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 and some code found in Room.cs
- Some codes found in ledBlink
- 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

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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 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 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 a physical prototype model that users can physically interact with. This physical testing will show users' more realistic reactions compared to watching a 3D animation from previous testing round.

The hypothesis set are:

- 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

Some additional hypotheses for this testing round are:

- People would turn the alarm off fast
- People would try to find the bug quickly and kill it fast

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

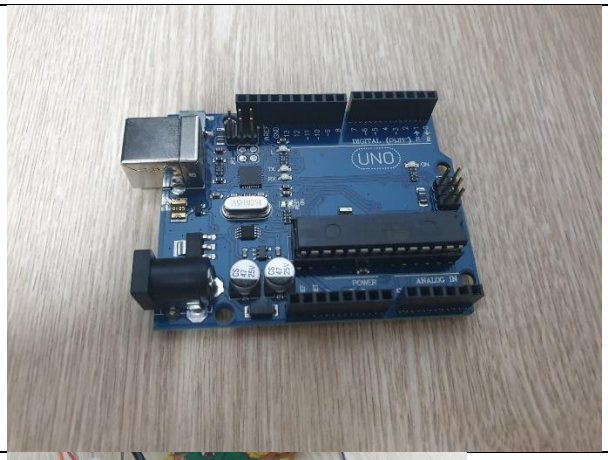
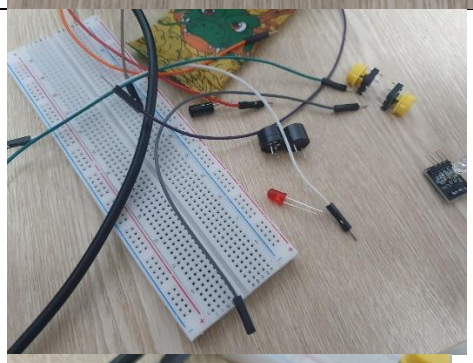
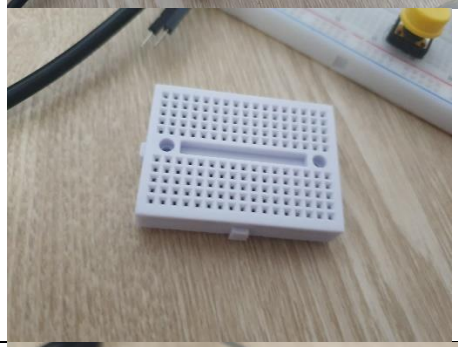
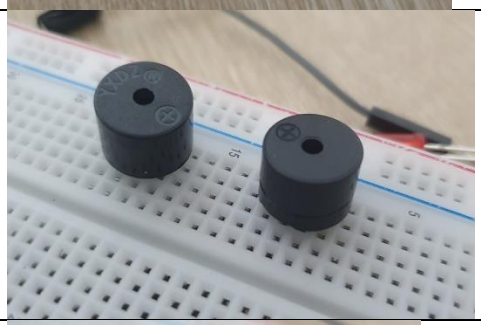
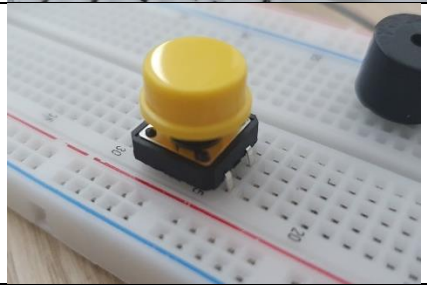
The visual prototype was built on Unity with graphics and C# coding.

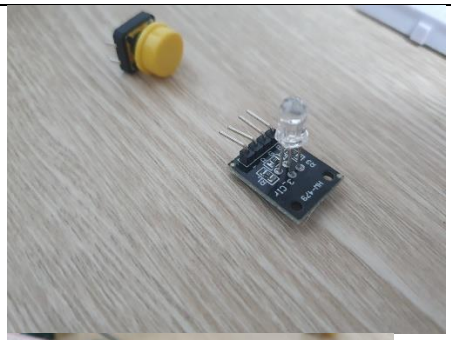
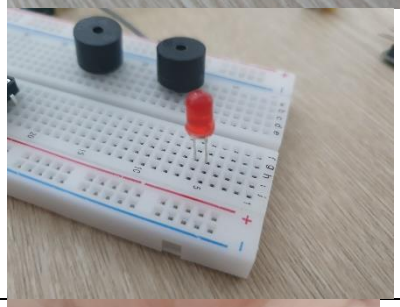
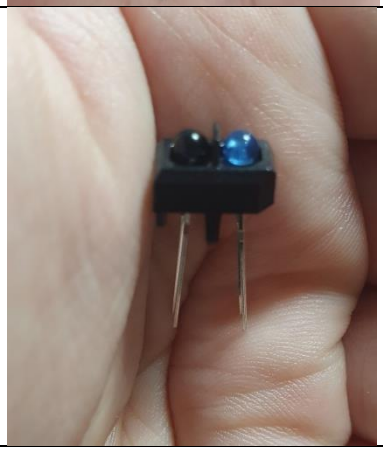
The physical prototype was built with Arduino, specifically Arduino uno model, with multiple sensors attached to it.

Some of the sensors and objects that are used are:

- Buzzers – Passive & Active
- Buttons
- LEDs
- Tilt sensor/switch (SW520D)
- Infrared receiver and remote control
- Proximity Sensor (TCRT5000)

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	
Button	

LEDs	 
Tilt Sensor/Switch	
Proximity Sensor	

Infrared Switch and receiver	
Electrical Bug Killer/racquet	  

Visual Prototype with Unity

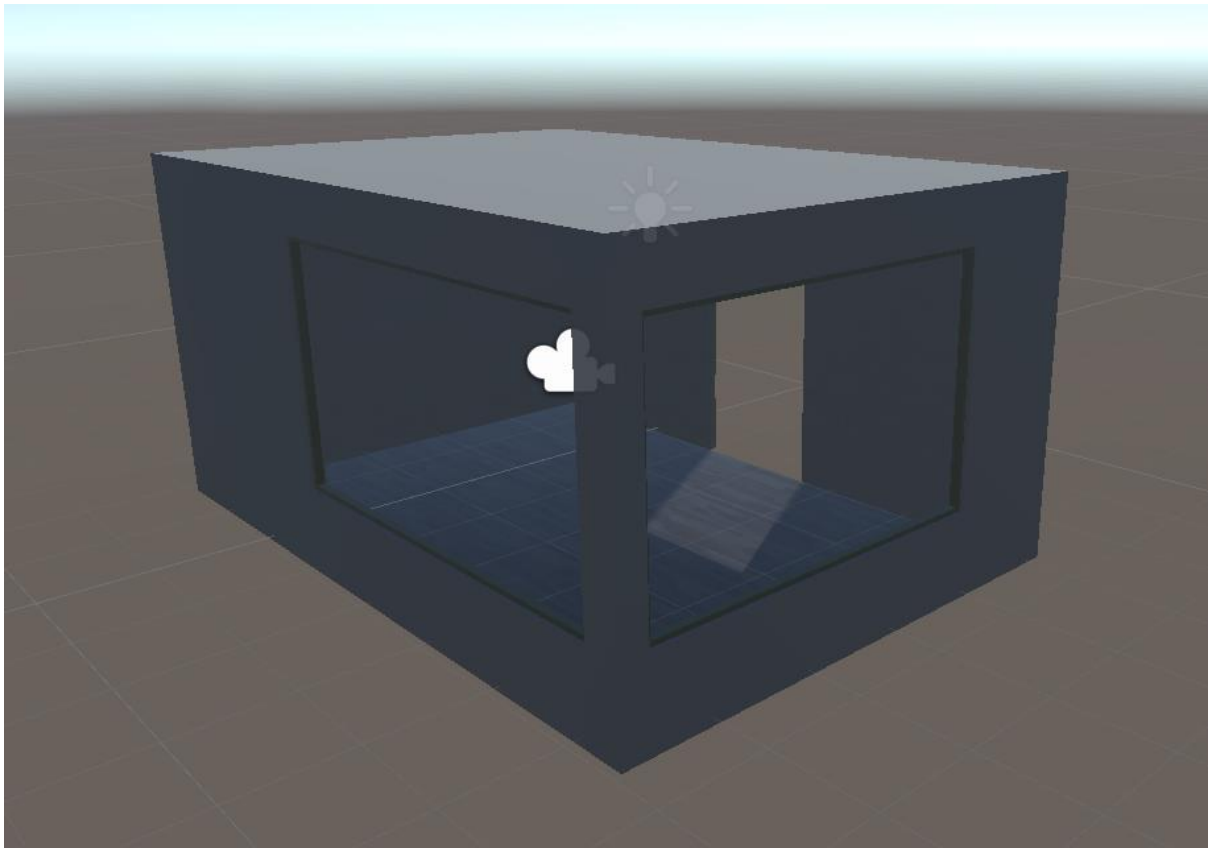


Image 1: Room where the test is held

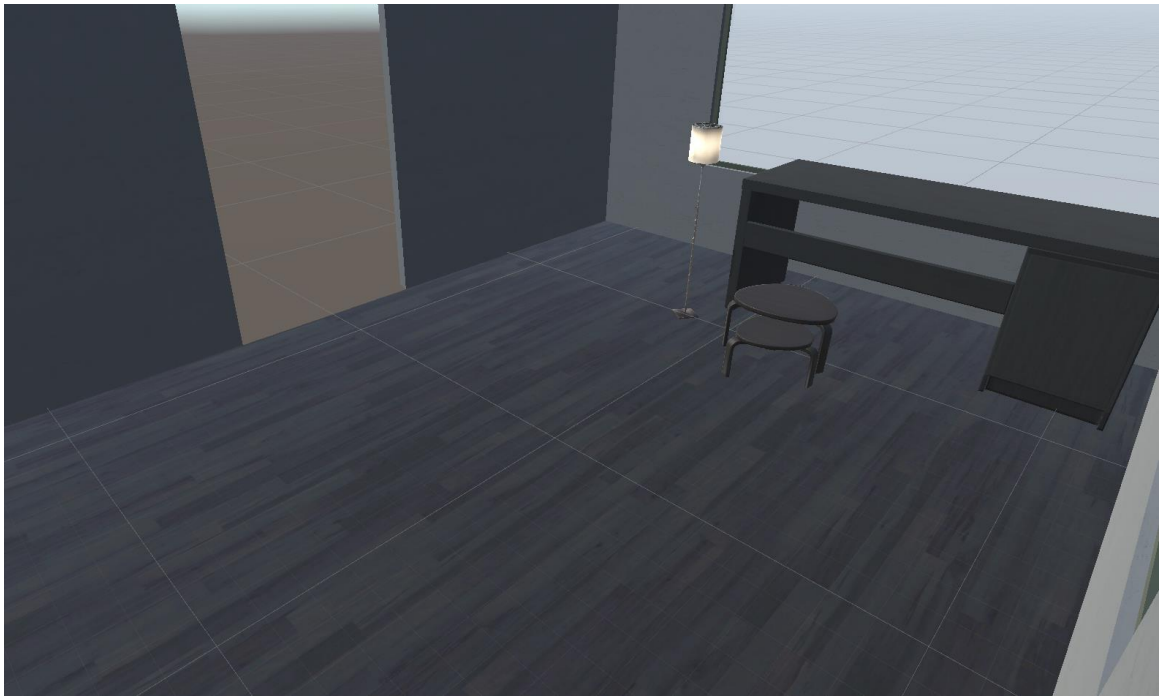


Image 2: How the room looks from inside

Image 3: Spider from Unity Asset Store

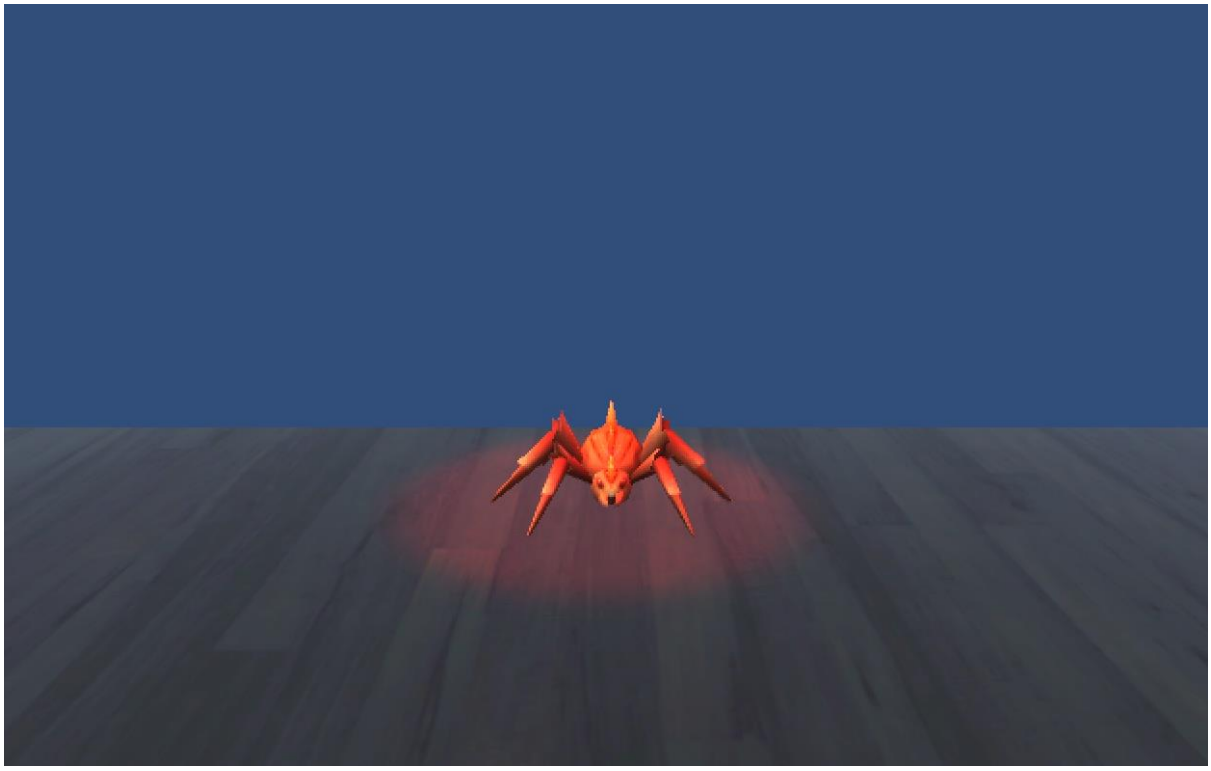


Image 4: Actual viewpoint of the user during the testing

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. In this testing round the bug will be killed if the tilt sensor/switch is changed by the swing movement of the racquet.

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 go front and backwards and rotate left and right.

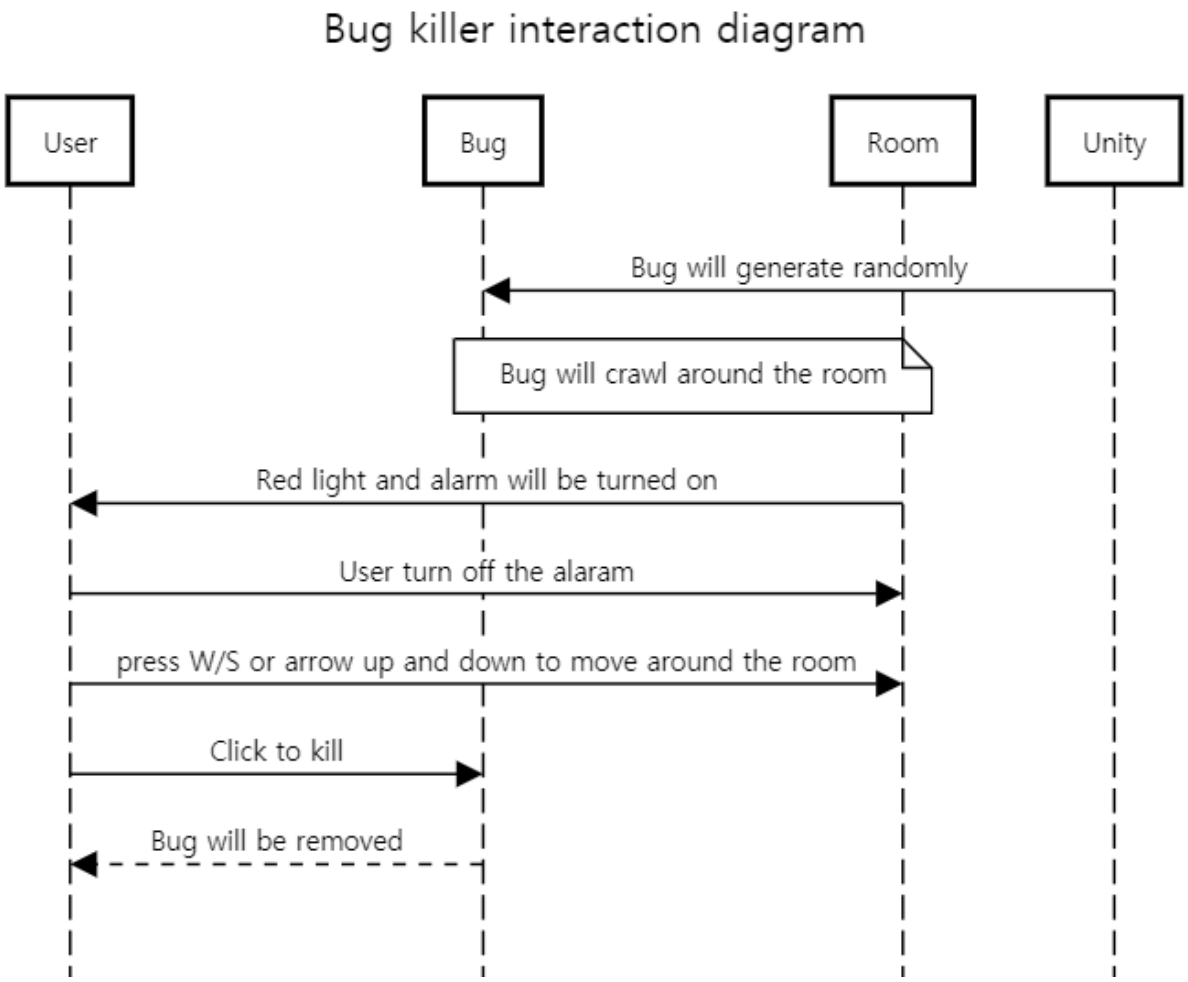


Image 5: Interaction Diagram of the prototype

As the game start unity will generate bugs randomly to the room. Once bugs are generated room will alert the user with red light and alarming noise. User will then turn off the alarm and press WASD or arrow key to move around the room to find the bug.

Once user finds the bug user will click to kill the bug.

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, sensor/alarm, and the bug killer.

The alarm is built with buzzer, led and a button. 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 button to kill the alarm.

The bug killer was planned to be built with tilt sensor and an button on an electric bug killer racquet. This would have given users to press the button to zap and kill the bug or swing the racquet to 180-degree angle to activate the switch which will also kill the bug. There are 2 different methods of killing the bug to observe users prefer the classic swing and kill method or electrocute the bug.

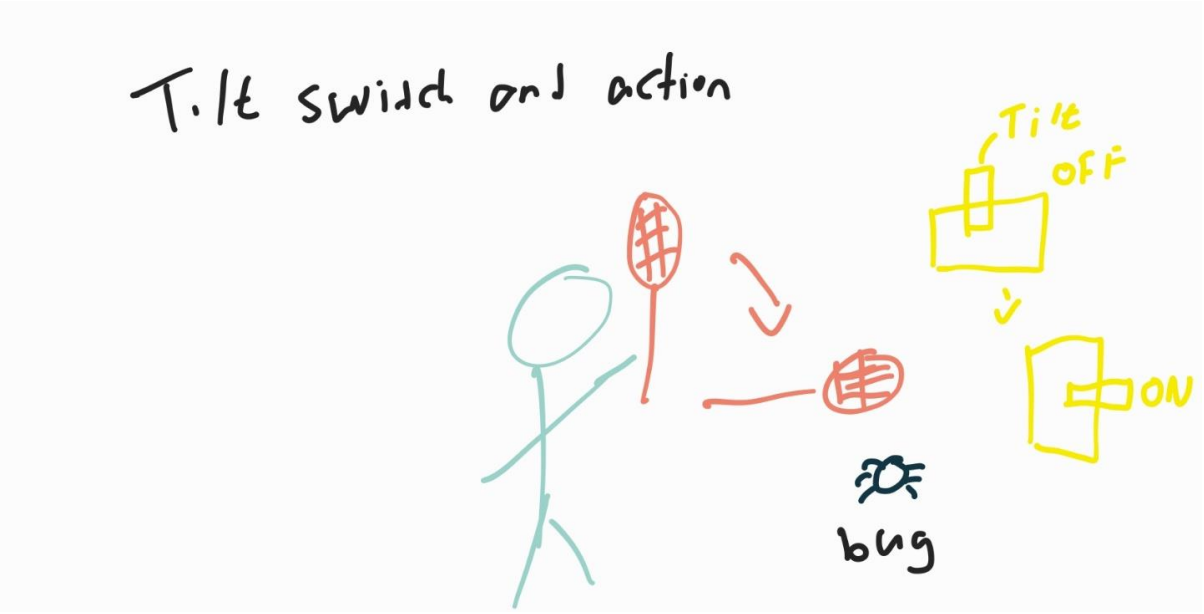


Image 6: Sketch of the concept on user's interaction with the racquet

This prototype was not successful due to the limitation of cables. To connect the bug killer racquet and Arduino device, a breadboard with switch and tilt sensor was attached to the racquet with rubber band as image below.

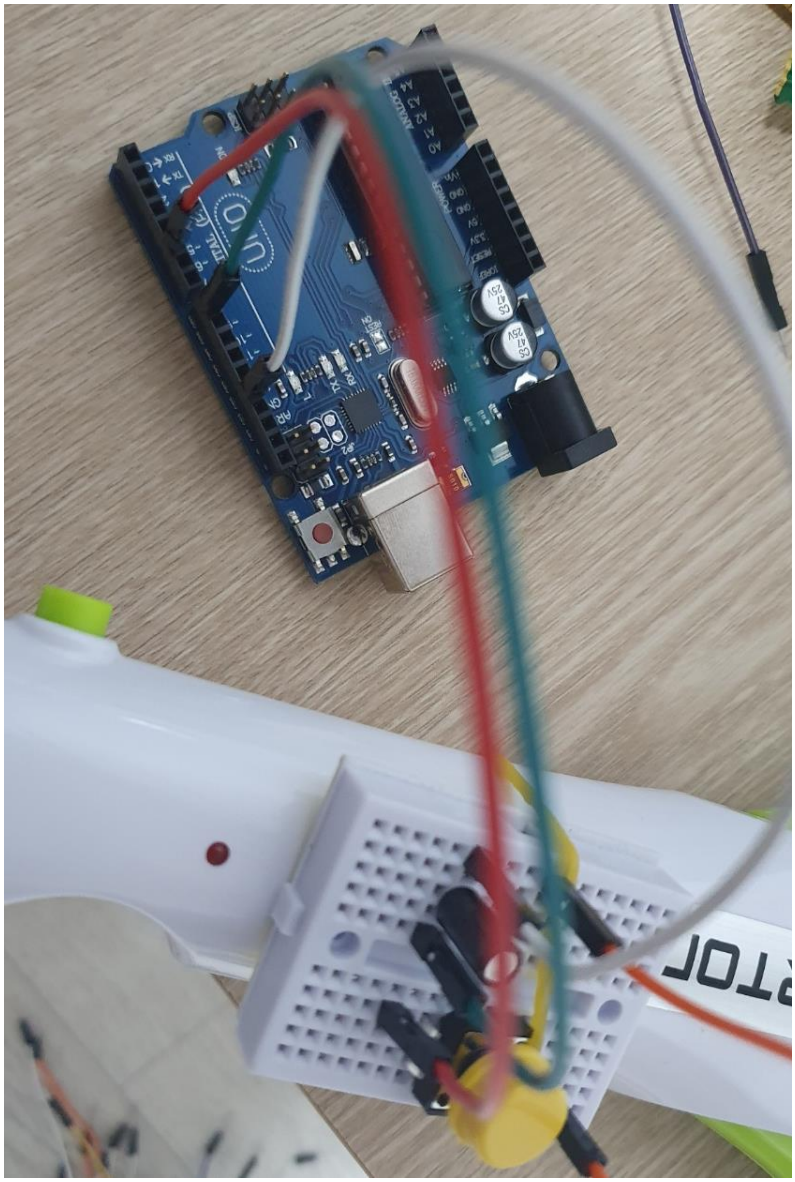


Image 7: Image of Arduino connected with breadboard on the racquet

As they related to cables, it was nearly impossible to swing the racquet and had many difficulties to move the racquet around to use the tilt switch.

The next idea was to use the proximity sensor by connecting a proximity sensor on the bread board and swing the racquet to the proximity sensor to read the racquet in range to kill the bug.

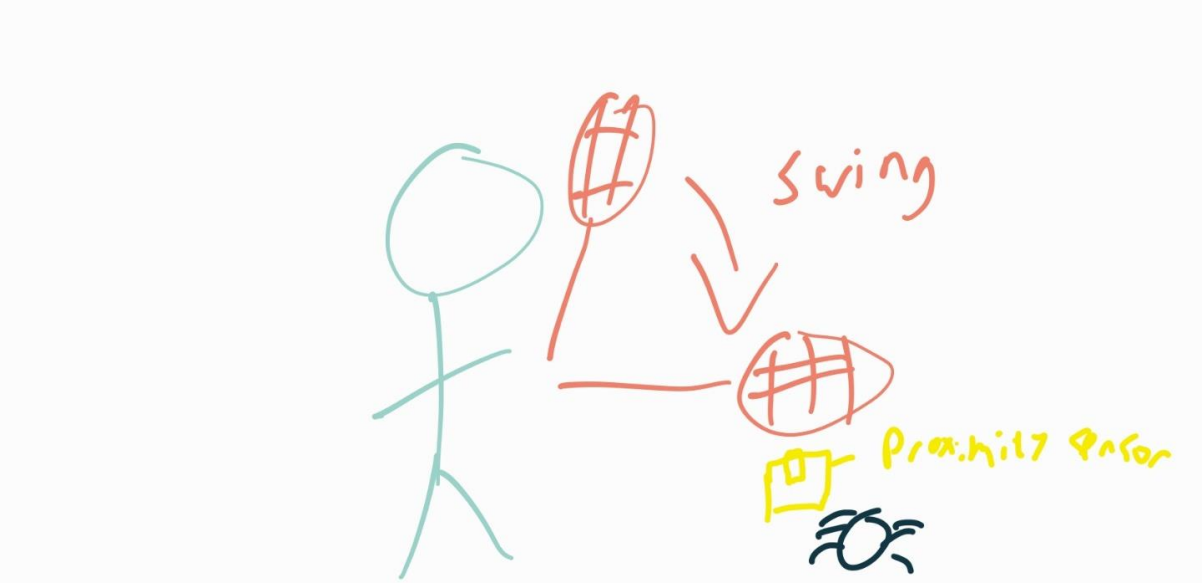


Image 8: Sketch of the concept of using proximity sensor

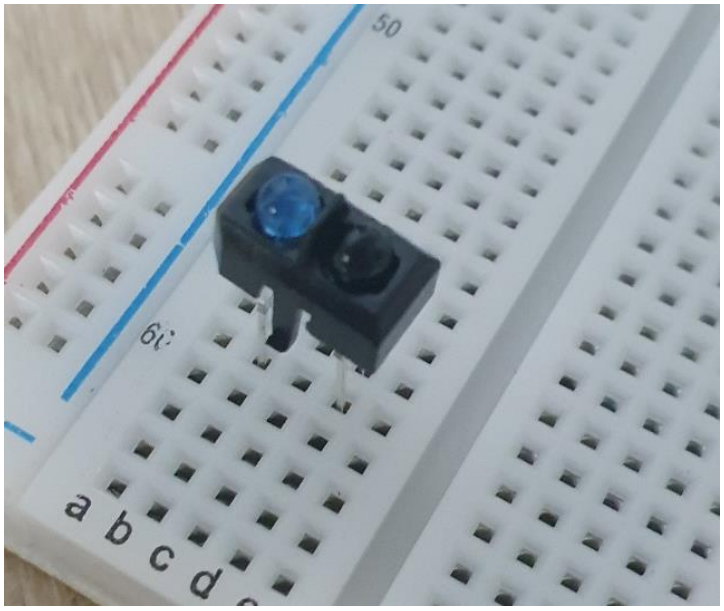


Image 9: Image of proximity sensor on breadboard

Image 10: Image of racquet on the proximity sensor

This concept did not work very well due to unknown issue. The proximity sensor did not read and catch the racquet in its range properly and acted differently every time. This could be since there are holes in the racquet, or they are made from metal.

While using the proximity sensor, instead of the original button, a infrared remote control was attached to the racquet this time to replace the button to act wirelessly.

Image 11: Image of infrared remote control attached to the racquet

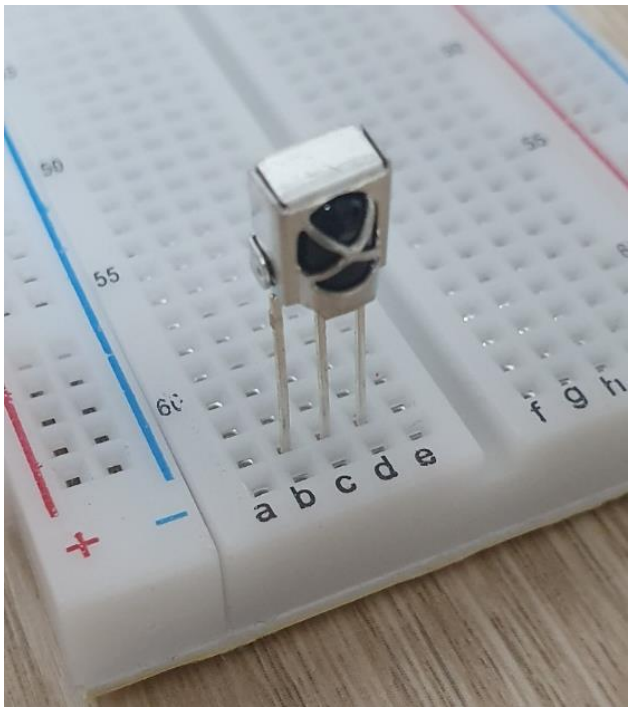


Image 12: Image of the infrared receiver

This infrared button worked well as a wireless version replacement of the button.

After multiple testing with different sensors and device final prototype was alarm with buzzer, LED, and button a racquet with remote control and separate tilt detecting device 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 and decide to choose the remote control on the racquet to activate the electricity to zap the bug or use the swing module to act as swing mechanism to kill the bug on the unity room.

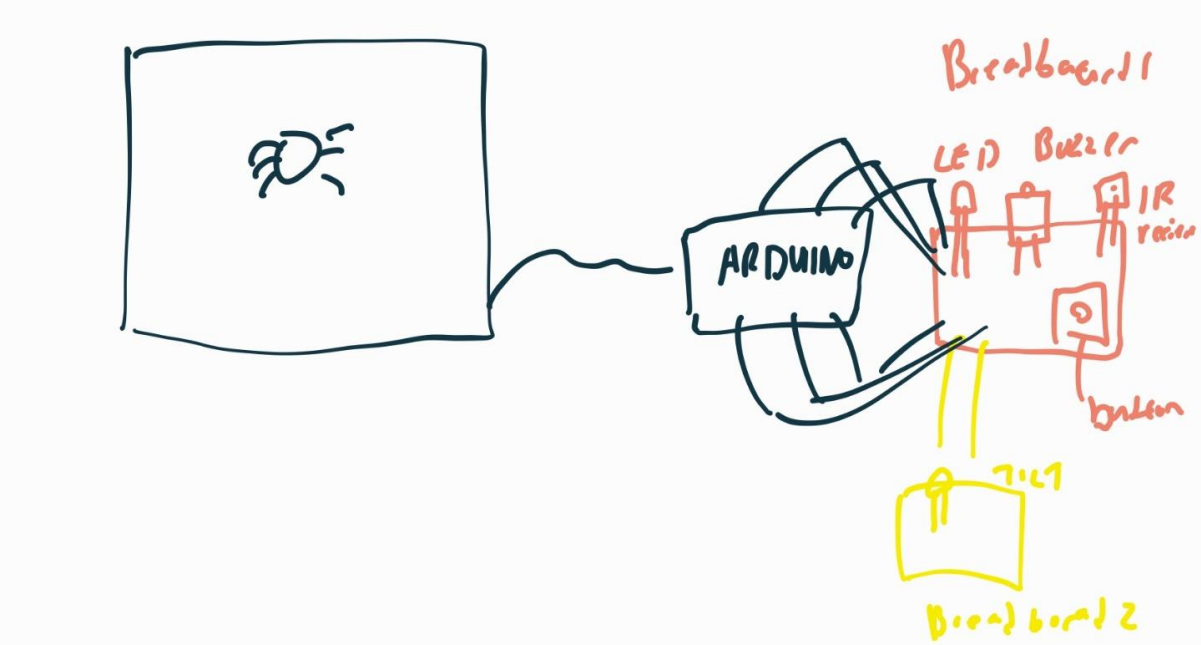


Image 13: Concept sketch of the final prototype

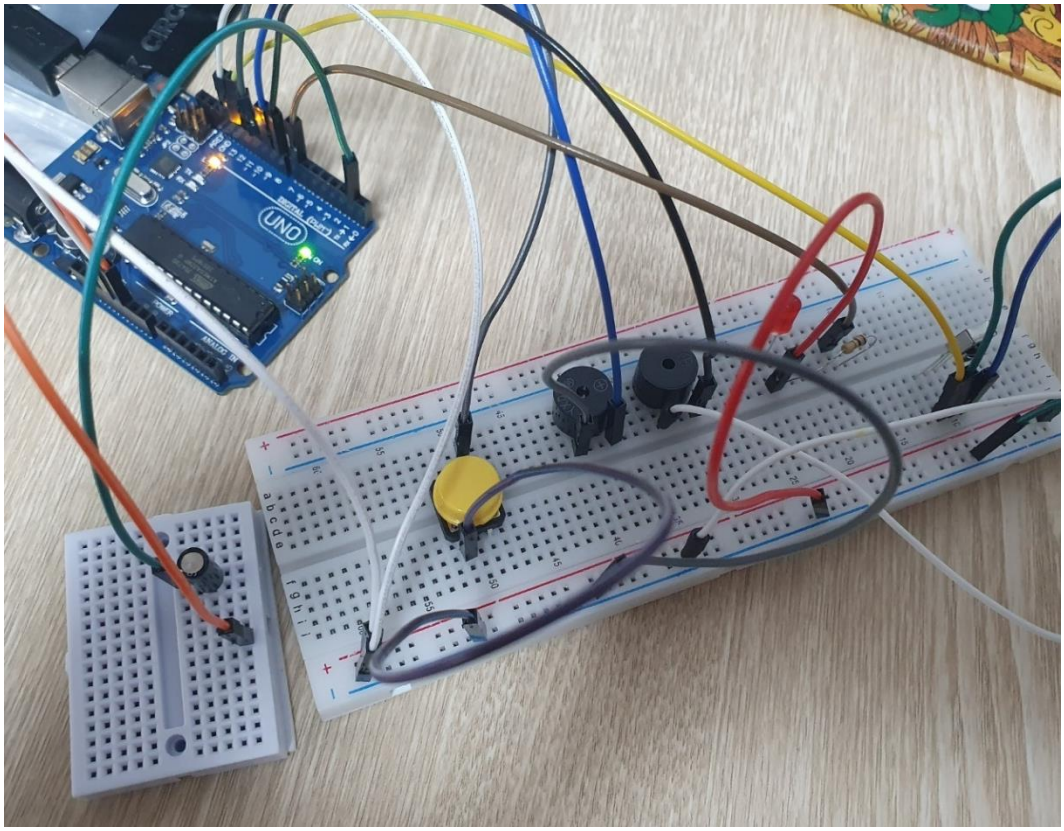


Image 14: Image of final prototype with sensors on breadboard connected to Arduino

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 turning the alarm off by pressing a button and 2 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 turn the alarm off and kill 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. This was to see how users react to the alarm and observe how the feel about the alarm. Once the user finds the bug, users can either use the tilt module to tilt and kill the bug or use the button on the racquet to kill the bug.

Online testing

To observe properly users were explained well before the testing.

The key observations to be made during the test were:

1. How did user react when the alarm first started?
2. How fast did the user ordered to turn the alarm off?
3. Which method did user ordered to use to kill the bug?
4. How fast did the user ordered to kill the bug?

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 a offline testing, users were let free in the room without any interference.

The key observations to be made during the test were:

1. How did user react when the alarm first started?
2. How fast did the user turn the alarm off?
3. Which method did user used to kill the bug?
4. How fast did the user kill the bug?

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. How did you feel about the red light and alarming noise (separately)
3. Do you want to know if there is a bug inside your room? And do you want to be alarmed?
4. If yes, from your experience from the testing do you prefer light or noise or both?
5. Did you turn the alarm off?
6. How fast do you think you reacted to the alarm?
7. Why did you choose that method (swing or zap)?
8. How fast do you think you killed the bug?
9. Any other comments to make?

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.

From the observation of offline users, they noticed the sound alarm very quicky and reacted by pressing the button and turning the alarm off fast. They replied that they did not want to hear the disturbing loud noise for long and wanted to deactivate it fast. Generally, it did not take longer than 5 seconds for the users to turn the alarm off. Online users took little longer, but their responses on the sound alarm were similar. They also did not like the loud annoying noise and wanted it off. All the testing users replied that they could not notice the small light much. From previous testing, many users responded that they would prefer small light than a big light. In this testing round the small LED light may have been too small to notice in a bright testing environment.

Even with loud and annoying noise alarm, all the users responded that they would want the alarm to notify if there is a bug in the room. Some of the users suggested changing the sound to a smoother or much round dull sound such as the discord notify sound or making the sound to a melody instead of the beeping alert. However, some users responded that if the sound was not sharp, they would not bother to turn it off fast or react to it fast. This is still questionable point and would need further investigation.

During the testing for the methods to kill the bug, all the offline users decided to use the electrical zap button on the racquet and push the bug instead of swinging at it. Most of online users also used the zap method. Most replied that it would be much safer and easier way compared to swing which may miss the bug. Sometimes swing does not kill the bug at once, but electricity does.

All the offline users reacted fast and killed the bug quite fast, and similar with online users. They wanted to get rid of the bug fast.

There were only 5 testing conducted and only 2 out of 5 were offline testing. If the situation was better and more offline testing could be conducted, it would have been better to provide much accurate result.

Also, the method of swing was not provided in an intuitive way, as it was put separate from the racquet due to the wire problems. If there was a wireless, possibly a Bluetooth and attached to the racquet, it could have provided user more chances to swing instead of zap method.

Also, if there were more sensors available, more different methods could have been tried, such as movement sensor, gyro sensor or accelerometer. It was unfortunate, some of these sensors were difficult to obtain and were not able to be used for this prototype.

Testing Plan

In the next prototype, the dark horse prototype will be used to test the user. This time there will be some unrealistic ideas will be implemented and tested to see user's reaction. Such ideas controllable laser bug killer, or bug detector which can identify type of the bug will be developed and tested on users to how they react.

Some twists maybe applied, such as not killing the bug, but catching the bug instead and releasing it to a safe natural area.

If VR or AR is available, with HMD, sensors and controls users may feel more realistic inside the testing condition and would get much more accurate datasets.

If there were no visuals of the bug, it would make users to focus the sound and follow the sound of the bug. Maybe mosquito buzzing sound.

Many different ideas can be applied and tried for the next prototype.

Miro Link

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

Video Link

https://youtu.be/TJ6uvpP7BK0

Appendix

Test Participant 1 - Online

Q: Please stay in the room for a minute.

Observations

After the alarm, user did not turn the alarm off and killed the bug by zap

User turned the alarm off in 28.4seconds and killed the bug in 6.3seconds.

Interview

Q: How did you feel about the alarm?

A: Bit loud and annoying, but definitely alarming

Q: How did you feel about the red light and alarming noise (separately)

A: Sound was helping, light was not much noticeable

Q: Do you want to know if there is a bug inside your room? And do you want to be alarmed?
A: Yes, alarm was kind of helping

Q: From your experience from the testing do you prefer light or noise or both?

A: Definitely sound but would prefer some lighter or more round sound than sharp beep. Maybe something like discord sound.

Q: Did you turn the alarm off?

A: Yes, after a time later, I knew I had to turn the alarm off, but became little use to the sound and forgot to

Q: How fast do you think you reacted to the alarm?

A: Bit late

Q: Why did you choose that method (zap)?

A: Think it's much safer way to kill the bug. Safer as more clear way.

Q: How fast do you think you killed the bug?

A: Quite fast.

Test Participant 2 – Online

Q: Please stay in the room for a minute.

Observations

Turned alarm off quite quickly but hesitated a bit deciding which method to kill the bug and chose to swing.

User turned the alarm off in 5.2seconds and killed the bug in 14.7seconds.

Interview

Q: How did you feel about the alarm?

A: Very alerting and alarming, but too sharp

Q: How did you feel about the red light and alarming noise (separately)

A: Sound definitely alerting, light may be dark night but not very good in days

Q: Do you want to know if there is a bug inside your room? And do you want to be alarmed?
A: Yes, don't want the bug in my room

Q: From your experience from the testing do you prefer light or noise or both?

A: Would prefer light, because sound was bit annoying, but light was barely noticeable without sound, even it was in visible area

Q: Did you turn the alarm off?

A: Yes didn't want to continue hearing it

Q: How fast do you think you reacted to the alarm?

A: Right away

Q: Why did you choose that method (swing)?

A: I think it would be bit more easier

Q: How fast do you think you killed the bug?

A: Quite fast?

Test Participant 3 – Online

Q: Please stay in the room for a minute.

Observations

Turned alarm off bit late and decided to choose the racquet to zap, but took a long time to kill the bug

User turned the alarm off in 9.4seconds and killed the bug in 18.6seconds.

Interview

Q: How did you feel about the alarm?

A: Noisy and disturbing

Q: How did you feel about the red light and alarming noise (separately)

A: Light was not much helping, sound was loud

Q: Do you want to know if there is a bug inside your room? And do you want to be alarmed?
A: Yes

Q: From your experience from the testing do you prefer light or noise or both?

A: Would prefer sound. Light easy to miss

Q: Did you turn the alarm off?

A: Yes

Q: How fast do you think you reacted to the alarm?

A: Bit after

Q: Why did you choose that method (zap)?

A: Think it would be easier to kill

Q: How fast do you think you killed the bug?

A: um... bit slow?

Test Participant 4 - Offline

Q: Please stay in the room for a minute.

Observations

Turned alarm off very fast and killed the bug very fast with zap

User turned the alarm off in 4.1seconds and killed the bug in 8.2seconds.

Interview

Q: How did you feel about the alarm?

A: Alerting and noisy

Q: How did you feel about the red light and alarming noise (separately)

A: Light, I don't really know, noise very alerting

Q: Do you want to know if there is a bug inside your room? And do you want to be alarmed?
A: Yes, I want to kill the bug

Q: From your experience from the testing do you prefer light or noise or both?

A: Prefer sound, but smoother sound, maybe a melody like doorbell

Q: Did you turn the alarm off?

A: Yes

Q: How fast do you think you reacted to the alarm?

A: right after the alarm started, didn't want to continue here it

Q: Why did you choose that method (zap)?

A: May miss with swing. Would go zap and push

Q: How fast do you think you killed the bug?

A: Quite fast, right after I noticed

Test Participant 5 - Offline

Q: Please stay in the room for a minute.

Observations

Turned alarm off straight away and killed the bug right after with zap

User turned the alarm off in 4.8seconds and killed the bug in 19.5seconds. (clicked the button right after around 6-8 seconds, but infrared remote malfunctioned)

Interview

Q: How did you feel about the alarm?

A: Noisy, bit annoying

Q: How did you feel about the red light and alarming noise (separately)

A: Sound was loud and light I am not too sure, turned off pretty fast

Q: Do you want to know if there is a bug inside your room? And do you want to be alarmed?
A: Yes

Q: From your experience from the testing do you prefer light or noise or both?

A: Definitely sound, but wish it was more smooth

Q: Did you turn the alarm off?

A: Yes

Q: How fast do you think you reacted to the alarm?

A: Pretty fast

Q: Why did you choose that method (zap)?

A: Would kill more fast and easier compared to swing, that may miss

Q: How fast do you think you killed the bug?

A: Right after, I turned the alarm off, but button didn't work

References

Image Assets Used:

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Code Used:

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