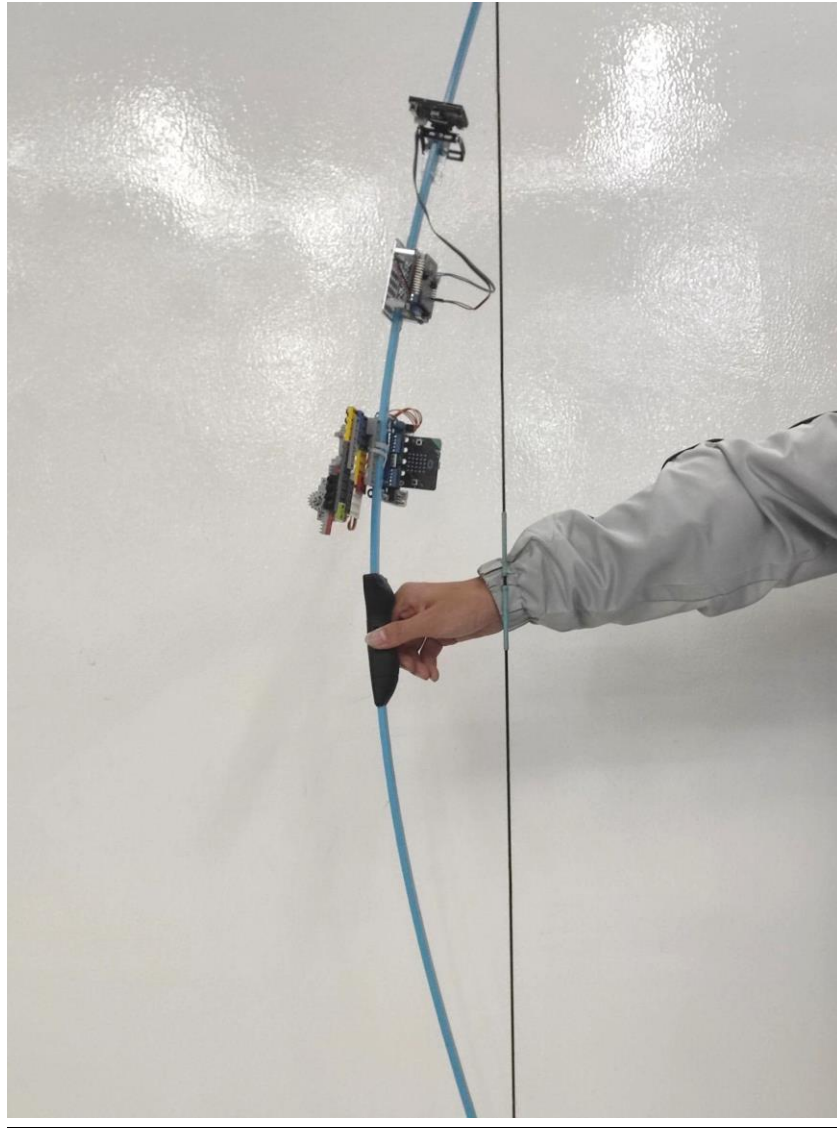


Robofest Hong Kong 2023

Exhibition Category

Eagle's eye



Baptist Lui Ming Choi Secondary School

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Team Information (Senior Group)



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- ❖ Sandy Yang is responsible for writing report and construction
- ❖ Karman Wong is responsible for writing report and programming
- ❖ Adelle Chen is responsible for construction and programming

Abstract

Thanks to the easing of the pandemic, everything has been resuming to a “new” normal, and so do the sports fields. A number of large-scale events such as the Olympics have been held successfully.

On top of that, archery as an extracurricular activity is held in our school, BLMCSS, whereas a school team is set up for talented students to participate in different inter-school competitions. As there are gradually more schools in Hong Kong setting up archery lessons, its potential development is also one of the main concerns of our design.

Regarding the growing popularity of archery, we have designed the Eagle’s eye as a refined sight which utilizes the techniques of archery that support a better aiming by minimizing the intractable errors during the release.

It aims to assist both pupil and professional archers by training their stability and boosting their confidence. At the same time, we would like to further encourage the development of archery in Hong Kong.

Therefore, in this report, we would like to introduce our design, the Eagle’s Eye which focuses on aiming, positioning while learning archery.

Problem Analysis

The topic of this year is “Science of Sports and Safety of Sports”. We will be exploring both of the items.

Below are a few backgrounds and reasons for choosing the topic of archery.

1) Archery in Hong Kong

As different sports policies have been launched by the Hong Kong government in recent years, many new-rising sports such as archery have developed more broadly and rapidly. As it not only retains the essence of one of our country’s authentic cultures, its own kind of thrillingness has also drawn interest from the public at different ages, whereas numerous international awards have also been clinched by Hong Kong representatives.

a) Popularity among teenagers

Due to the limitation of venue and basic equipment, archery might not be an accessible sport for every school. However, among different inter-school competitions organised by the Hong Kong Schools Sports Federation, archery has always been an competitive event in which a number of prestigious schools are willing to put in remarkable effort exclusively in archery. At the same time, a new wave of new-rising sports being promoted these days has also resulted in a positive response among teenagers. This is mainly due to their willingness to try new things, especially a kind of sport considered “cool sports” like archery.

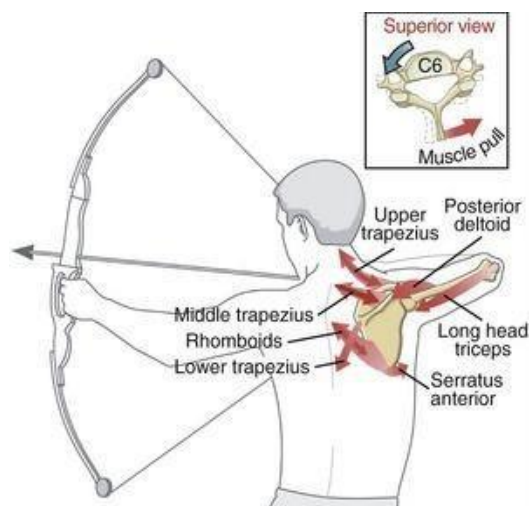
b) Other benefits

of



physical archery

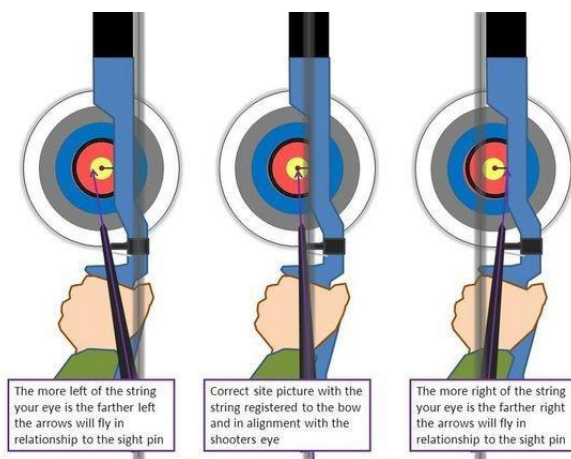
Besides archery's appealingness to teenagers like us, it also provides a breadth of advantages physically. Through daily exercises and competitions, participants are unconsciously developing the skills of instant concentration and emotional relaxation, and their physical performance is also improved. According to long-term observations, many people who have participated in orthodox training have been able to improve their bad postures such as slouching, strabismus and slant to varying degrees.



2) Common problems faced by beginners

a) Unstable body

If the waist is not stable, the center of gravity of the body will change and the body will move more at the time of releasing. When the body posture is correct, the body weight is distributed equally to both legs and hence can experience a slight inward contraction of the knees.



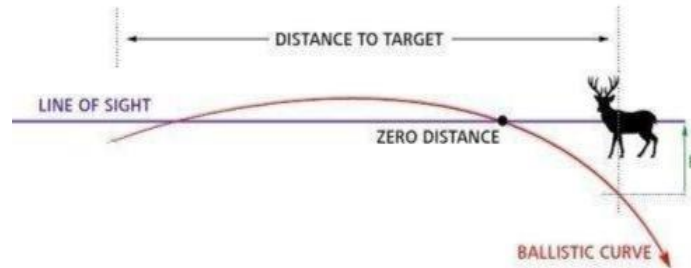
b) Incorrect releasing posture

Releasing posture is always considered the foremost part of archery. In order to ensure the horizontal movement of the bow, people have to raise the arm holding the bow (left hand) and the arm hooking the string (right hand) close to horizontal, and the right elbow should be careful not to sag below horizontal at any time. Especially when drawing the string, the string should be pulled and straightened along the left arm to the midline of the chin, at the same time checking if the string is pulled with the back muscles.

Above are some of the main problems the beginners usually face, which can be greatly reduced by our design that helps train their stabilization of arms and back muscles. On the other hand, for the intermediates or even professionals, the above mentioned problems might not be a great concern to deal with. On top of that, most of them have a higher expectation of accuracy by adopting the design of common sights and the minimization of uncontrollable factors.

c) Substantial error

According to the team USA compound archery Makenna Proctor, although any harsh weather conditions are some of the difficulties to compete in, the hardest one for most archers to



conquer is the wind. As a result, the stability of archers might not ensure a high shooting average due to the wind.

Besides, the aiming distance is also an essential factor to be considered, in which the parabola of different arrows will lead to the measuring error even with the sighting devices when hitting towards the bullseye.

Therefore, to specifically solve the above mentioned problems, we have designed the Eagle's Eye.

Our Solutions

In order to give a solution and even an improvement on archery development in Hong Kong, we have invented

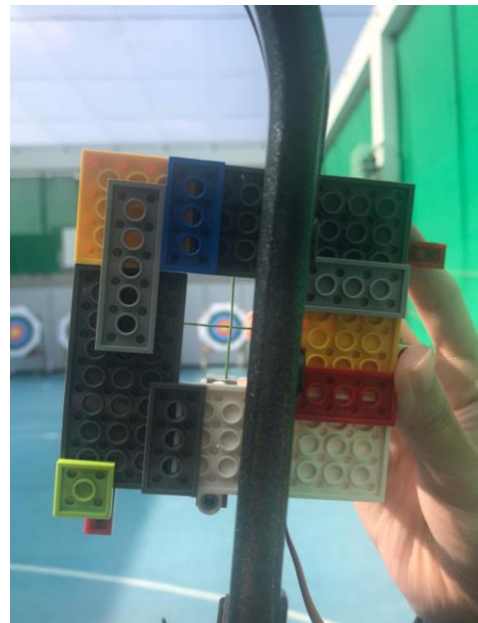
-- Eagle's Eye

1) *Constructions*

Briefly to say, our robot consisted of two main parts: aiming and detecting.

a) Aiming

First of all, the device for aiming utilises the x and y



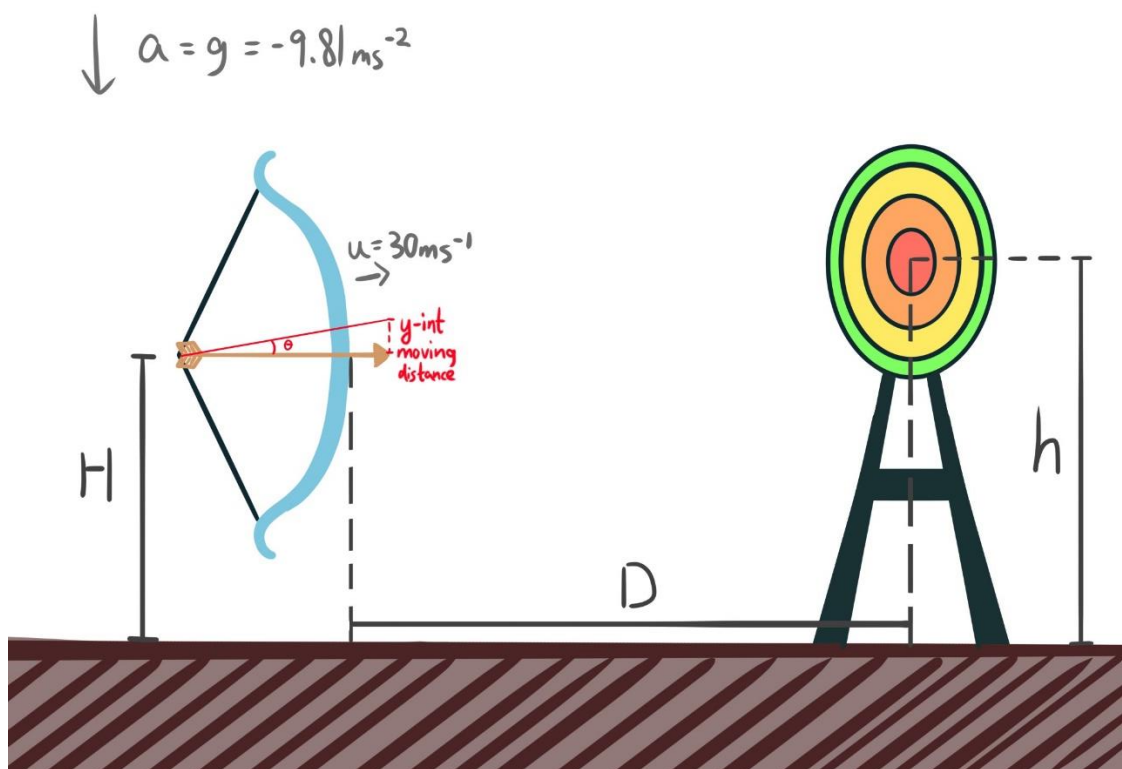
coordinates to automatically deduce whether the crossing intersections of x and y coordinates are delicately adjusted to get a shot on a bullseye.

After correcting to the correct coordinates, the two thin iron wires move then stop to focus at a point, when athletes can use the intersection on our device to focus on the bullseye.

In order to deduce the correct coordinates, we have picked the distance between the target and the archers and speed of wind and some errors because of distance between the device

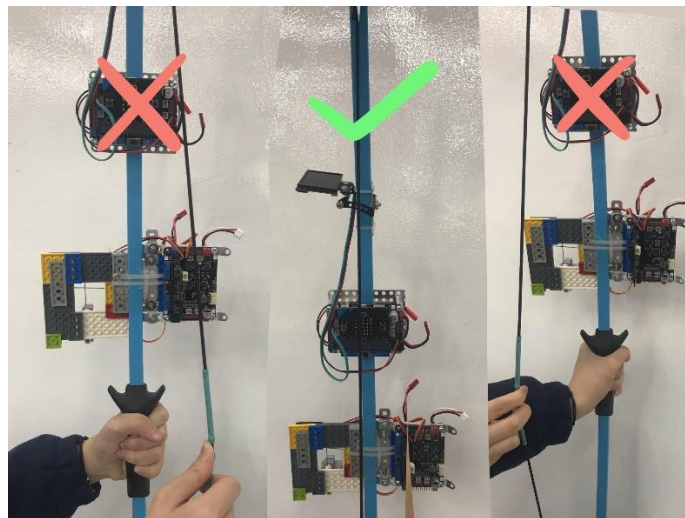
and arrows will also be considered by inputting this information in a program which can be made like an app to input all the values in. Moreover, after inputting the values in the app , if it appears, we will use Microbit to receive data from the app through Bluetooth.

Later, using the final output value to the aiming device, the two sticks will move and stop to generate a perfect angle to shoot.



b) Detecting

By research from PE teachers and professional athletes, we know that one of the most important things that will affect the aiming is the position of your hands pulling the bowstring.



If the bowstring and the bow are not in a straight line, even if you aim it correctly, you still can't hit the bullseye. Therefore, there will be a camera for detecting whether the arrow controlled by bow string and hands are holding straight or not.

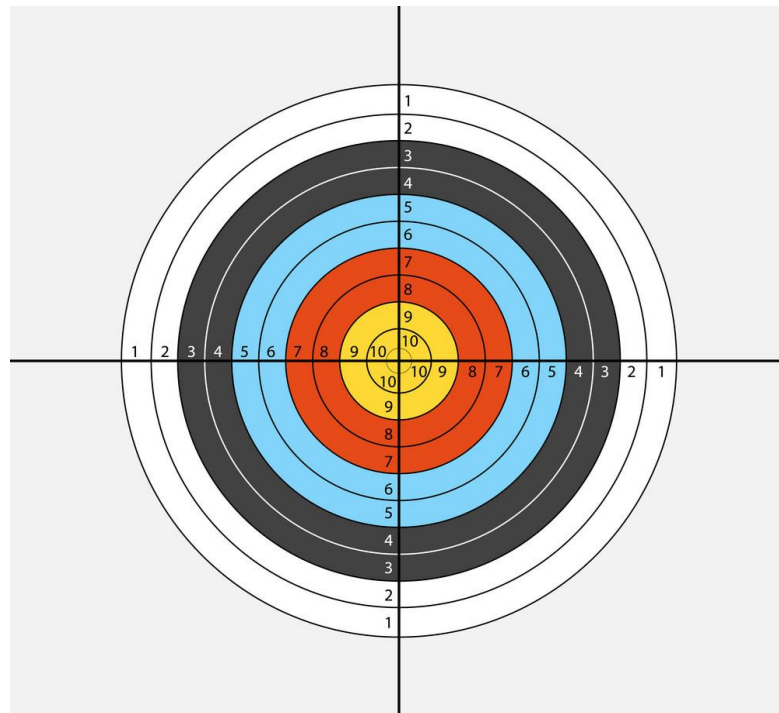
An AI (Artificial Intelligence) camera, Huskylens, is used for detecting targets in Eagle's Eye. It is connected to Microbit to show shape to alert players whether their bows are held

correctly. This would not only just help on aiming, but also on safety that their posture can be adjusted by these Huskylens to prevent any accidents from happening.

2)Advantages

a) Train the learner with better aiming

As mentioned, Eagle's Eye can automatically calculate the target point and change its coordinates to perfectly match the information of distance, wind speed, height etc. Therefore, it can be more convenient for the learners to aim and the aiming is more accurate than using traditional method. With no adjustments needed, players can spend more time on aiming and stabilize their position, the width when hands pull the bowstring etc which can also improve their aiming and build up their strength and habit. In short, our invention can help players aim in a convenient way and let them build up a good habit during practicing archery.



b) Develop good habits on archery posture

By using the huskylens detector which is installed on the bow detecting the angle of the arrow. So as to ensure the bow, bow string and the hands are all in a straight line or they are in parallel line, this detector can be responsible for this.

The reason why we need to detect if they are straight is to build up a good posture of players and also prevent any errors caused by bad hand posture that affect the aiming. With this detector, we believe those beginners can build up good archery habits on archery at the beginning.



c) Create self confidence

To most beginners, confidence is one of the most important reasons why they would continue playing archery. Confidence determines whether they will focus on archery.

So as to build up their confidence, aiming perfectly when they have archery for the first time is a decisive step. Therefore, we believe our design can be one of the important roles to achieve this. While players are using Eagle's Eye, we believe they can nearly shoot the bullseye. When they notice their good aiming, confidence is hence built up.

d) Discover potential archery athletes

We believe by our invention, players can build up archery skills and confidence, hence interests. By knowing these, more and more underlying but outstanding archery athletes can be found out. So, they can get more professional training, and represent Hong Kong to join different competitions.

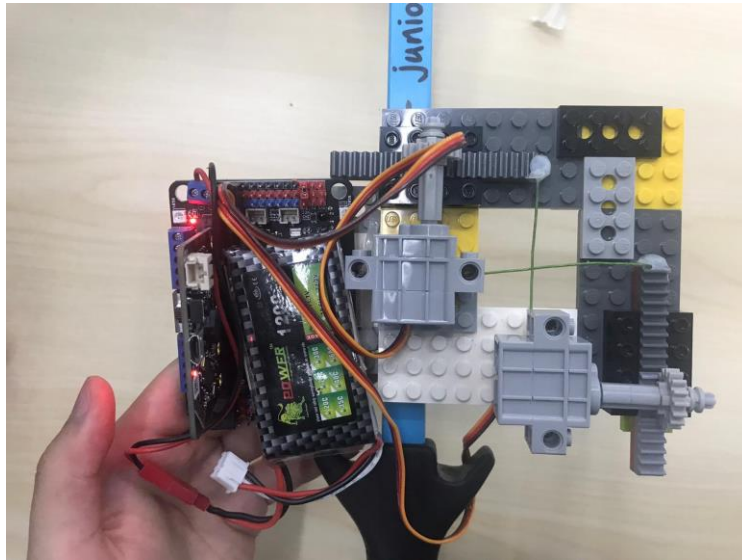


Design of the Robot

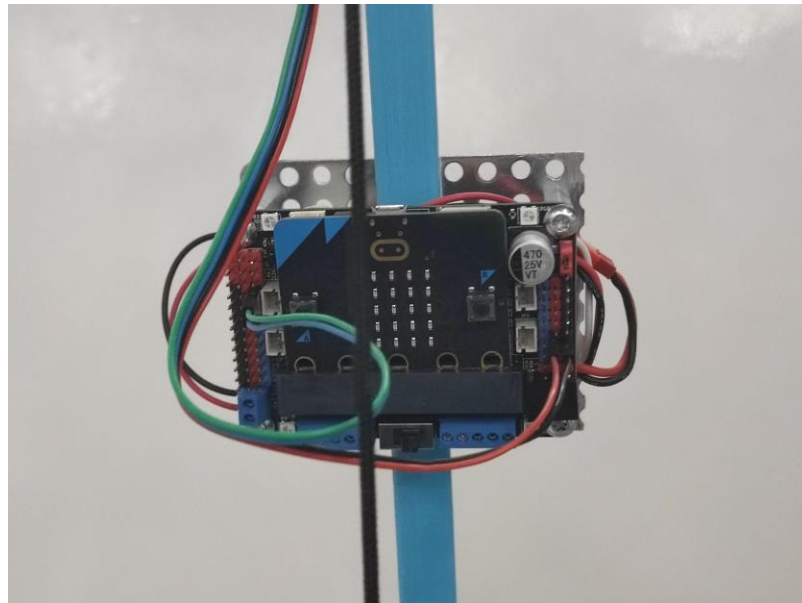
1) Hardware

a) Aim

We make use of servo motors to create x and y coordinates and make intersections.

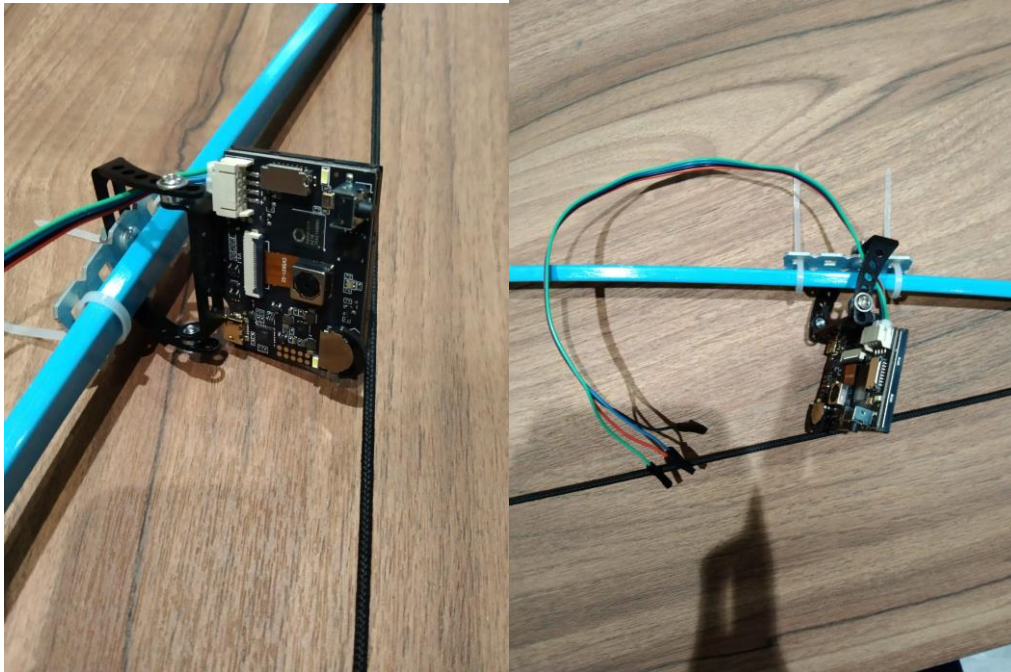


b) Microbit

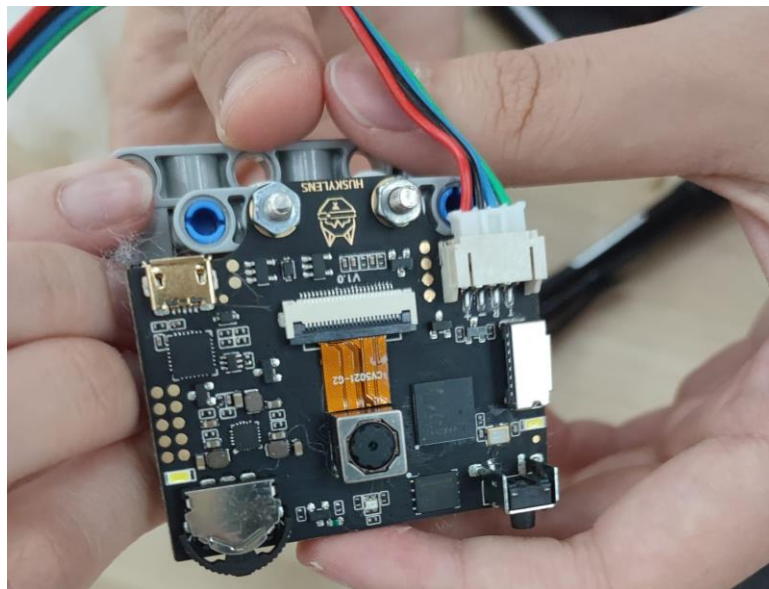


It is used to control servo motors and get signal from the huskylens.

f) Huskylens

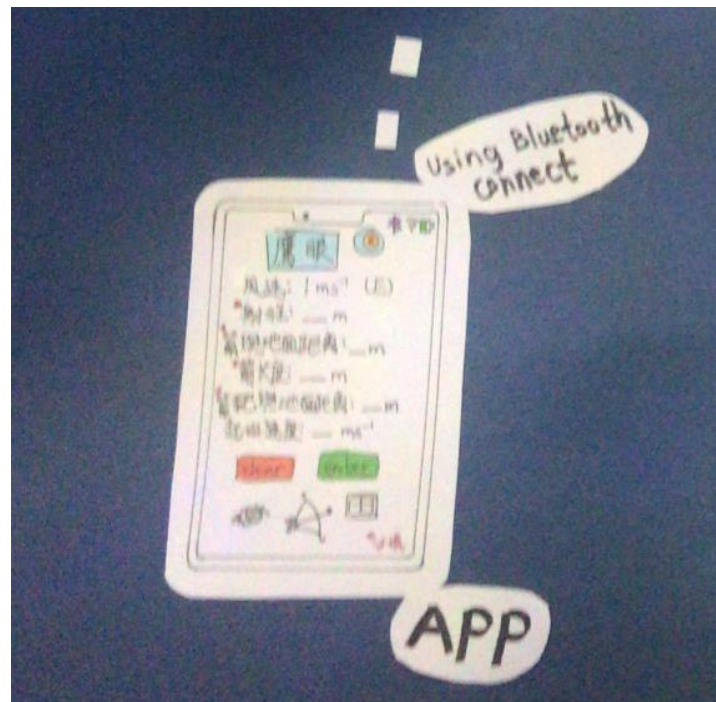


We will be using Object classification to detect whether the arrow is in the correct direction.



2) Software

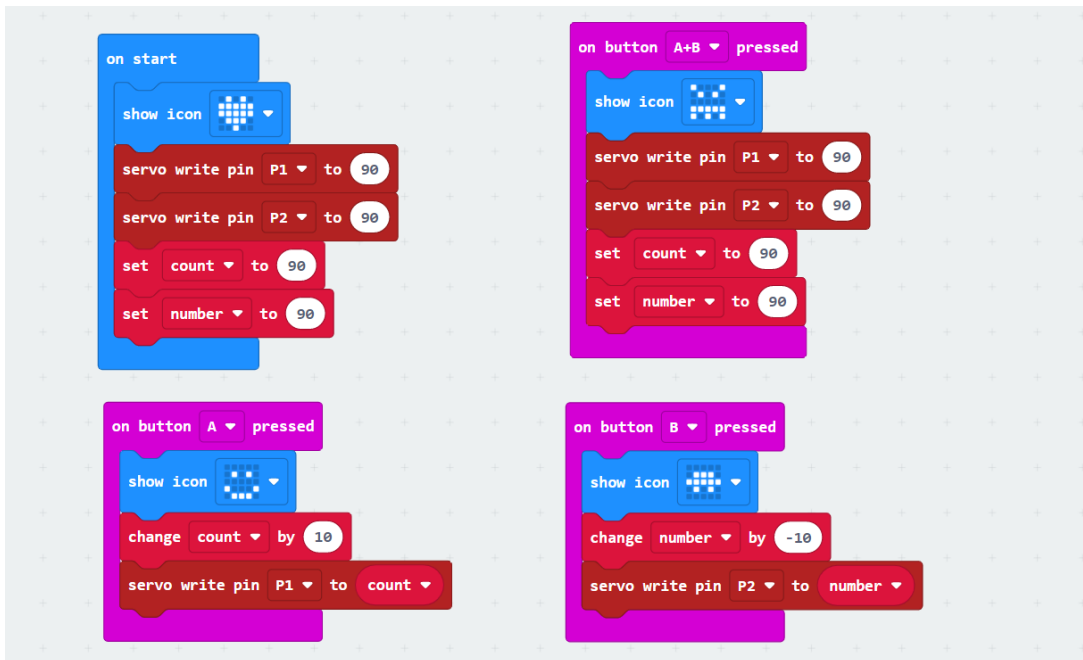
a) App for receiving data



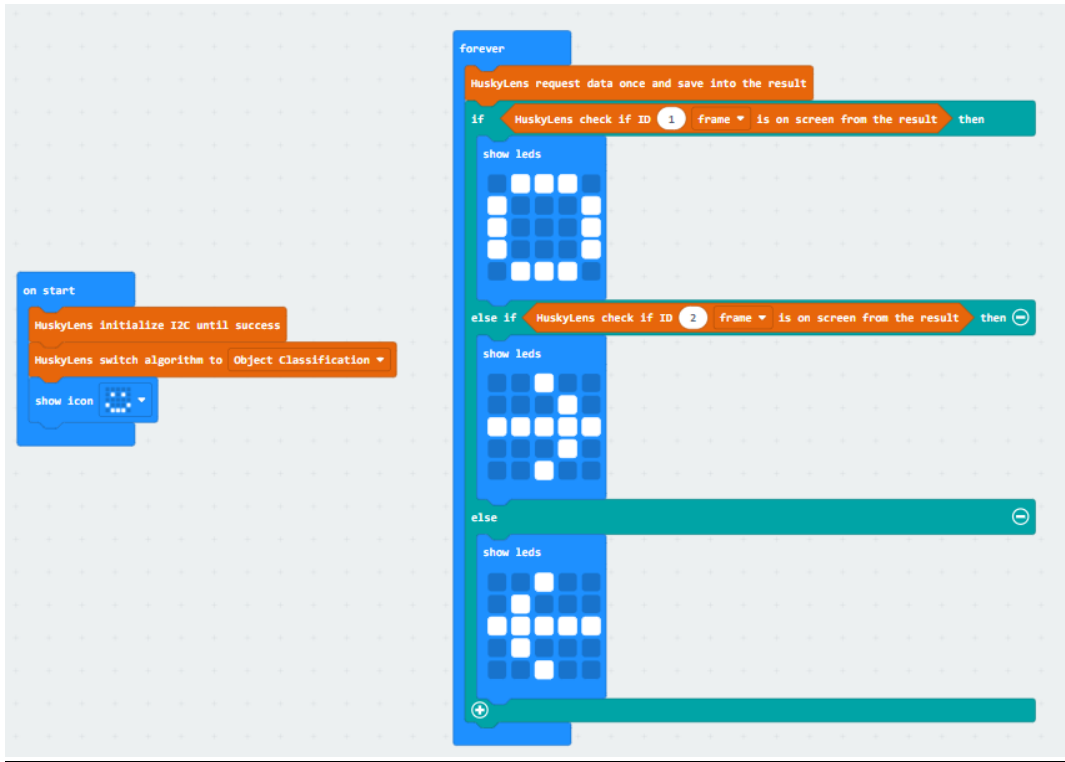
Data included:

1. Height of bullseye from ground
2. Distance between archers and archery target
3. Height of the arrow from ground when pulling
etc
(Every information that will affect the aiming)

b) Programs



Demonstration of how the servo motor will move when receive the data about $\tan\theta$



Demonstration of how the huskylens work and sends signal to microbit so as to remind archers

Evaluation

1) Existing solutions

a) Bow sight

The two common sights are single pin sight and multi-pinned sight, also known as the fixed pin sight. The latter can be configured for any distances in initial set up and they cannot be easily moved or adjusted. As a result, many archers prefer using single pin sights over their multi-pinned counterparts for the simplicity of their use.



b) Special things about ours

Yet, comparatively, our Eagle's Eye sight is similar to the overall design of some common sights like above. An essential thing about our sight is that it is designed more delicately aiming the bullseye. As we have also considered the problematic basis of the uncontrollable errors faced by professional archers, despite the negative effects of wind speed and aiming distance on the bow released, our design increases the possibility of hitting the bullseyes under unstable conditions. As for the beginners, they are also benefited by adapting certain environments that lead to a higher accuracy through correct postures.

2) Future development

As time is limited, only a prototype has been produced. However, We believe that with more advanced technology, our products can provide a better experience. First, as for the size and weight, if there are better materials developed, our inventions may be able to anchor on the bow better and reduce the burden of weight on players because of materials. Second, as for accuracy, with an advanced technology or design on how to combine all data and calculations, we believe the accuracy of automatic aiming will be improved. Third, as for types of bow, we just did more research on recurve bow, so in the future, we may do other research on other types of bow such as compound bow, longbow, or even barebow. We think our simple design and a bit cheaper price are suitable for students in school since low prices and no need to adjust for every student during archery lessons.

3) Conclusion

Our Eagle's Eye, which has a simple design, is convenient and easy to handle. Compared to modern sighting devices, our design has more functions and also can detect whether the user is having a correct posture so as to provide a better taste of archery for beginners.

We believe our design still has more development area, so with more financial support, technology and time, our design can be one of the best sighting devices.

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