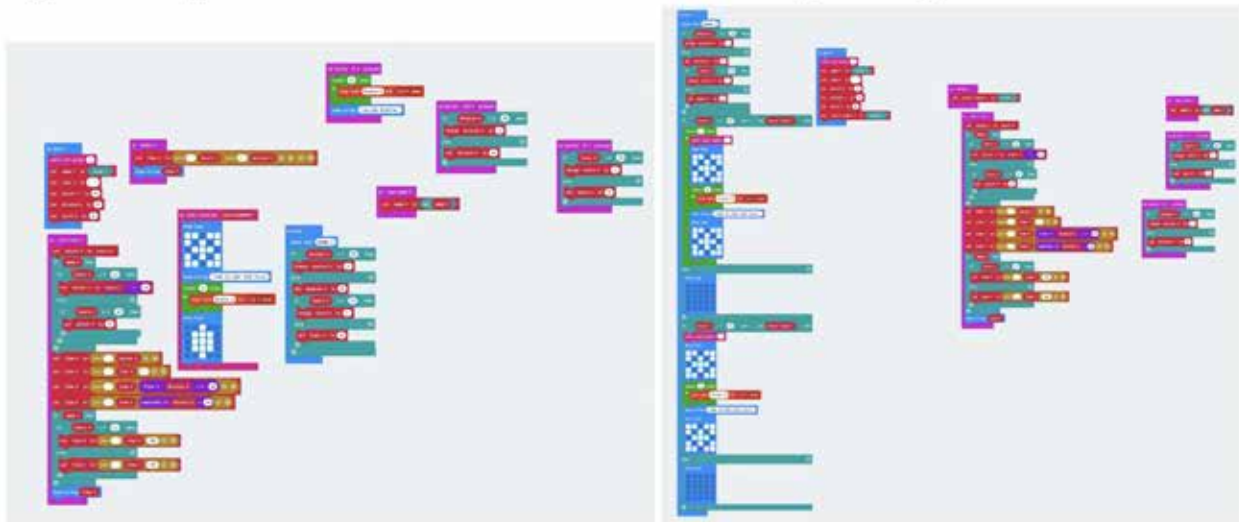
→ Made out of a reused box.

Fig 5. and **Fig 6.** Final Codes of Pill Box and Watch respectively

KEY FEATURES OF INVENTION

We created an electronic pill box that you can keep at home and keep one month of supplies in and we also made a portable pillbox that the elderly can bring outside their homes. These two pill boxes of similar functions ,that include buzzing and lighting up, when the elderly needs to take their medication and there motion sensors on the underside of the compartments so if the compartment door was opened it would send a signal that the eldlery had already taken their medication, and prevent the alarm from being triggered. If they didn't take the medication, the watch would remind them to take the medications as a signal would be transmitted from the pill box. It helps the elderly to remember when to take their medication and since there are different compartments for different times of the day we can ensure that the

elderly do not double dose and take the wrong medication. The watch also has an emergency button so that whenever a senior needs immediate assistance a call would be directed to a hospital, relative or caregiver. The watch also has a free fall function where if the watch free falls a call would be immediately sent to the hospital, family members or caregiver so that if the elderly falls or is in danger they can be saved promptly.

There are many existing solutions out there that include electronic pill boxes and apps. However, the electronic pill boxes can only be used at home and if the elderly does not hear the alarm or see the lights it might ineffective. Elderly are not very tech savvy and we found out in our survey that many senior citizens don't even have a smartphone. Thus, our product has more functions and is more effective in different places, in benefitting the targeted audience.

First Place

E Wen Wong
Christchurch, New Zealand
BIRD: Biomimicry Identification Robot Device

BIRD

Biomimicry Identification Robot Device
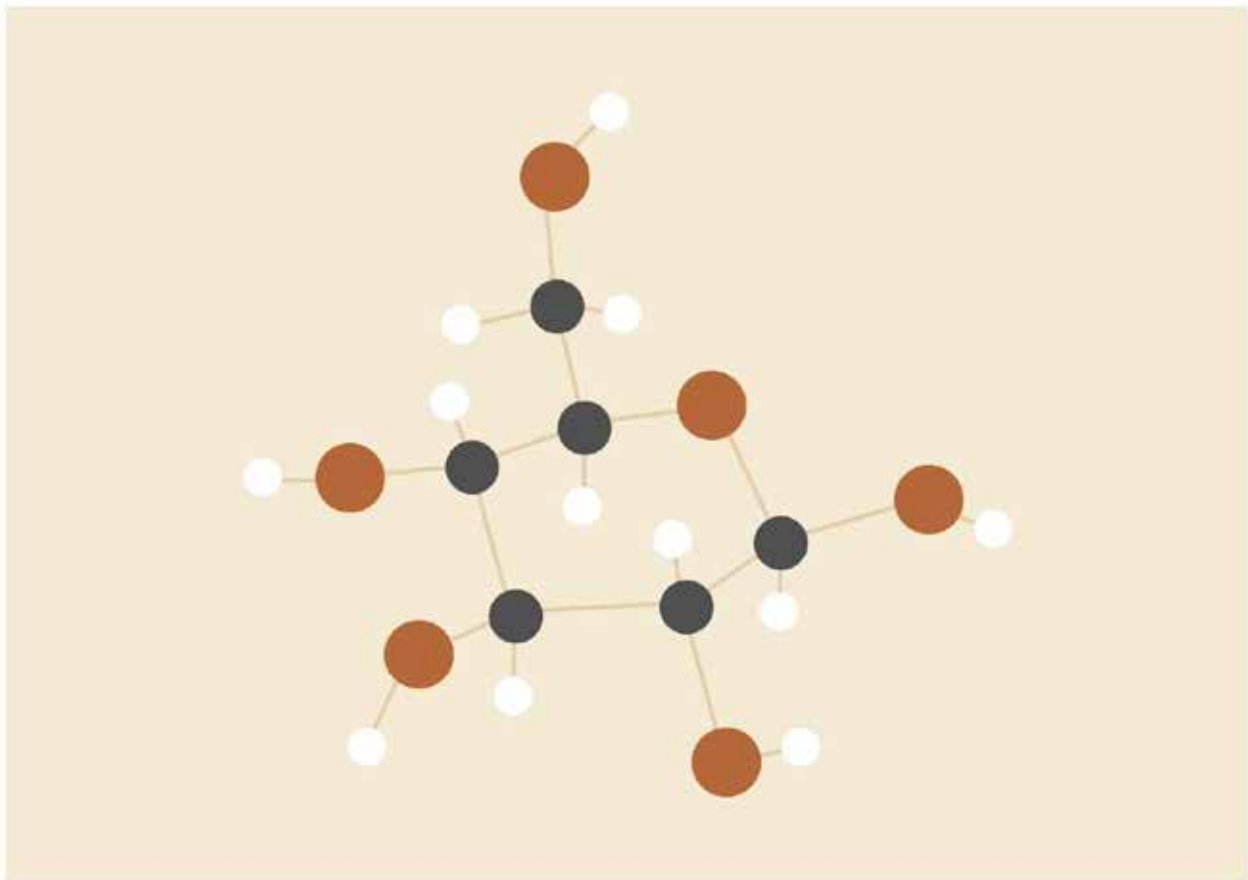
E WEN WONG

Context: In 2016, I founded an organisation called P.S. Our Beaches, dedicated to raising awareness about plastic pollution. As an environmental advocate, I wanted to use technology to impact the plastic pollution issue in a tangible way.

Issue: Due to the rising and increasingly worrying plastic pollution issue, there is a local, national and global need to deter the population from plastic litter cultures, while working to dispose of existing accumulation of plastic.

Pieces of plastics, especially on beaches, are sparsely scattered and often quickly swept quickly from their source. This also makes it difficult to track and retrieve plastic now, and hence anyone wanting to pick up rubbish is hampered by the absence of effective, specific, high-throughput methods to accurately detect and dispose of plastic. Existing plastic pollution research with nets/manta trawlers has been very slow, dangerous and time-consuming because all this plastic has been sorted by hand under a dissection microscope. Dr Joseph Christie-Oleza research findings also found that only 1% of all plastics which has made its way into the oceans in the ocean is able to be accounted for using present conventional detection methods

Conceptual Statement: I will design and make a UAV capable of detecting and locating macro-plastics such as plastic bags using machine learning software and onboard GPS to provide georeferenced locations for any plastic pieces identified by the UAV. The georeferenced locations will then be linked to a crowdsourced beach clean-up app to guide rubbish collectors to each item of rubbish, so that it can then be disposed of.

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[4]https://www.cypnow.co.uk/cyp/news/1067099/environment-young-people-drop-most-litter-in-uk

Specifications:

- My outcome should be easily accessible to users. It should therefore be easy to download for iOS and/or Android devices and be able to used offline and in remote areas like beaches.

- The app must serve benefits for the environment. Societal considerations must be analysed to avoid inadvertent environmental harm. I want it to change wider perception and attitudes towards plastic pollution through interactive

involvement with the plastic and marine environment. I must therefore undertake regular testing and consultations with stakeholders.

- My outcome must not be hazardous to marine life or humans. It must meet health and safety regulations, and therefore not interfere with everyday beach activity or birds flight. People should not feel threatened by the drone presence and it should therefore blend into the natural environment, as this is what my stakeholders have indicated. It must also be of appropriate materials to withstand weather conditions.

- My outcome must be fully functional by accurately detecting plastic, linking georeferenced locations to the app and allowing users to interact with its findings.

OTHER MATERIALS/DIAGRAMS:
EXISTING TECHNOLOGIES/IDEAS

SUMMARY

When I look at these existing projects (below) a similarity was that they all share a focus on location or detection. This is fairly explicit for all projects except Litterati and the Robot Fish. Litterati while not detecting plastic, uses human interaction to map locations of rubbish. Similarly, the robot fish does not detect plastic, but instead water pollution levels.

Whilst analysing these projects, the aspects which I would look to use in my own project are machine-learning software (MATLAB), a crowd-sourced app (human interaction) and a focus on rivers/beaches. On the contrary, aspects I would not incorporate are targeted recycling technologies such as laser diodes as these beams are too narrow and would therefore require a boom which is both an ineffective use of resources and insecure method of identification.

FURTHER ANALYSIS:

One solution in the making is the 'Ocean Clean-Up'. However, this idea doesn't detect plastics in areas outside the great pacific garbage patch. Where is the issue centralised?

- We don't really know where most of the plastic is in the ocean. In 2015, a Science paper estimated that around 8 million metric tons of plastic waste entered the ocean in 2010 from land. In 2014, another study estimated that there's about

270,000 tons of plastic debris floating in the ocean. That means that only 3 percent of plastic is floating at the surface. The rest is thought to either be at the bottom of the sea floor, suspended in the water column, eaten by marine animals, or washed up ashore in remote islands. Microplastics can also be found in sediments and even frozen inside Arctic ice.

- Plastic waste sinks, shreds, and breaks down into microplastic before making it to the open ocean, Eriksen says. So while Slat's booms in the great Pacific garbage patch will detect some plastic, most of it will be big pieces of debris- not the plastic debris that's most harmful

- Solution? Eriksen says, mostly catching plastic in rivers before it enters the ocean. Otherwise, the debris is going to shred and sink to the bottom, where it's unreachable.

- https://www.theverge.com/2017/7/13/15960142/ocean-cleanup-plastic-pollution-silicon-valley-peter-theil-boyan-slat

Location/Sensor Technologies

- Some existing technologies like the one below have used proximity sensor and ultrasonic sensors, however these do not provide for effective detection of PLASTICS. This robot used such sensors, centralising at the point of the Arduino-microcontroller

- This robotic fish is another interesting idea. Similar to my concept with biomimicry the aim is to maximise efficiency by modelling after a fish. However, this design does not detect plastic but instead measures water pollution levels

Thus, I researched into some technologies used in **recycling**. The following existing sensors could be used as alternatives:

- Infrared spectroscopic analysis is at present, the most valid alternative to manual/visual sorting. However, it is very expensive.

- In plastic sorting and recycling systems, Shortwave infrared (SWIR) cameras and linear arrays are the most common type of multispectral systems used. Most are based on InGaAs (a semiconductor alloy of gallium and indium arsenide). These include IDEC's technology, InGaAsP semiconductor laser diode (LD). Upon measuring light absorption spectra in plastics, in the wavelength range of 300 to 3000 nm, the peak values were always observed at or near 1700 nm, regardless of

plastic types.

- Similarly, different plastic molecules have different resonant frequencies and by tuning laser diodes to these frequencies, they excite the molecule of the plastic and are therefore detected.

- Or perhaps a variant on as chromatography–mass spectrometry (GC-MS) could also work. I did some reading on this technology, however a substantial limitation would be its lack of portability and bulky form.

For microplastics, a dye called Nile Red has shown promise of being able to bind to microplastics with high specificity with fluorescent tagging, therefore simplifying the ease of detection and quantification of microplastics

Drones and Tagging

- AUVs or UAV's could form the bulk of the technology frame. Some drones like the Swellpro drones can operate on land, in the air and in the water which would be ideal to replicate for my project.

- The would also require an onboard GPS so that the camera system can provide georeferenced locations for any rubbish identified by the BIRD and machine learning software to rapidly autonomously identify rubbish from the drone's camera feed, rather than having the need for a human operator to manually identify items as rubbish, could act as a second confirmation from the pre existing sensors

- Georeferenced locations could then be easily connected via the app to guide rubbish collectors to each item of rubbish.

Why people litter

- The Keep America Beautiful (KAB) 2009 National Visible Litter Survey and Litter Cost Study showed that personal choice was a big reasons behind littering. Nearly one in five, or 17% of all disposals observed in public spaces were littering, 81% of which being intentional. Others felt no kind of responsibility in public areas and had the mentality that someone else should be picking up after them and the availability and proximity of bins were also an issue

- I must therefore develop an outcome so that people understand the extent of the plastic pollution issue and their individual actions and responsibilities

EXISTING TECH ANALYSIS

	Plus:	Minus:	Interesting/Next Steps:
Boyan Slat's Ocean Clean-Up	Collects existing plastic in the Great Pacific Garbage patch	Only collect plastics in areas on the surface of the great pacific garbage patch. Only 3 percent of plastic is floating on the surface. Slat's booms won't detect these microplastics.	Solution could be catching plastic in rivers and beaches before it enters the ocean. Otherwise, the debris is going to shred and sink to the bottom, where it unreachable.
Trash-Bot	Existing proximity and ultrasonic sensors have been used to detect objects	Does not provide effective detection of plastics	What type of sensing to plastic recycling plants use?
Essex Robotic Fish	Efficient modelling of water pollution levels by mimicking a fish	Does not detect plastic	Can more effective, environmentally friendly power sources be used instead of batteries?
Recycling technologies	Infrared spectroscopic analysis is at present, the most valid alternative to manual/visual sorting. Shortwave infrared (SWIR) cameras and linear arrays are the most common type of multispectral systems used. Also Chromatography–mass spectrometry (GC-MS)	Very expensive Bulky, lack of portability	Would these technologies be able to be used across wide angles? May be worth contacting recycling companies to find out more.
NIWA	Machine learning software to recognise different natural environment features	Expensive and time-consuming to produce database of images. Hasn't been used in the plastic context.	Research into MATLAB. Could be a more effective than initial idea of RFID tagging or laser diode booms.
Litterati	Geotagging and Mapping to encourage people to pick up rubbish.	Does not locate and detect plastics	Crowdsourced approach and connection to an app could be useful

DESIGN IDEAS
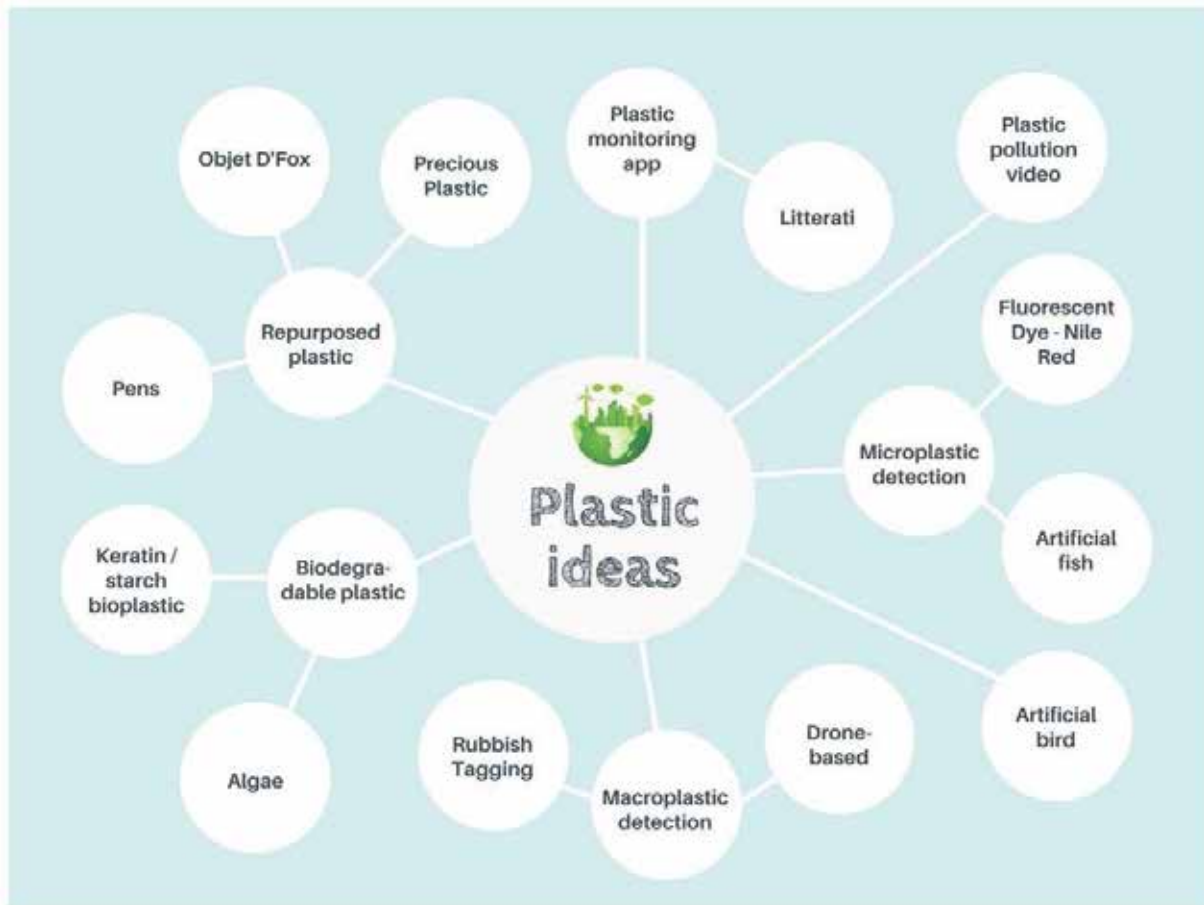
INVESTIGATION - KEY FACTORS / ATTRIBUTES

Main stakeholders / end users - App users collecting rubbish, specifically young people so that they are motivated to clean up beaches and reduce their plastic waste.

Secondary stakeholders / end users - The environment is a secondary stakeholder as it benefits from reduced total plastic and contributions to climate change and marine life harm. The wider community/society can also benefit from the adoption of environmentally friendly practices and attitudes, as well as a better appeal and reputation for their beaches. City councils are also a stakeholder as they could use the statistics from BIRD to influence the regularity of their rubbish disposal systems and use data to better understand the issue.

INITIAL IDEA

My idea Biomimicry Marine Life will forms part of my wider enterprise, P.S. Our Beaches: a Pollution Solution aiming to increase awareness around plastic pollution. I plan to design artificial native birds and fish capable of detecting and locating both micro and macro plastics. Once located, these plastic particles will be mapped using RFID tags and linked to a crowdsourced beach clean-up app where BIRDs display their mapped plastic in order for the general public to find and dispose of it. I plan on using a UHF RFID tags as well as infrared, capacitive and touch sensors.

Once located, these plastic particles will be GPS mapped and linked to a crowdsourced ocean clean-up app where all Biomimicry Marine Life products display their mapped plastic in order for the general public to find and dispose of it in an appropriate manner, then update their contribution to the app.

This idea incorporates robotics, programming, digital design, information management and various other aspects of digital technology. The GPS mapping and app design will be of the greatest IT focus, however programming and designing the mimicking robots themselves to maximise efficiency is also extremely digitally dependent. Additionally, the development and design of prototypes will be powered by sustainable energy (solar/wind for the birds and hydroelectric/wave/tidal for the fish). I am hope to use CAD design to 3D print the design concepts.

Once properly established, my purpose is for the project to be globally implemented to the countries and areas (like Henderson Island and the Great Pacific Garbage Patch) which need it most. Although New Zealand has its individual plastic pollution issue, we are fortunate enough to have a fantastic clean green reputation. My goal is to help to keep that in check and to also help other areas achieve similar approval.

REFINED IDEA

My BIRD development idea stands for Biomimicry Identification Robot Device. As part of this, I am designing artificial UAVs capable of detecting and locating macro-plastics such as plastic bags and bottle tops using either laser diodes or machine learning software to rapidly autonomously identify rubbish from the UAVs camera feed, removing the need for a manual human operator. Once located, the plastic will be tagged through the UAVs camera system, which provides georeferenced locations for any plastic pieces identified

by the UAV. The georeferenced locations will then be linked to a crowdsourced beach clean-up app to guide rubbish collectors to each item of rubbish, so that it can then be disposed of.

The idea of the biomimicry element came from the 2016 Future Problem Solving International Conference, at Michigan State University. Representing New Zealand as an Individual Global Issues Problem Solver, other state and national champions and I were faced with a hypothetical energy crisis set 40 years in the future, based around biomimicry energy. In BIRD, the Biomimicry B refers to its power source: solar cells which mimic the rose-butterfly and wings which generate wind energy like a dragonfly for maximum efficiency. The shape of the UAV will also be modelled like a bird to ensure the flight is as efficient as possible.

DRONE CONCEPT:
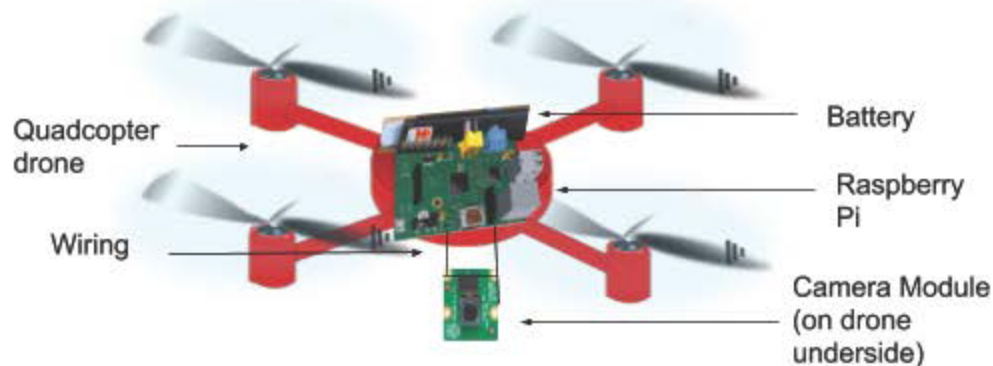
I decided to use a quadcopter such as a DJI Phantom, as this was suggested to me in a phone call with Brendon Smith. Brendon is a mechanical engineering technician at NIWA, and specialises in a broad range of drone work and laws. Quadcopters are easily attainable and generally powerful enough to add accessories such as a camera module. One downside is that it is unable to carry heavier payloads.

For this reason it may be worth using a Raspberry Pi Zero as it is smaller and more compact than a 3 B+; however, these are more difficult to find/purchase.

The camera module must be on the underside so it can capture footage of the beach from the most ideal angle. It will also require a battery and wiring to piece it all together.
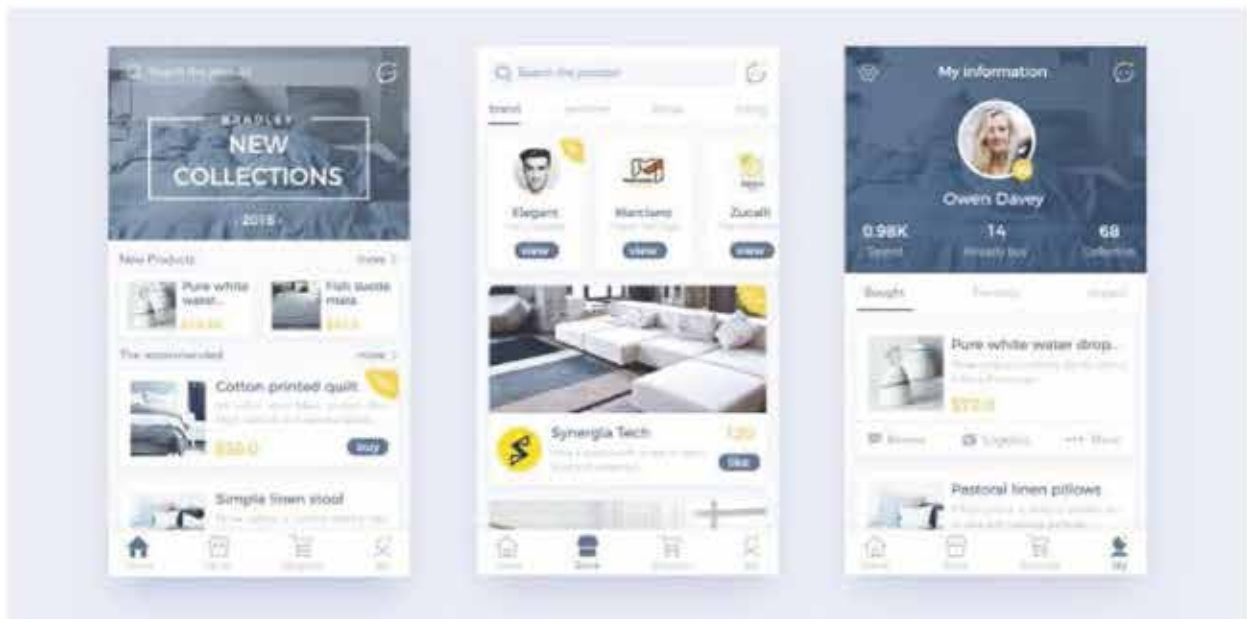
Feedback

Brendon Smith - NIWA	I met up with Brendon at the NIWA office. We discussed deep-learning vs laser diode booms and talked to Jeremy who had experience with machine learning software technology. Laser diode booms could easily miss plastic pieces as they have a direct target/line of sight. However, deep-learning is very expensive, unless on a free trial. We took a look at different types of drones and footage, as well as some other projects the NIWA technicians had been working on.
Jennifer - Friend, 17, Christchurch	"I like how the design of this device will allow it to blend into the nature-I prefer it over a random drone flying over the beach." "If the laser diodes are used on this device, it would mean that the light would be shot from above-this may lead to eye-related issues in case a person on the ground was looking directly towards it." Laser-diodes could be hazardous or threatening to humans and marine life.
Ashley - Friend, 17, Christchurch	"I like how plastic will be detected without human operation and the whole idea of how it will keep our environment cleaner." "I would be thinking more about how the plastics would be disposed because not all people might want to collect the rubbish and dispose of it." "I think it is helpful to the environment. It makes cleanups easier by guiding us to the rubbish instead of us having to find it." Initiate more incentives to use the app.
Sharon - Environmentalist, Wellington	"[I like how it's] using technology to solve pollution issues" Concerns over "Control over when it flies, how it captures images, what happens to the data, privacy issues"

I plan to use deep-learning instead of laser diodes, but will trial this using a webcam at the adventure park, gondola or a local park if I have access to a drone. Also, I will introduce a points-based incentive system and potential a virtual reality concept based on Pokemon Go as this is relatable for the main target audience of young people but also enjoyable for the wider community stakeholders. Footage should not be released to the public for privacy reasons and should fly when few, if not no, people are at the beach
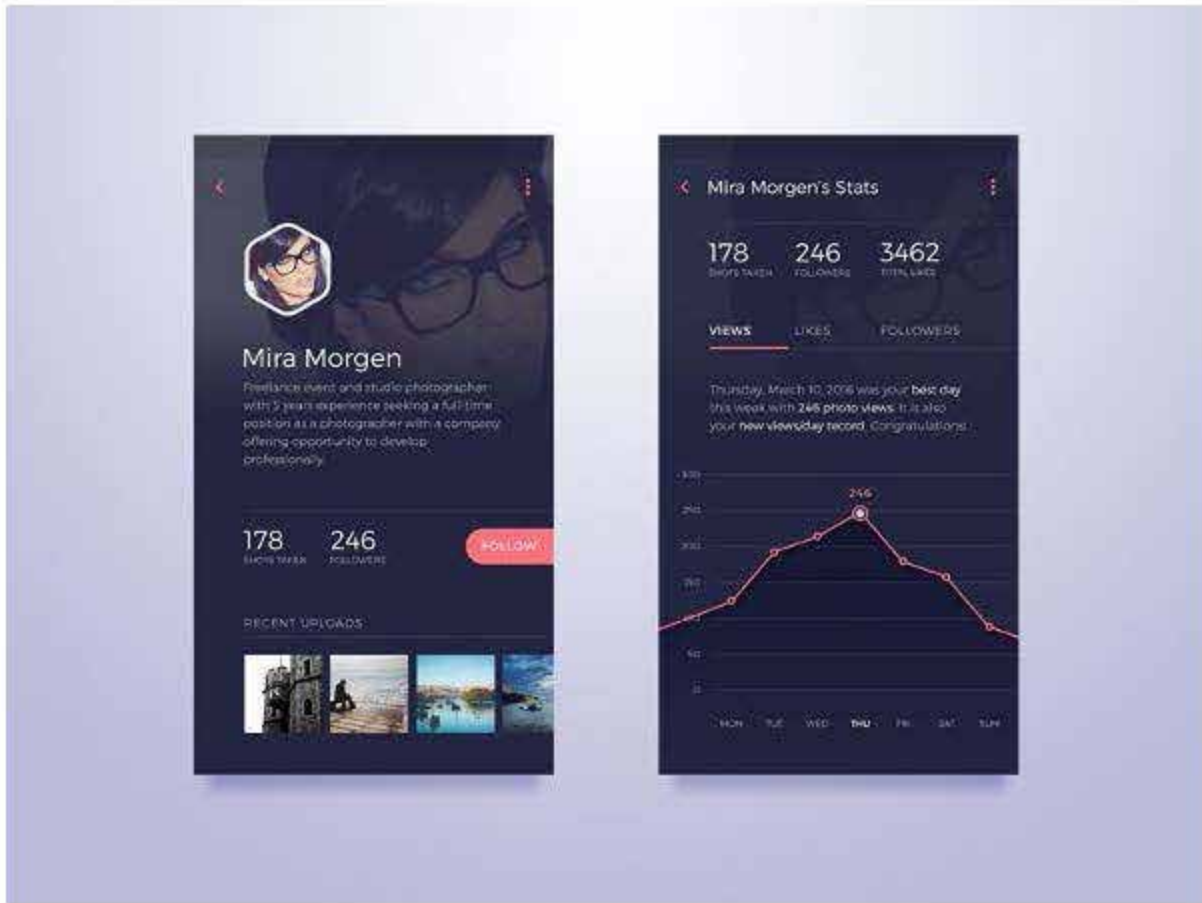
APP CONCEPT

I first worked on design ideas with Canva and GIMP:
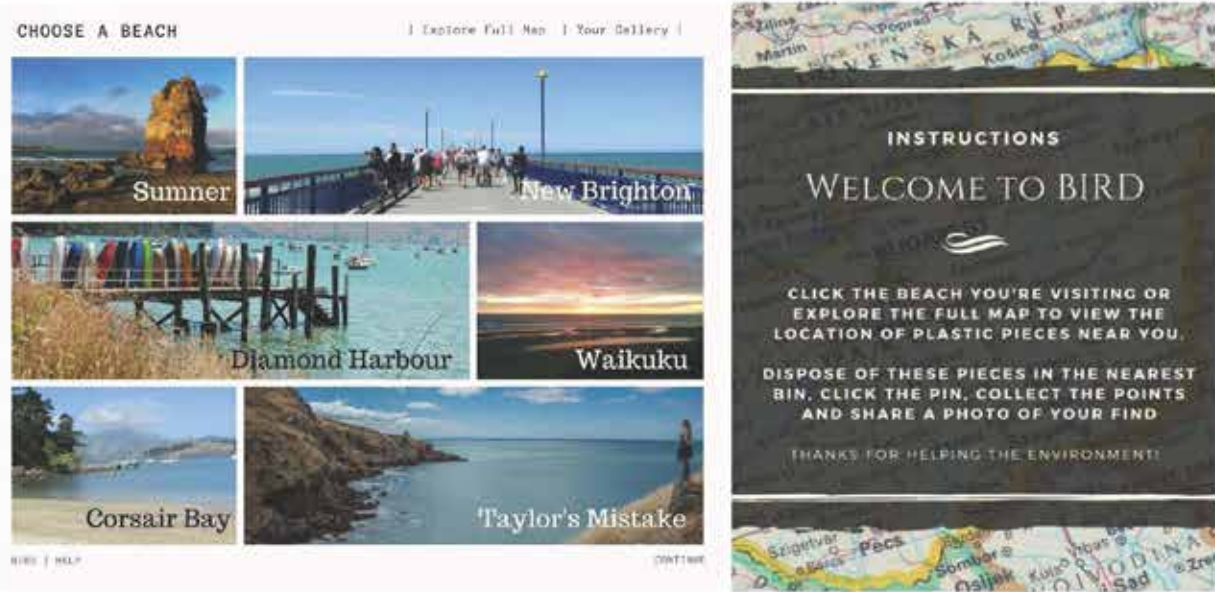
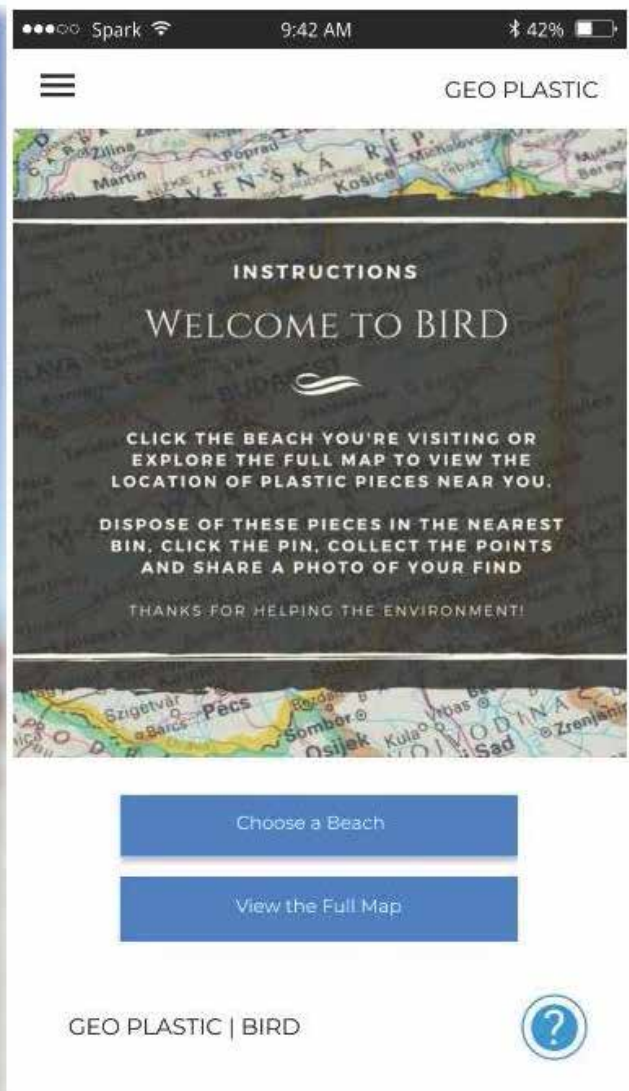Afterwards, I referred to several sources of design inspiration to improve my ideas:

I then used Figma to develop vector images and the app prototype. Link to the responsive and interactive prototype:
https://www.figma.com/proto/5TgxRLw9ky4D6mWpKPhWcj/Geo-Plastic?node-id=0%3A197&scaling=contain

Jpg images:

Second Place

Salwa Raed Almajed, Zain Khamis Al-noaimi,
Mariam Tariq Mohamed, and Mariam Mahmoud Sharif
**Isa Town, Bahrain**
Silent Ring

THE Project AIM:

" Helping Hearing impaired and deaf people to communicate with the outside world.

" Create a new type of investment business that helps needy people.

" If someone with a hearing loss is living in your home, it is important that you put more thought into your doorbell. It can be frustrating to miss someone at your door or miss an important delivery because you couldn't hear the doorbell ring.

" A doorbell that you are sure to hear will give you a greater sense of security especially in case of fire breakout and more independence in your home.

" The best doorbell for someone with hearing loss is a doorbell that can provide an additional alert that can be detected. This may come in the form of an amplified chime, flashing light and vibration notification. The option with a light is a good one unless you are asleep! The buzzer is the only way to make them safe.

- " The invention not specified to be used inside the home but also can be used outsides according to the needs as it easy to be transferred from one place to another.
- " The chime receiver can be plugged into any standard wall outlet while one can put the push buttons at the required place.so we have 2 options of usage
- " 1-we can fix the push button beside the doorbell of the home and keep the chim receiver with the hearing impaired as he can move with it from one room to another inside his home.
- " 2-Both push button and the chim receiver can be transferred and used in anther place outsides for example in work.

THE IMPLEMENTATION:

- " We brought two Arduino Nano circuits, one of them(transmitter circuit) had attached with a push button, and the other(receiver circuit) was attach with a Led and vibrating motor .
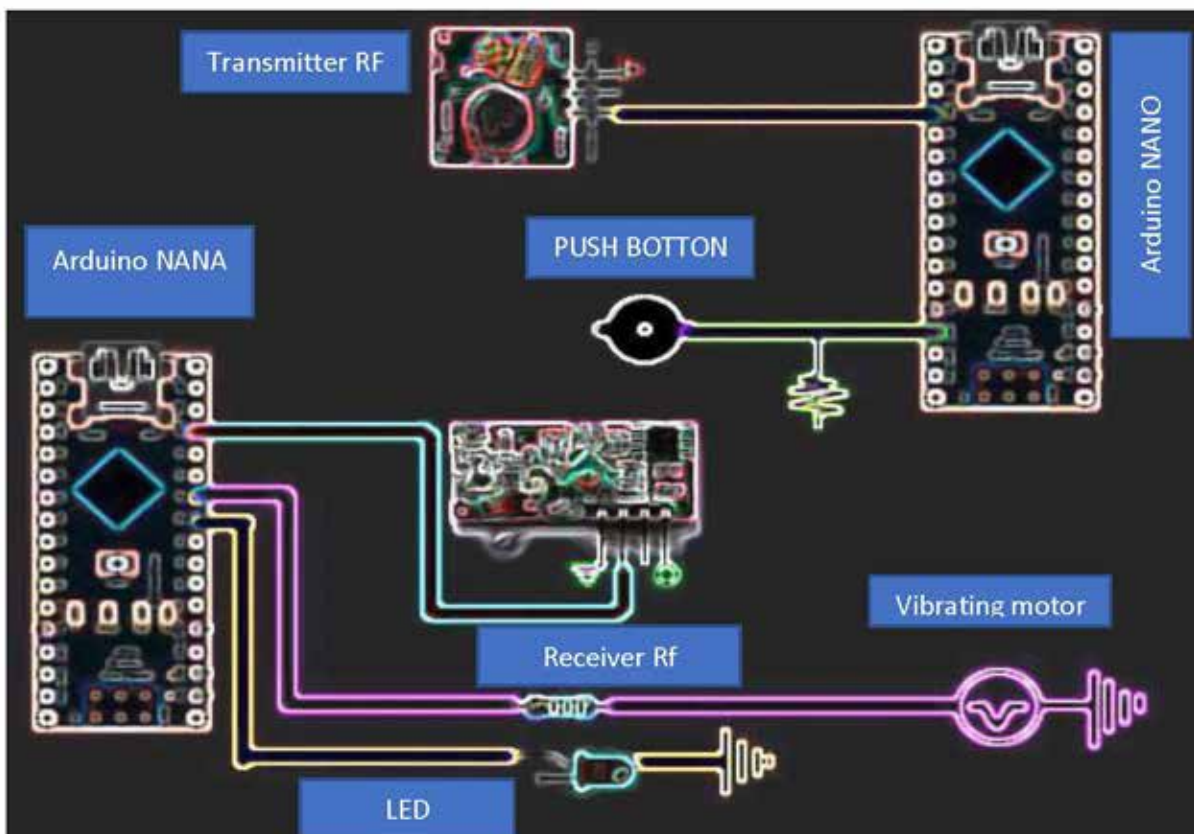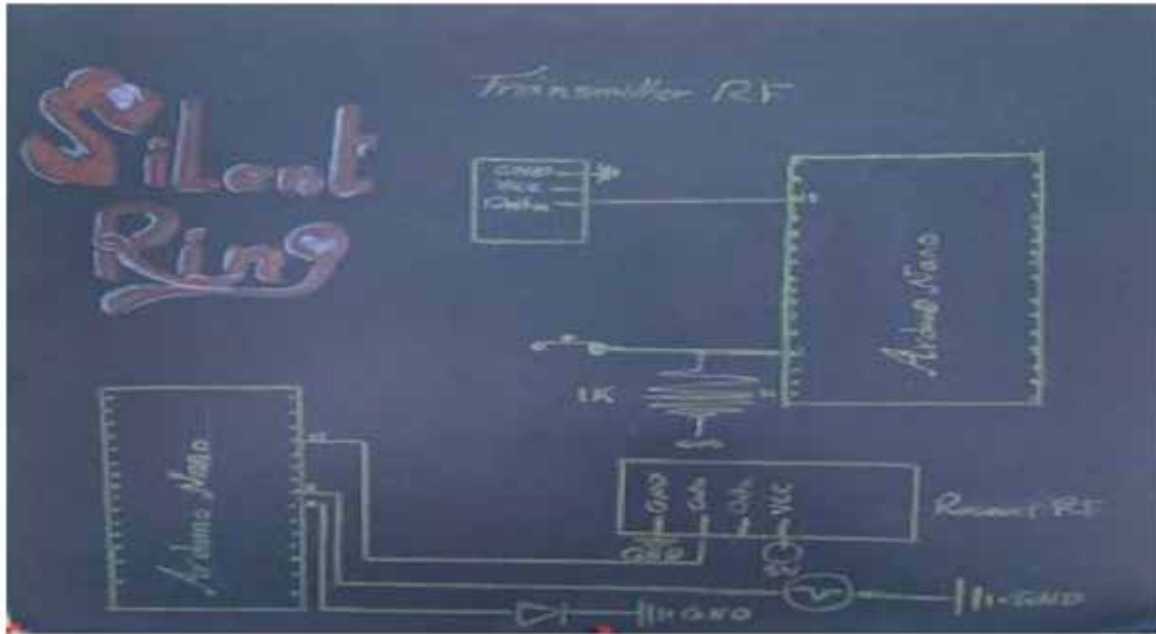
RADIO FREQUENCY 433 MHz:

" We connect the two circuits by radio frequency 433 MHz , which give a range up to 200m, then we add an antenna to increase the range of transmission.

OUR STANDARDS:

" The criteria of our product:

" Small in size.

" Can move from a place to another.

" Easy to use.

THE EXPERIMENT:

" Firstly, we used two 3-volt batteries, but it didn't work, so we replaced them with 9-volt batteries.

OUR FUTURE PLANS:

" Look for rechargeable small batteries.
" Manufacturing a code for each product so that the holder can follow the average visits.
" To connect our project with artificial intelligence will add camera to the transmitter circuit to make scanning for visitor's face and by comparing these pictures with that in azure web site we can know the identity or the name of that personal.

By Comparison between actual result and expected ones

" The device works very efficiently.
" The size of the device is small but does not fit to be a bracelet due to the large size of battery.

CONCLUSION:

" The team hopes to develop more new features that will help to improve this invention, which will notify the holder of a visitor at the door, making it easier to provide a smooth life for all who suffer from deafness, and our goal is to help those who need help anywhere in the world.
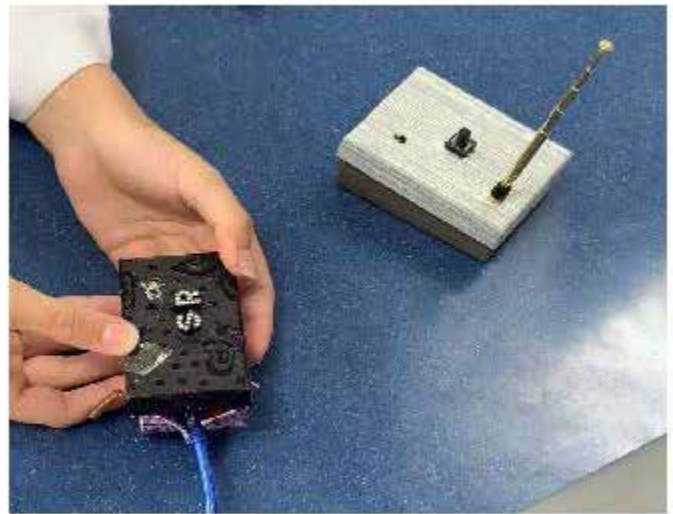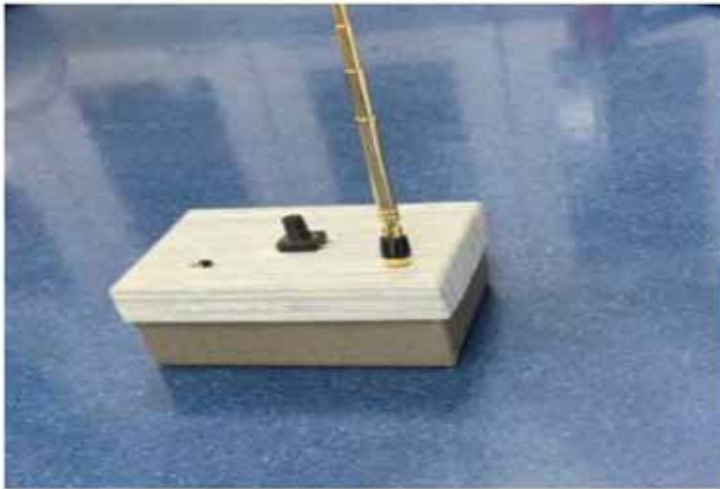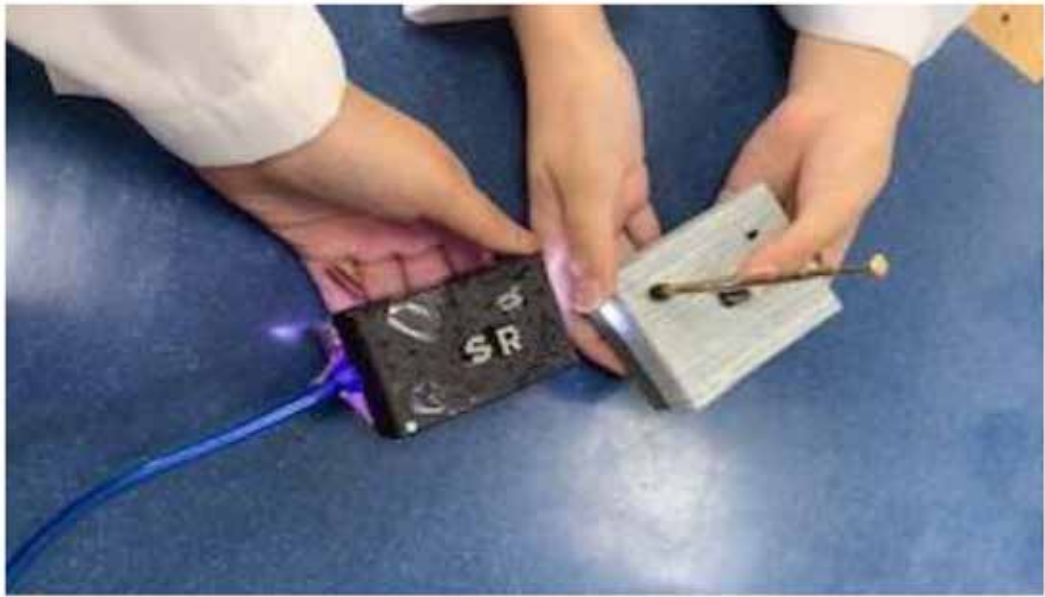
Third Place

Winston Chen and Aditya Santosh Kondepudi
St. Louis, Missouri
Interconnected Balloons

Introduction:

We were tasked with using a design to model the charging and discharging of batteries. Intuitively, they should fill up simultaneously. However, like particles in a battery, some balloons will fill up to larger sizes (stages) before others.

Moreover, the balloons will sort of "wait" for the other balloons to fill up to full. We believe this is because it takes a lot more pressure to pop a balloon than to fill one. If all the balloons are able to overcome the initial air pressure needed to fill up, one could potentially fill an entire board of balloons.

Goal/Idea:

Based on the many-particle model for batteries, we wanted to create a device that could fill up many balloons. There are many practical uses for an air delivery system or a concept based on it such as propulsion. For example, if one were able to know which hole the force would come out, they could have a propulsion system that moves a vehicle in any number of directions. However, a more reasonable goal would be to use it for its original use: filling up balloons.

Design:

We created a board to hold a 5x5 array of balloons. The board is 48" x 48", so each of the balloons is placed 9" apart with a 1.5" border at each edge. Each of the balloons on the rightmost and leftmost column are on elbow connectors. The 3 columns in the middle rest on t-shaped connectors. The air delivery system runs between the 2nd and 3rd column with a cross connector at each of the 5 rows. The connectors are all 0.5" male and the clear plastic piping connecting them is 0.5" female. All the connectors are zip-tied down to the board to ensure they don't move, and they face outward in relation to the board.

Result:

While we were not able to fill up all twenty-five balloons as we had intended to. However, we were able to fill up four balloons. While this may seem like a failure, it's a proof of concept. We did not have the practical means of getting enough air pressure to fill up the whole board. However, for industrial use or any product designed to give extra air pressure, it should not be difficult to fill up all the balloons.

Purpose:

Although the current design of the concept can be used for many including filling up party balloons, one practical application that we have devised is using it for planetary exploration.

The balloons would instead be solar balloons. A barometer could be kept inside of the balloon, and when it reaches a high enough pressure for that particular atmosphere the balloon would be released and able to gather data for scientists at home.

Having multiple balloons would be better than having one large balloon for a solar balloon because it increases the total amount of area sunlight can strike a balloon, which would cause the balloon to rise faster and more efficiently.

All they would have to do is have send a system like our board attached to a supply of pressurized air. In the future, this type of design could utilize balloons which may be much cheaper than sending full rovers to other planets.

Third Place

Dora Ivkovich
Okemos, Michigan
Mcaps

MCaps (Multi-colored Prescription Bottle Caps)

By Dora Ivkovich

Imagine living in a household with one or more household members, with everyone taking prescription medication. How do you make sure that you do not take a wrong medication? It is challenging enough to keep track of the medication you are supposed to take by relying on familiarity with the shape, size, and color of the pill. Add to it the risk that, inadvertently, a member of your household might take someone else's medication, perhaps because they cannot make out its name on the bottle without glasses nor the name of the person for whom it has been dispensed? Or, what if someone forgets to check the name? This may not be too dangerous if it results in an extra dosage of an ordinary antibiotic, but taking someone else's heart medication may be serious, if not fatal.

The FDA estimates that 1.3 million people in the U.S. are injured by medication errors annually, and points out that a significant fraction of these incidents are preventable. There are thousands of serious cases each year, and hundreds of deaths. Not all of these horrible occurrences can be traced to confusing the medication across different individuals, but at least that aspect of the problem is quite preventable. That is where MCaps come in!

Color-coding the bottles people receive from the pharmacy would minimize the risk of taking another person's medication. The manufacturers of the bottles need only produce different colored caps, and the pharmacist need only ask the patients when delivering medication which cap they would like. It would take minimal additions to the current system, but would help prevent potential harm to the patients!

The MCaps are quite simple and feasible. We already have all the pharmacies dispensing medication with pink bottle caps during the breast cancer awareness month. Therefore, the technology to produce caps in various colors is clearly there. We already have rainbow-colored stackable pill planners. Therefore, the concept of using colors to avoid confusion has been deemed effective for a similar purpose (the same individual, different days of the week).

The proposed MCaps are virtually costless to produce and the information about the patients' preferences and past choices can be easily maintained in the pharmacy's database. A patient could request different colors for different medication. Similarly, different household members could use different MCap colors. MCaps could easily save lives and minimize the risk of injury to thousands, if not millions of individuals.