STATEMENT OF DELIVERY

Room bug detector and killer

Statement of Original Work

I certify that the following used in the creation of this prototype are my own original work:

- Code found in Bug.cs
- Some codes found in ledBlink.cs and Room.cs
- Stage background color and camera settings

References for all external sources can be found on page X of this Document

Hyun Jeon 42865320

DECO2300 Studio 2 - Laura

Table of Contents

The concept

The concept of this project is to detect and alert user when there is a bug inside a room. Flying bugs such as mosquitos or creeping bugs such as spiders or cockroaches can be scary or annoying to the users. It is nearly impossible to live in such environments where there are no bugs. There will be some users, who do not care about living with bugs in their room, but there are large numbers of people who would hate to feel that they are living with a bug in a same room.

A detector will detect the bug with camera and sensor and will alarm the user with either sound or light. Users then will be able to locate the bug and flee from the room with bug until the bug leaves or try to catch/kill it.

The concept of this prototype is to find out the best suitable method to alert people when there is a bug in the room. Also, this prototype tests the psychological safe distance between the bug and what is the area users wants to be alerted.

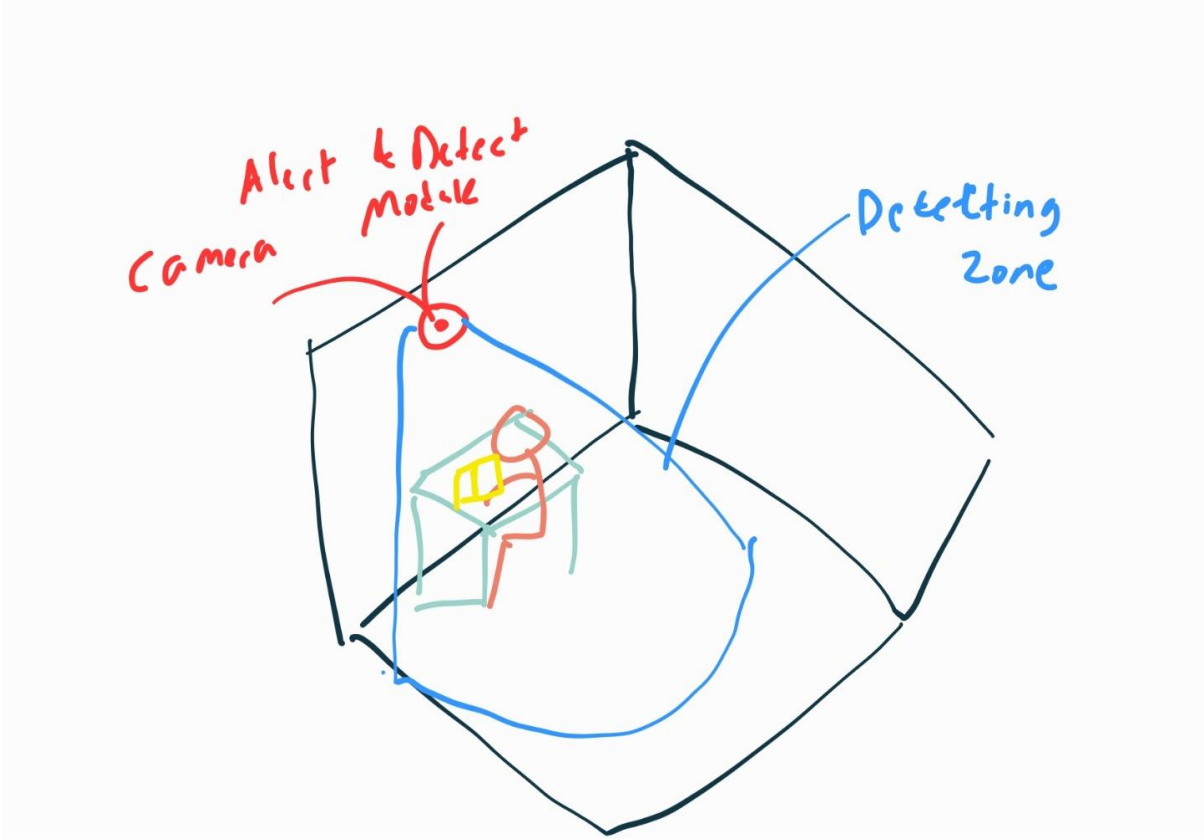


Image1 – Concept sketch of the detecting and alerting system

The purpose of this testing round

The purpose of this testing round is to prove the hypothesis that has been set and observe users' reactions in certain situations. These questions and hypothesis have been modified from previous testing round after its result. In this testing round, there is both physical prototype model that users can physically interact with and visual prototype to aid the users to feel more realistic. This physical testing will show users' more realistic reactions and visual aids will also help users to feel the situation more realistic.

This round of prototype is a Darkhorse prototype which extends the idea further to extreme and test something that is not available or something that has less chance of working. Some modifications on hypothesis has been made.

The hypothesis set were:

- People fear the bugs and don't want them in the same room
- People would want to know if there is a bug in their room
- People would want to kill the bug
- People would be alerted and look for bugs when alarmed
- People would turn the alarm off fast
- People would try to find the bug quickly and kill it fast

Some additional hypotheses for this testing round are:

- Users would prefer to kill the bug in a furthest distance possible
- Users would prefer to not clean the dead body of the bug
- Users will only want to know the bug if it enters a certain radius away from them

To find out and prove hypothesis, it was important to set questions that can answer the hypothesis and create prototype that can test all the questions.

As this prototype is for testing purposes, there will not be any gamification or game like interface, such as score. Also, there will not be any unnecessary graphics or sounds that will make the prototype look unrealistic.

The main aim of this prototype testing is to find out if the idea is helpful to the users and find any improvements from observation and interviews.

The additional hypothesis in this testing round is made from observation in previous round of testing. Each physical interaction users make are timed to see how fast users react to each case. This will give idea on how users feel about the alarm and the bug.

The form of the prototype

This prototype is a Darkhorse prototype, which is testing out some extreme technology which has very scarce chance of working.

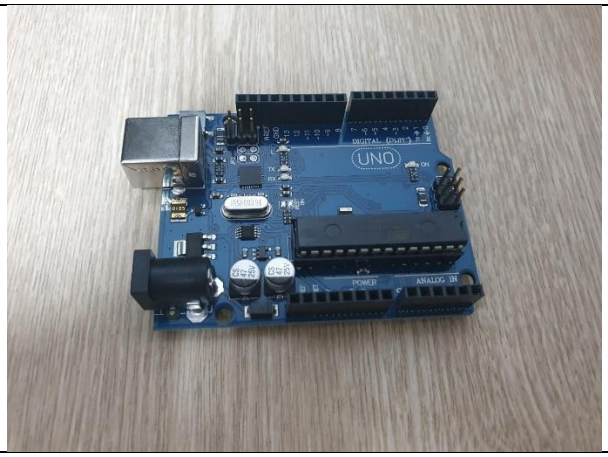
The visual prototype was built on Unity with graphics and C# coding.

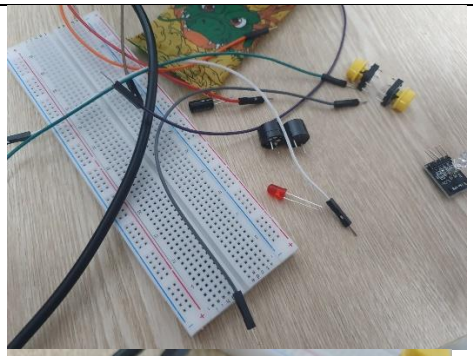
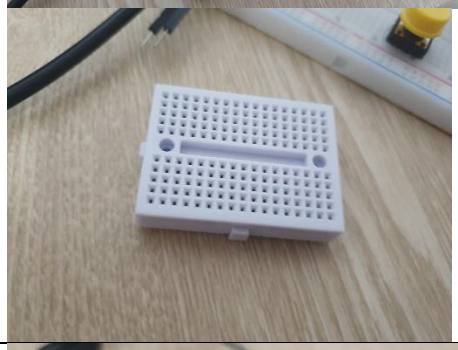
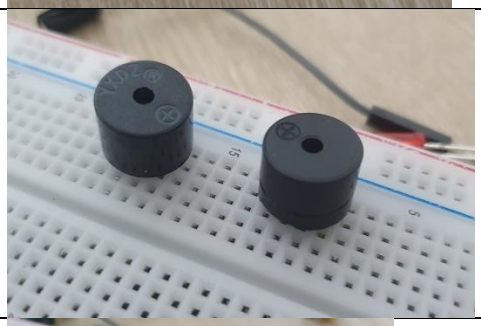
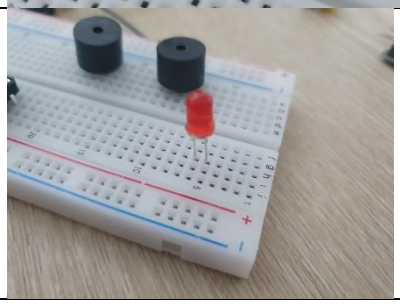
The physical prototype was built with Arduino, specifically Arduino uno model, with multiple sensors attached to it.

Some of the sensors and objects that are used are:

- Buzzers – Passive & Active
- LEDs
- Infrared Receiver
- Infrared Remote Controller
- Servo Motor
- Toy Spider
- Laser Pointer
- Electrical Bug Racquet
- A Book

Table1 – Table of images of the devices, objects and sensors planned to be used for the prototype

Arduino Uno		

Breadboard and Cables	 
Passive & Active Speakers	
LEDs	

Infrared Switch and receiver	
Electrical Bug Killer/racquet	  

Visual Prototype with Unity

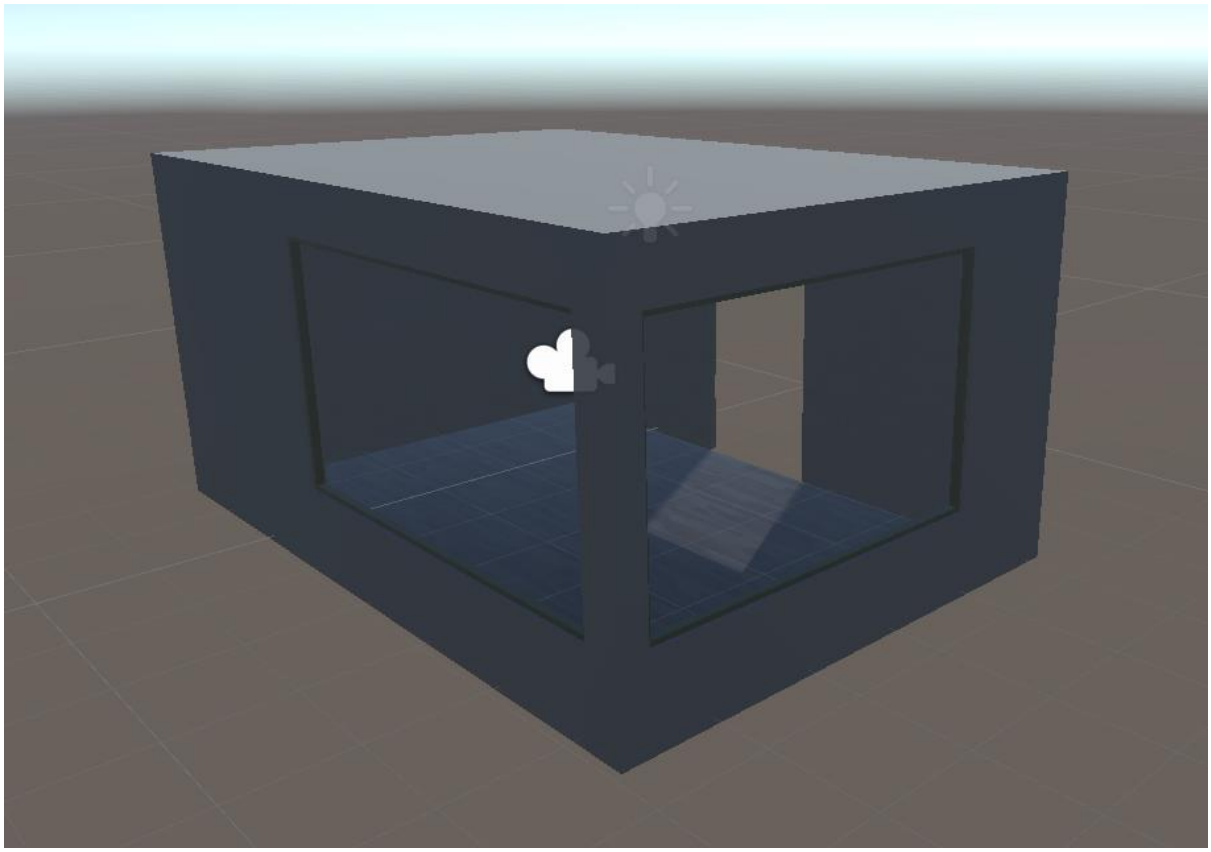


Image 2: Room where the test is held

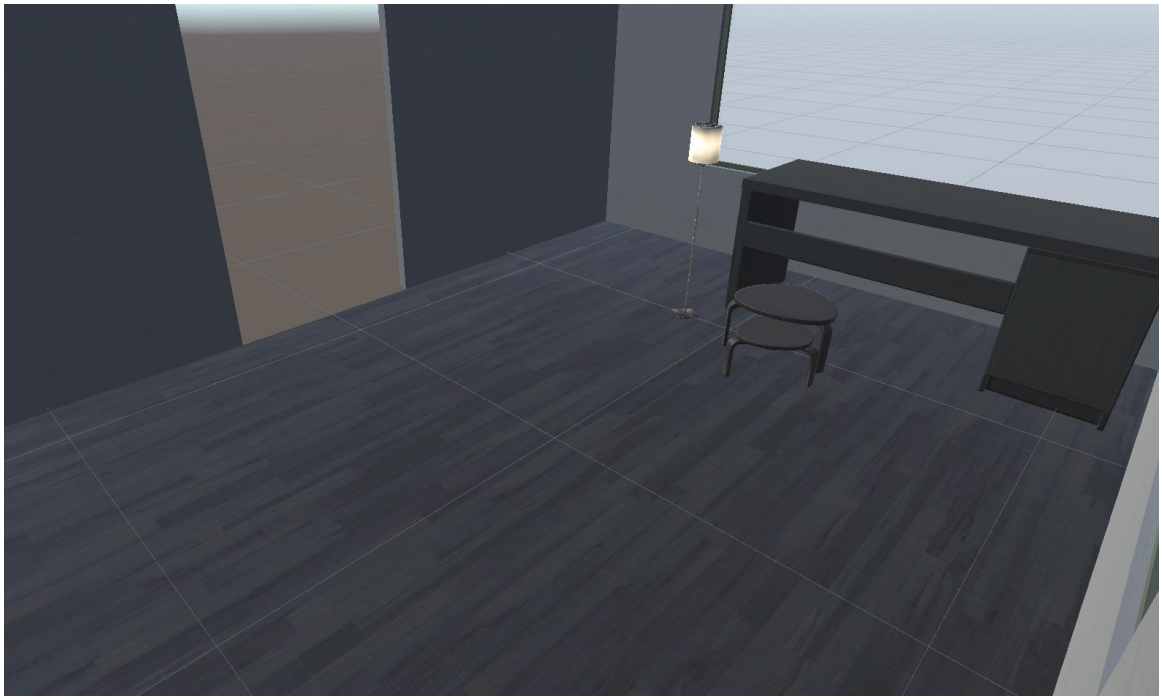


Image 3: How the room looks from inside

Image 4: Spider from Unity Asset Store

Image 5: Starting viewpoint of the user during the testing

The room was created in a rectangular shape with some furniture to make the room more realistic.

The spider that has been created has been set as a prefab that will be randomly generated in random area and move randomly around the plane. This spider will be killed and removed once they have been clicked by mouse or Arduino model gets physically interacted. In this testing round the bug will be killed if the remote control signal gets received by infrared sensor, which is suppose to be a laser pointer.

The camera acts as the user instead of making another object to be a user, as this is not a game and making the view first person will make the testing more realistic. Users can control the camera to move up and down and go front and back, so the users can find the emotional safe distance from the bug.

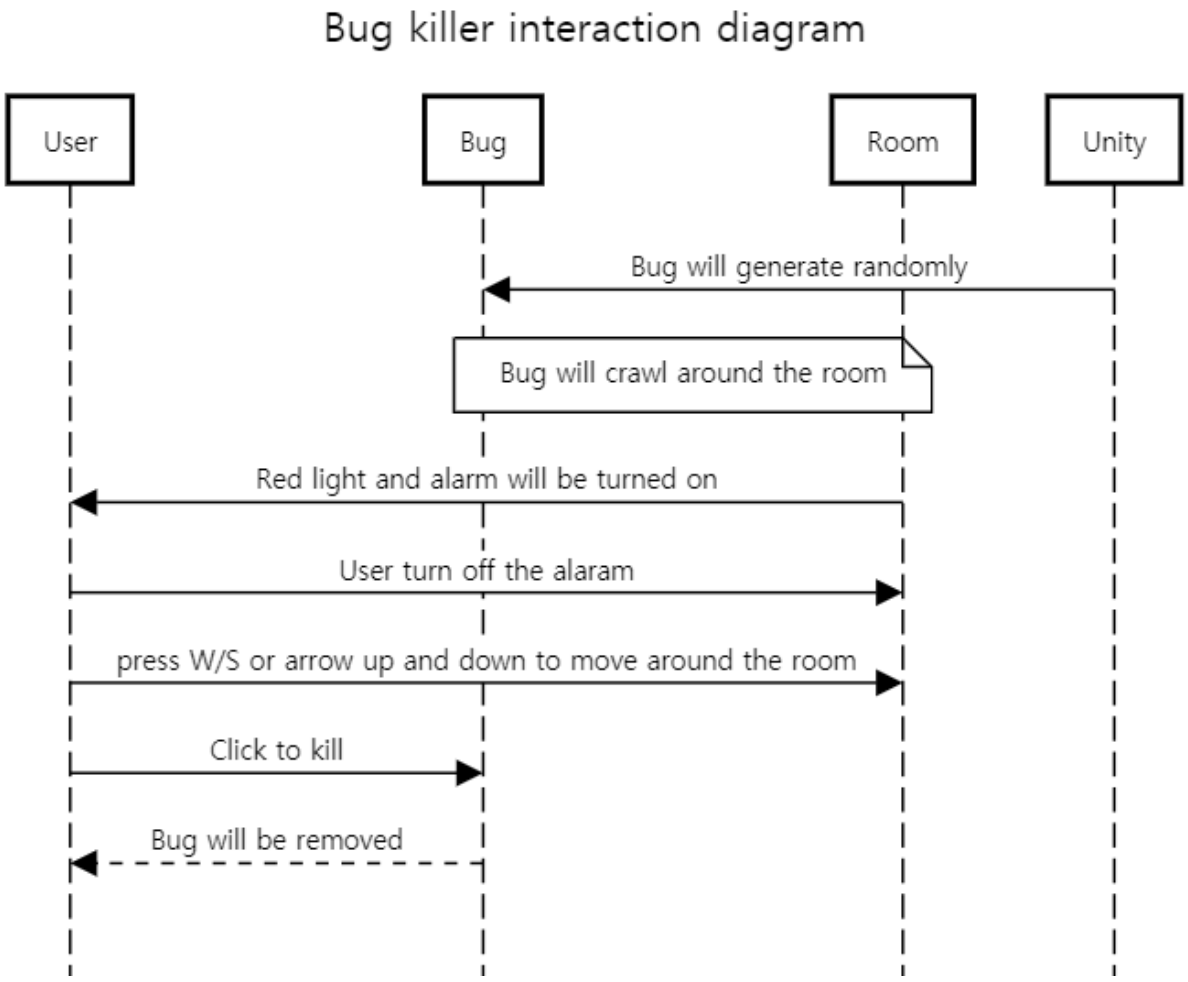


Image 6: Interaction Diagram of the prototype

As the game start unity will generate bug to the room. Once bugs are generated room will alert the user with red light and alarming noise.

Once user finds the bug user will click to kill the bug or decide to move back and flee.

The physical prototype

The physical prototype built by Arduino connects with unity and communicate together to perform the physical interactions on to the visual prototype.

The physical prototype is built in to two parts, alarm part, bug mimicked by servo motor with sensor.

The alarm is built with buzzer and led. Whenever the bug appears on the visual prototype(unity), alarm will run with the light in led and sound in buzzer. Users can interact with this alarm by pressing the off button on the remote control.

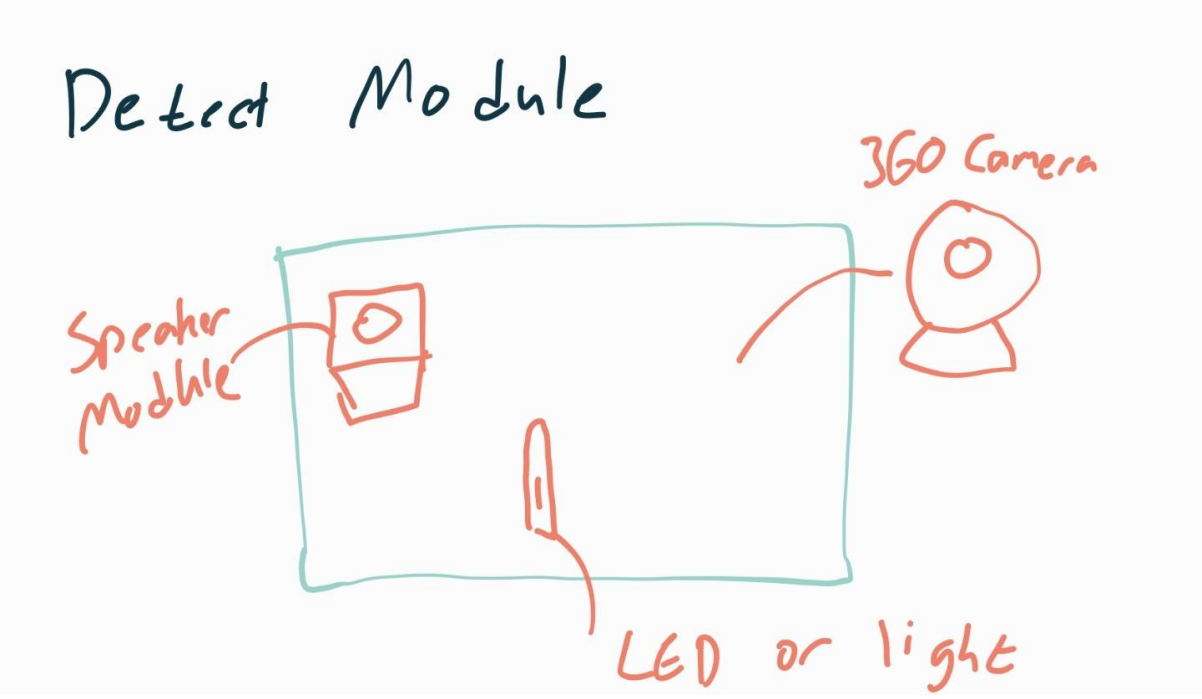


Image 7: Concept build sketch for detect module

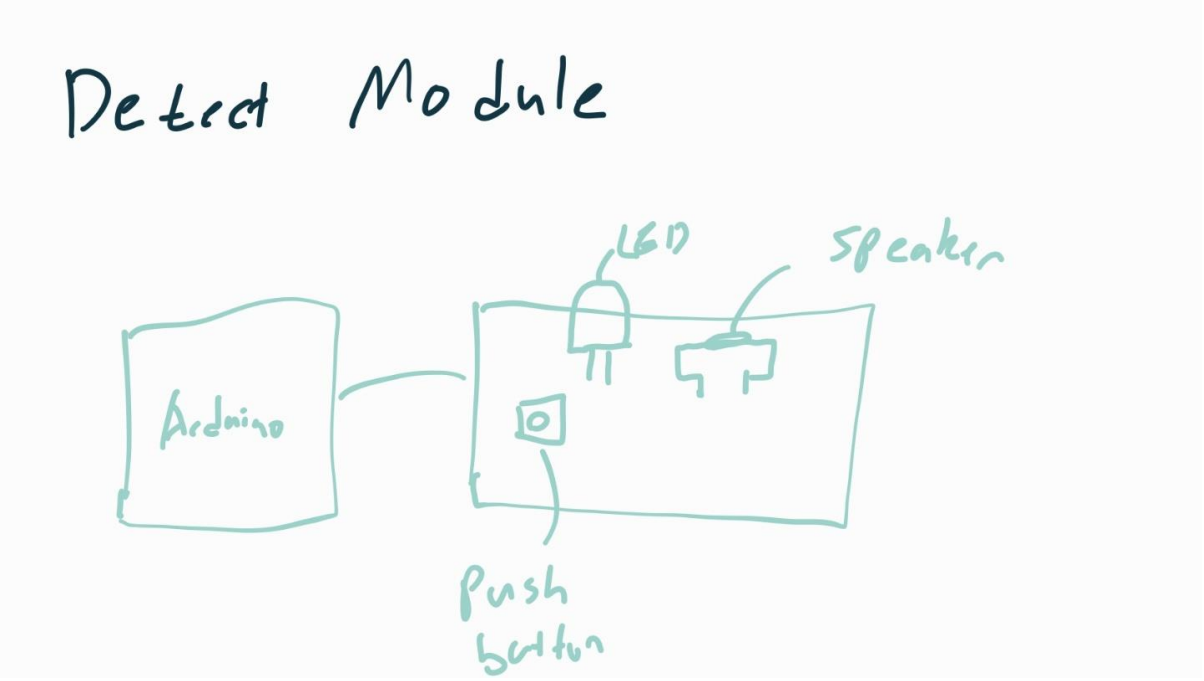


Image 8: Sketch of actual detecting module attached to Arduino

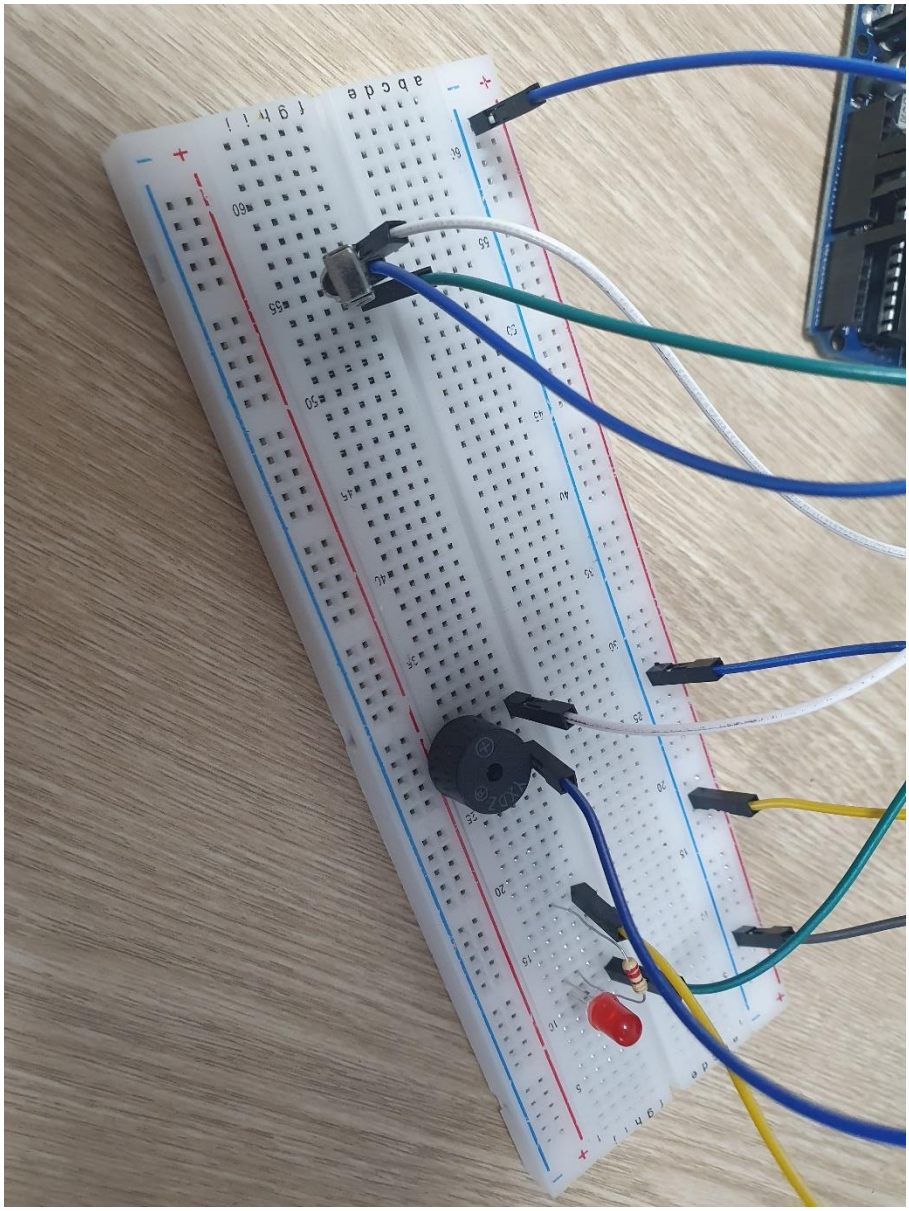


Image 9: Photographed image of the breadboard with sensors

The servo motor has been connected to the Arduino to act as the bug. Some cable ties have been attached to connect the motor to the toy bug to mimic the movement of a bug, so the users can feel more realistic.

Image 10: Photographed image of the servo motor and cable ties

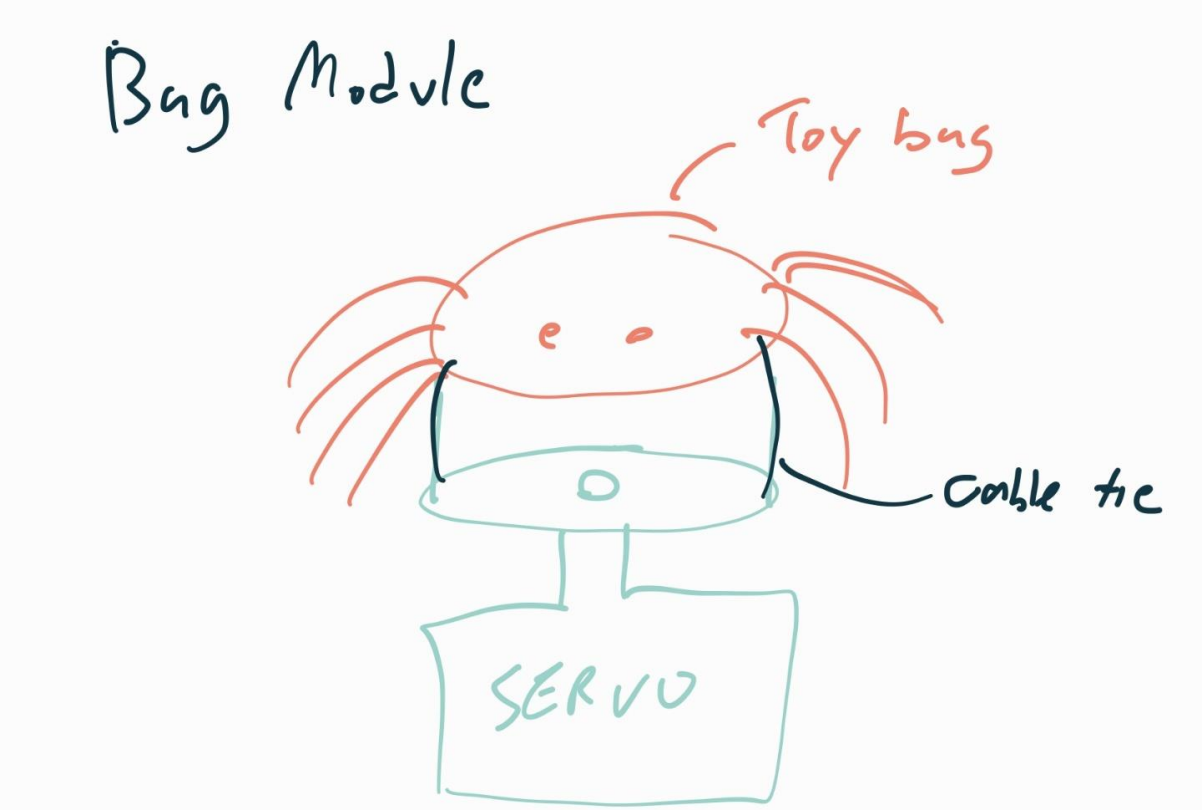


Image 11: Photographed image of toy bug attached to the servo motor

The bug originally planned to have a light sensor attached to it to receive the light from the laser pointer to detect the signal to kill the bug. However, this was not functioning properly, due to the sensor not being able to read the light from the laser pointer. There maybe a sensor that can read the laser light, but the sensor that was in hand did not function.

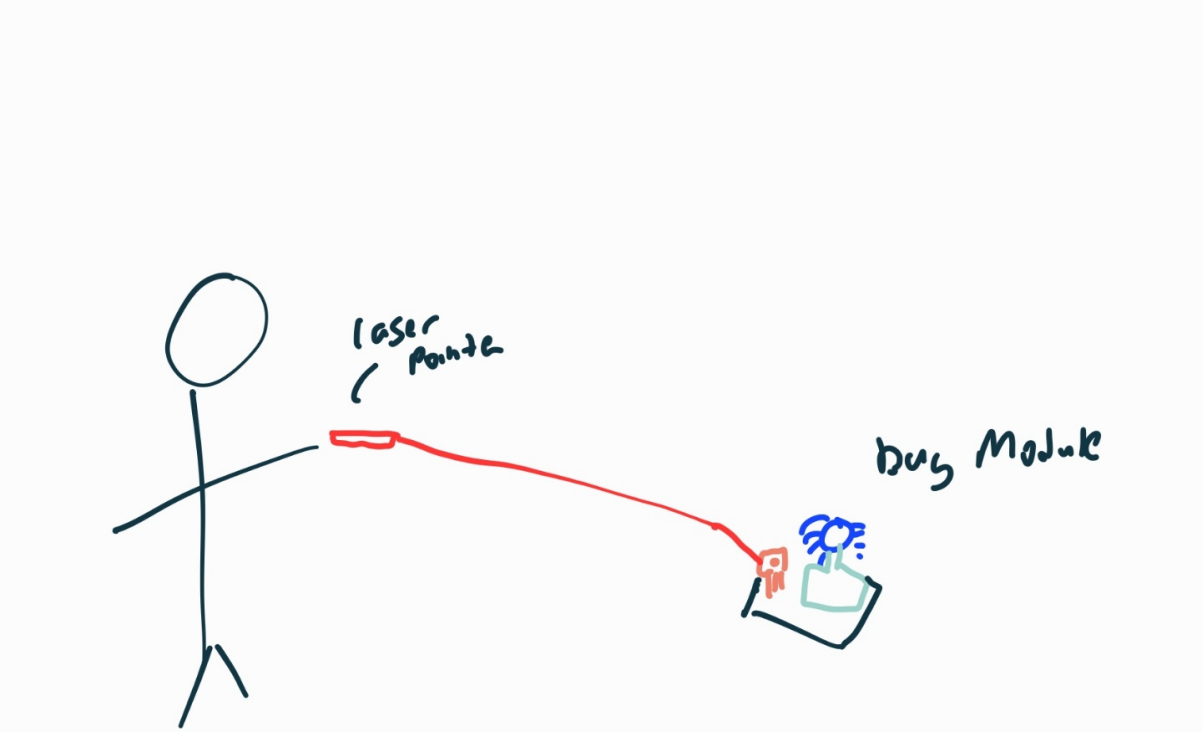


Image 12: Concept sketch of shooting laser to the bug module

Due to this reason, the light sensor was replaced with infrared sensor which receives signal from the infrared remote control.

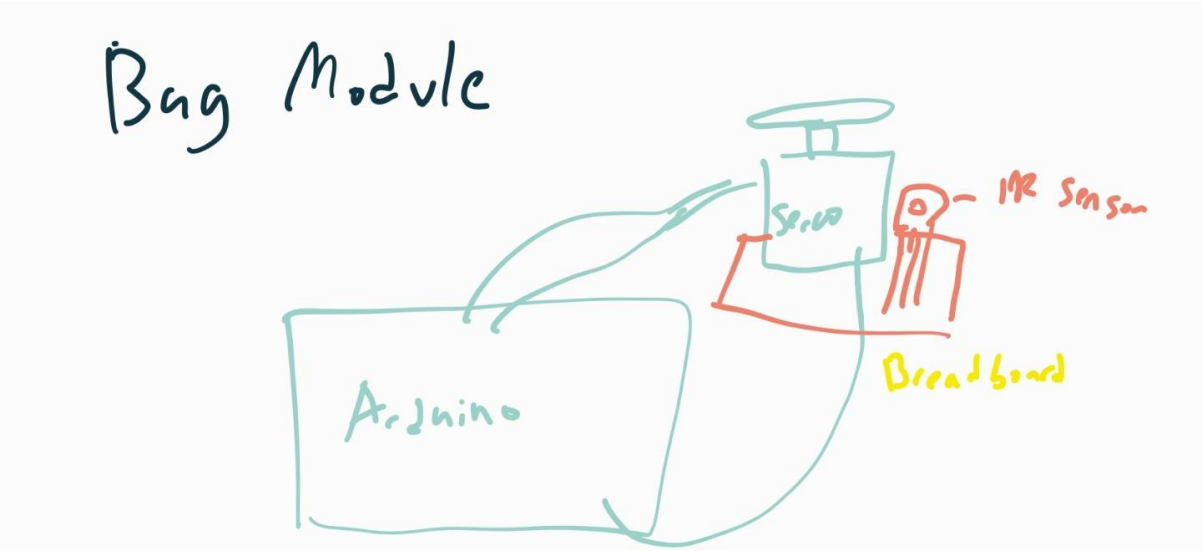


Image 13: Concept sketch diagram of the bug module connected to Arduino

Full testing prototype

In a unity room user will be placed. Randomly bug will appear in unity room and the physical alarm will run with red LED and sound buzzer. Users can press the button on the physical alarm to deactivate the alarm. User first have a method to move closer to the bug. In physical testing model user can decide to walk towards the bug module or to move away and in the visual testing model, users can press the arrow keys instead. After this process users can decide to choose between 3 methods to kill the bug. First option is to use a classic method of smashing the bug with a book. Second option is to use electric racquet to activate the electricity to zap the bug and the third option is to shoot a laser with a laser pointer to the bug to kill it.

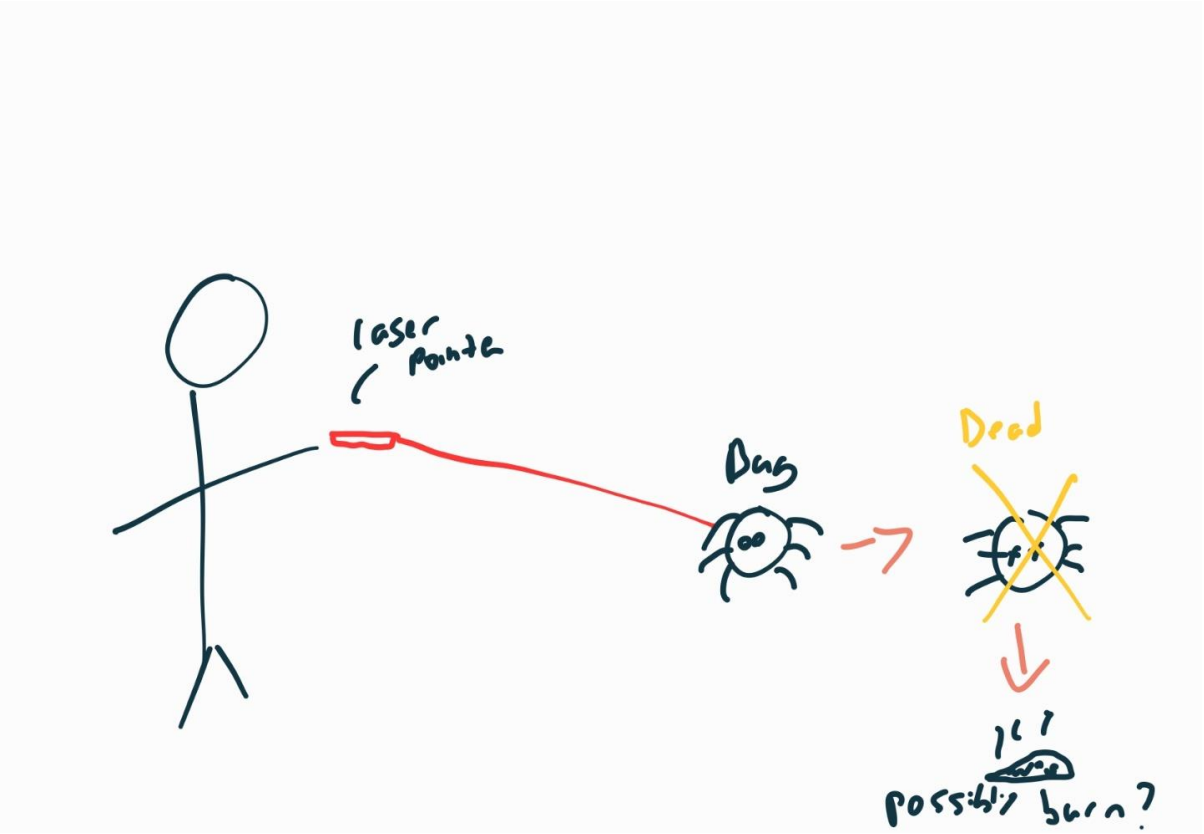


Image 14: Concept sketch of the final prototype

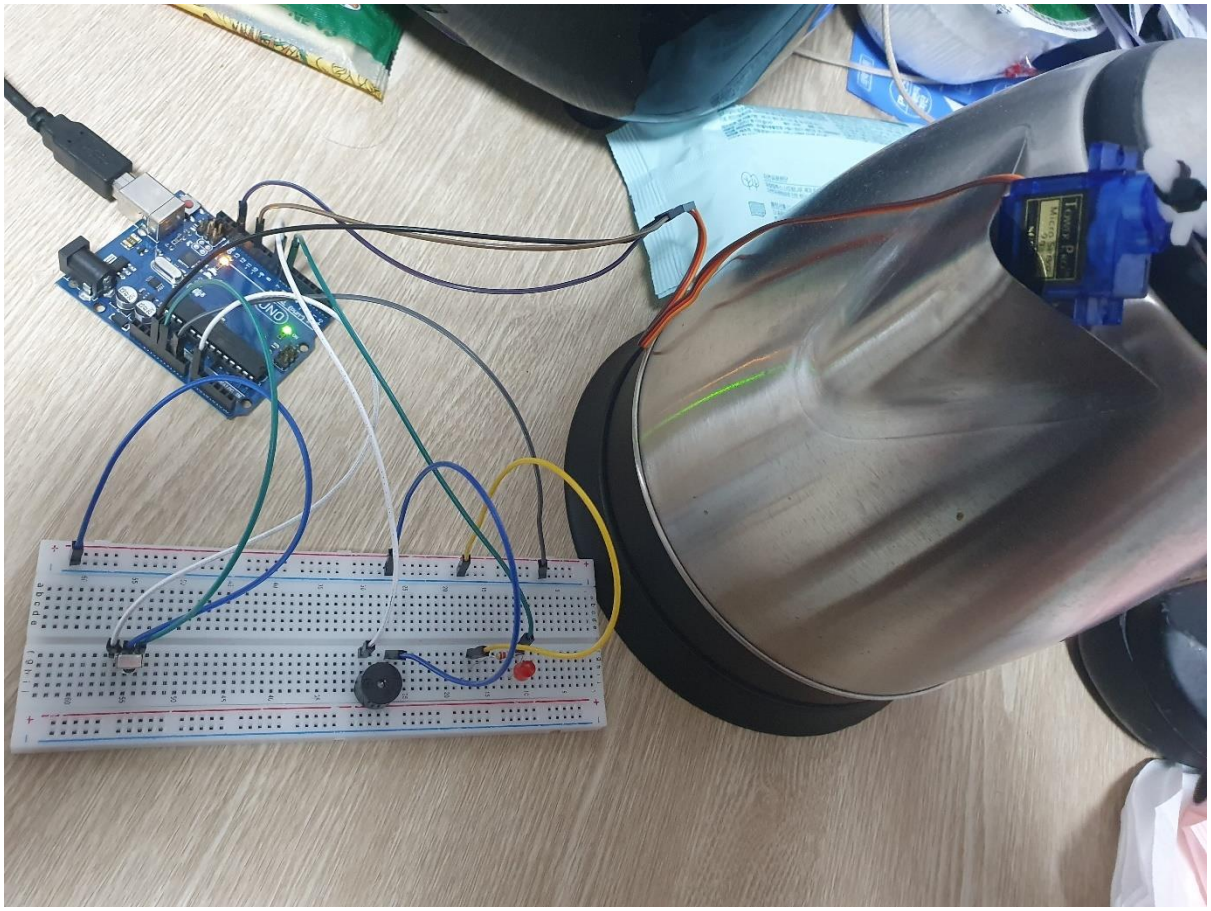


Image 15: Image of final prototype with sensors on breadboard

The testing approaches

The testing was taken to observe the user's reaction and to receive feedbacks after the testing. Before the testing, users were explained about the purpose and information about the test. The manual to move towards or away from the bug and 3 methods to kill the bug was given to the user. Testing was conducted with 2 different methods. First method was online version, as current condition with COVID, many users were tested through 'zoom' screen share with giving orders to perform reactions. This did not give accurate responses, as there were many delays due to internet and did not give users any physical interactions, so it was difficult to gain much information from this. Second method was in-person testing. Few of the friends were invited to do the testing with actual physical model and testing has been conducted.

First for user to feel more realistic and closer to the actual testing, user's imagination was required. As this is simple prototype and does not have any VR/AR features applying user's imagination was the method chosen to make user's feel as if they were in the room. Users were introduced to the room and was told to stay calm and imagine as if they were inside that room. Users were told that they could be doing anything while waiting for the test to begin.

After a minute or two the prototype game was played by generating crawling bugs into the room. As the bugs are generated, the physical alarm will start to run with red light on LED and alarming sound on the buzzer. Users will be able to act after this to move towards or away from the bug. As users were told that the alarm means that there is a bug in the room, users will be alerted to find the bug. After user notices the bug, user can decide to move towards or away from the bug. After user positions themselves, they can choose between 3 methods to kill the bug.

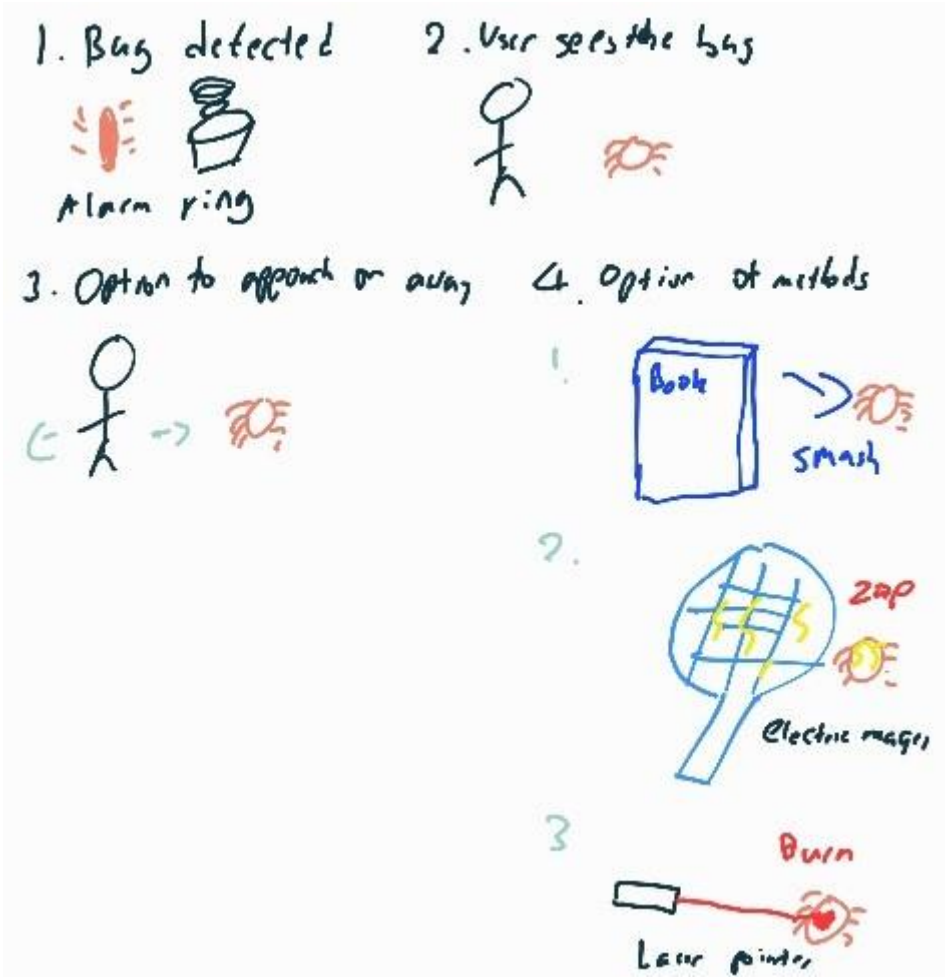


Image 16: Sketch of the user's process

Online testing

To observe properly users were explained well before the testing. This online testing was mainly relied on the visual model on unity.

The key observations to be made during the test were:

1. How much did the users move and what was the distance between the user and the bug
2. Which method did user decide to use

These observations are critical in the testing as this would show how users will react in such case and find out what users would do in such cases. This will help proving the hypothesis.

However, this online testing did not go very well, as it did not give any realistic feeling to the users which is the pros of creating a physical prototype.

Offline testing

To observe properly users were explained well before the testing and as this was an offline testing, users were let free in the room without any interference and physical model was mainly used.

The key observations to be made during the test were:

1. How did user react when the alarm first started?
2. How much did the users move and what was the distance between the user and the bug?
3. Which method did user decide to use?

These observations are critical in the testing as this would show how users will react in such case and find out what users would do in such cases. This will help proving the hypothesis.

After the test completion users were interviewed with several questions.

The questions were:

1. How did you feel about the alarm?
2. Why did you approach or move away from the bug?
3. How much do you think you moved?
4. How much do you think is a safe distance between you and the bug?
5. Which method did you choose to kill the bug and why?
6. If not used laser, why?

These questions are asked as an interview after the observation, so not all the questions are needed to be asked and they don't have to be in any order.

These interviews will get deeper understanding of the user reactions that were observed and how user's felt.

Evaluation Outcomes & Reflection

During the observation of the online testing, there were number of issues, with disconnection during the testing, delay in communication and miscommunications. To test a physical prototype, online environment was not suitable, and the results would not be much accurate and meaningful. So, in this testing round results from the online testing will be only used as reference and main evaluation would be done on the testing with offline users.

After users were explained about the functionality of the laser pointer the testing was conducted. When the test conducted, the user was placed around 1 meter away from the toy bug with module. The visual model was also set around 1 meter away and was explained about this. After the alarm started, there were 3 types of users. Some users started to walk towards the bug, some users started to move away from the bug, some user stood still. Even though their movement decision was different, they all moved in a slow careful pace instead of moving in a fast speed. Users explained that they moved in slow speed so that they do not make the bug run away and hide again.

After their movement ended, users were given 3 choices to kill the bug. Large number or users chose electrical racquet. (5/8) and all other users chose the laser pointer. There was no one who chose the classic book and smash method.

All the users who decided to use the electric racquet approached the bug in a distance as close as 20cm to 60cm away from the bug. These users explained that they felt more stable to kill the bug in a short distance, so they do not miss it and have faster second chance when the bug tries to flee. They chose the electric racquet as they felt that it was much more trustworthy compared to book or laser. These users did not trust the laser or was worried about it. Some users answered that they were not confident with the accuracy with the small light and that laser will kill the bug. Some others replied that they were unsure about the safety of the laser, especially the bug was on a metallic kettle which has reflective surface.

One user has mentioned the concept 'Bigger they are easier they are to use' and criticized that the laser pointer is just too small to use and worried it won't have much affect on bigger bugs and difficult to target small bugs. This user suggested to making the function to adjust the size of the laser beam shot, but also was worried that this may burn or harm other people or animals.

It seemed that many users preferred to use well known and experienced technology than a new technology which is not familiar to them.

2 out of 3 users moved away from the bug going somewhere between 1.5~2 meters away from the bug. One user stood still on their original position and killed the bug with laser. This user explained their action as that he did not want to make the bug notice him move, so the bug moves from its original position. Other two users who moved away explained that they wanted to go far away from the bug, but in a somewhat distance that they can shoot the laser to kill the bug.

These users decided to user laser over book or electrical racquet, but they also did not trust the laser fully and showed some concerns. However, they still decided to choose the laser as they wanted to stay far away from the bug, and even the laser doesn't kill the bug, they would feel much safer in such distance.

The users were asked what the emotional safe distance from the bug is and many answered in range between 1.5~3 meters. Even those people who approached the bug to kill it with the electric racquet explained that if they could stay away and kill them.

This result shows that the emotional safe distance is somewhat between 1.5~3 meters and users would use the method to kill the bug from this distance away if it is safe and easy to use.

The main issue with the laser was that the pointer size is too small and if the laser has power to kill the bug, it can burn or harm other livings or housings.

When the users were asked to try the laser method considering that laser is safe to use, they all gave positive response. Users all experienced psychological safety and emotionally settled.

In overall the user seems to be feel safe in a far distance away from the bug and would want to kill or remove the bug in their comfort zone, using a strong affective method that they are familiar with and can trust.

Miro Link

https://miro.com/app/board/o9J_l3Z7P24=/

Video Link

https://youtu.be/OvoG_gkj5MI

Appendix

Scripts of user interviews. Offline test users were not recorded, so the scripts are missing.

Online test user 1

You chose method to go closer to the bug.

Why did u choose this over killing bug with laser with fast?

Choose the laser - but unconfident with the accuracy as a small laser light than kill the bug with the racquet

Laser was high powered and burn the bug. - Would definitely use this.

Definitely would use this

Much comfortable, less stressed and emotionally confident

Online test user 2

You chose the method to kill with laser,

kill it from far away. - Would throw the book rather than going closer.

Much more comfortable.

Feel safer, not afraid of bug but annoying and don't want to approach.

Less stressed.

Further away - 1.5m is not that bad maybe more to 2m.

If too far, not confident that laser will kill and bug can move away and hide.

Ideally if there was no limit to the laser distance, would run furthest away and use the laser.

Do you trust it?

Not completely, but even it doesn't kill I am far away from the bug so I can try different method later.

Really good idea, the radius of the laser light was bigger. Since there can be big bugs and difficult to point small light to the bug.

Also, maybe use some kind of bug spray.

Mix with electrical racquet, so incase it is in closer range and can not shoot the bug with laser in time you can kill the bug.

It's fine since it is dead. More ideal if the laser kill the bug and burns it can see that the bug is completely removed.

Online test user 3

You the chose method to kill the bug with electric racquet.

Not hard.

Laser pointer would be harder to control. Easier to control

Point something wrong. - Kill cat or point something wrong.

Feel more confident.

Confident - something I originally know familiar. Bigger they are easier to use.

Too small, small target size.

Risk annoying.

If the flashlight size and adjust the size of the light.

confident distance. 2-3meters.

Don't like bugs

Small spider and if I don't notice I feel fine.

Only want to know if it is very closer like 1m radius away.

Not harmful if it's away in distance.

It would be too much. annoying to be noticed too often.

Bug catcher - something that doesn't kill, paralyzing.

Teleports - move the bug.

References

Image Assets Used:

Animated low poly spider by Cattleya. Retrieved from Unity Asset Store (https://assetstore.unity.com/packages/3d/characters/animals/insects/animated-low-poly-spider-125114). Last accessed 1 September 2021

Office Room Furniture by Elcanestay. Retrieved from Unity Asset Store (https://assetstore.unity.com/packages/3d/props/furniture/office-room-furniture-70884). Last accessed 30 August 2021

Code Used:

(How to move camera) retrieved from Youtube by Professor Saad. (https://www.youtube.com/watch?v=uaiMvAK6Y0g). Last Accessed 1 September 2021

(Unity prefab and instantiate) retrieved from Unity Documentation (https://docs.unity3d.com/kr/530/Manual/InstantiatingPrefabs.html). Last Accessed 30 August 2021

(How to use IR remote control and receiver) retrieved from Arduino Documentation (https://create.arduino.cc/projecthub/electropeak/use-an-ir-remote-transmitter-and-receiver-with-arduino-1e6bc8) . Last Accessed 21 September 2021

(How to use IR remote control and receiver) retrieved from Youtube by DroneBot Workshop. (https://www.youtube.com/watch?v=8E3ltjnbV0c). Last Accessed 22 September 2021

(TRCT5000 proximity sensor with Arduino) retrieved from Youtube by The White Byte. (https://www.youtube.com/watch?v=iJfgHXbBrGg). Last Accessed 22 September 2021

(Code to use LED and Buzzer) retrieved from Basic Ardunio ("처음봐? 아두이노" – Korean book) by Yu. C. Last Accessed 23 September 2021

(Uduino, tool to connect Arduino and Unity) retrieved from Unity Asset Store (https://assetstore.unity.com/packages/tools/input-management/uduino-arduino-and-unity-communication-simple-fast-and-stable-78402?locale=ko-KR). Last Accessed 23 September 2021