Protect-U

Team 35 — Santan Katragadda, Bhavish Bhattar, Ali-Berk Eroglu
ECE 445 Project Proposal — Spring 2020
TA: Stephanie Jaster

1 Introduction

1.1 Objective

Sexual assault and harrassment has been a common problem in society for many years. It is known to be the most underreported violent crime. Cases are often times dismissed or not even brought to court as the evidence presented becomes a "he said vs she said" case in which the victim's pleas struggle to gain validity without concrete proof. During sexual assaults or assaults of any nature, offenders seek to neutralize the victim's phone and take advantage of settings where there are no cameras or recording equipment. This causes an extremely low percentage of offenders being held accountable for their crimes.

Our solution seeks to help victims through the use of a wearable device that can record audio and emit a loud siren to attract attention to the situation. The audio recorded from the device will be saved to the user's phone via bluetooth.

1.2 Background

According to statistics by the Rape, Abuse & Incest National Network (RAINN), 11.2% of college students experience rape or sexual assault through force, violence, or incapacitation [2]. More specifically, 23.1% of undergraduate females are victims of these crimes. Shockingly, only 20% of female student victims aged 18-24 report these crimes to law enforcement [2]. A major reason for this is the lack of evidence as the victim feels that he/she may lose the case. Overall, 995 out of 1000 perpetrators of sexual assault walk free [3].

As technology has evolved, there are no wearable products with prevalent market share that are made specifically for preventing or collecting evidence during these situations. Perpetrators will oftentimes seek to remove the victim's phone from them making it an unreliable defense. A simple phone app, thus would not suffice as it would be difficult for the user to unlock their phone, navigate to the app, and activate the alarm or recording without the perpetrator taking notice. A discreet wearable would minimize the amount of actions the victim would have to do in a critical situation. Sexual assault is still a prevelant part of society and it is time that technology is utilized to help protect victims and aid them in providing evidence to law enforcement.

1.3 High-level requirements list

- The device will only be activated when the user taps it 3 times within 2 seconds to turn on its recording capabilities or 5 times within 3 seconds to turn on the in-built alarm.
- The device can record up to 10 minutes of audio and save it in internal memory.
- The audio saved on the device is transmitted to the user's phone through a bluetooth connection and it will be saved to the phone through a software application.

2 Design

2.1 Overview

The successful functionality of the device hinges on the proper execution of 4 main systems, the user interface, the control unit, the functional unit and the power system. The user interface is the system that facilitates the interaction between the user and the device. This includes the trigger mechanism necessary to deploy the functionality of the device, the phone application to put in necessary information and access the data stored by the device and the LED Indicators that display device status information. In addition the functional unit carries out the main functionalities of the device, primarily the alarm system and the audio recording capabilities. Both these systems are driven by the control unit, which contains the device memory to store any recorded audio, the bluetooth module which will transfer the data to the phone and the microcontroller which will drive all the interactions between the components. Finally all of this is only possible with the power system, which will be driven by a rechargeable battery.
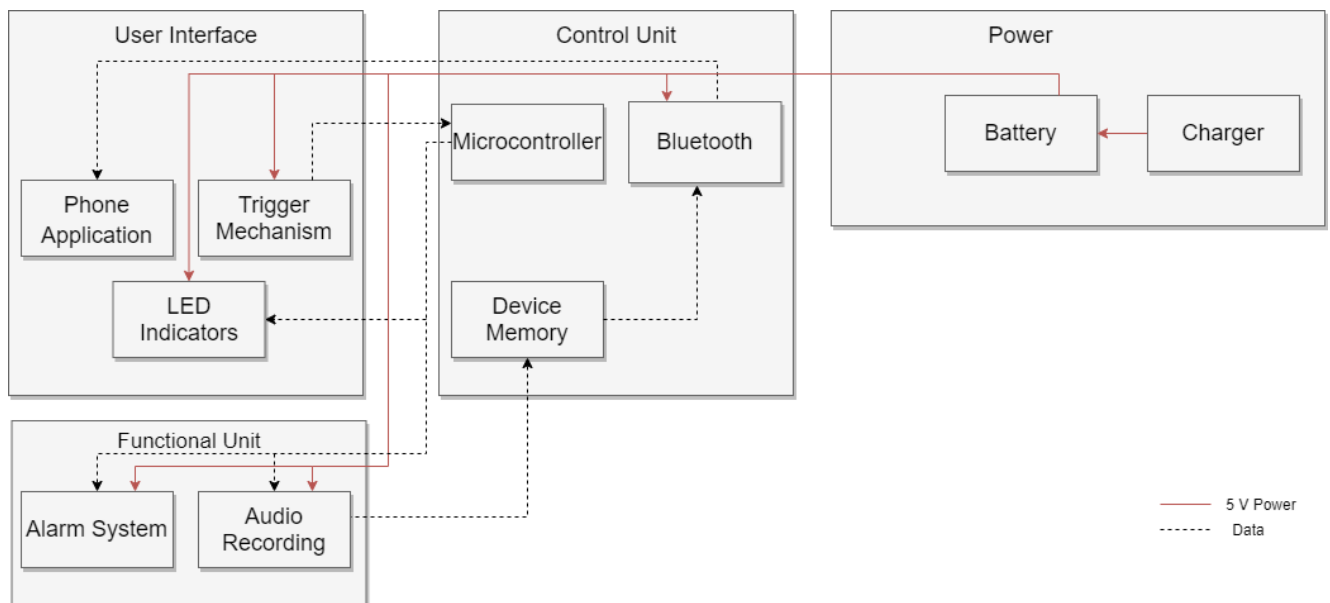
2.2 Block Diagram
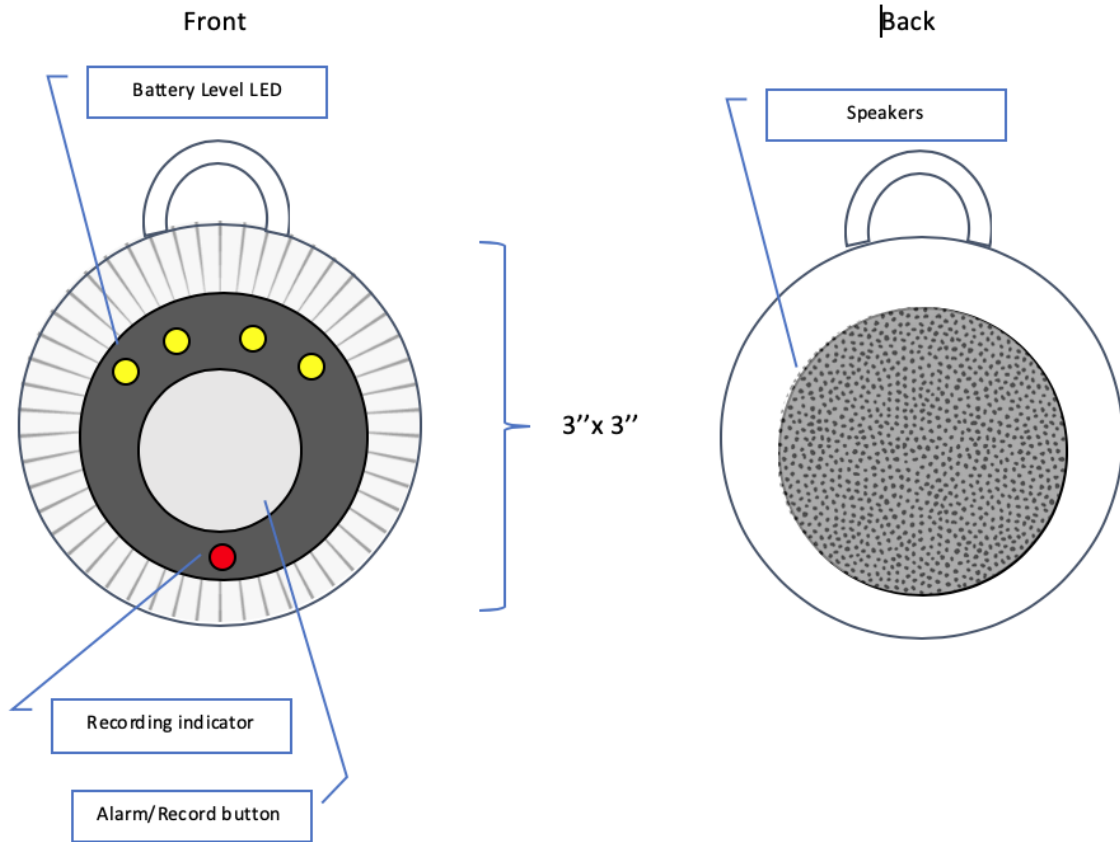
Fig 2.2 Block Diagram

2.3 Physical Design

Front   Back

Battery Level LED

Speakers

3″x 3″

Recording indicator

Alarm/Record button

Fig 2.3 Physical Design

2.4 Functional Overview

2.4.1 User Interface

Trigger mechanism:

A button on the wearable device that upon a three taps will begin recording audio and upon five taps will deploy an alarm and reach out to parties for help.

Requirement: A switch that is capable of sending signals to the microcontroller to indicate the rate at which the switch was triggered. It also must be easy to trigger, with minimal force so that it can be activated discreetly.

Phone Application:

An application which can save the audio recordings to the phone

Requirement: The application must have the ability to save files directly to the user's phone as well as being able to receive data via bluetooth. It must also be able to do all of these things while running in the background of the phone.

LED Indicators:

LED lights which are placed on the top of the device that will indicate to the user when the recording is activated, and the current charge level of the device

Requirement: The LED lights must be programmable in order to be able display the battery life accurately.

2.4.2 Functional Unit

Alarm system:

Once the alarm is triggered, the device must be capable of outputting a loud enough siren to attract attention from people in the vicinity. A speaker with an amplification circuit would be used here.

Requirement: The alarm must produce a sound capable of being heard at least a hundred feet away in the open.

Audio recording:

Device must be able to record audio in the nearby vicinity. We will use a microphone with an amplification circuit to accomplish this.

Requirement: An electret microphone that will record the audio in the range of 2 meters.

2.4.3 Control Unit

Bluetooth:

Device can send the audio recording via bluetooth to the victim's mobile device

Requirement: The bluetooth must be powerful enough to allow for audio files to be transferred between the device and the phone at a reasonable rate

Microprocessor:

Contains logic for managing memory, bluetooth, audio recording, and alarm system.

Requirement: Must be programmable and able to coordinate bluetooth and memory managing capabilities.

Device Memory:
Micro SD card to store audio recordings on wearable device

Requirement: Must be at least 100 MB so that it has the capacity to store a 10 min interaction directly on the device.

2.4.4 Power System

Battery:

Battery with a charging circuit and USB-to-serial converter

Requirement: Battery that produces output voltage between 3-5 volts.

Charger:

Requirement: Micro-USB charging port will be used to charge the battery.

2.5 Risk Analysis

The control unit poses the greatest risk for successful completion of the project. The bluetooth functionality may not function as intended as the group is inexperienced with the protocols. Coding the microcontroller may also pose a challenge as there are many conditions involving the button, LED's, alarm, and inputs from the phone that need to be taken into account. Also, writing to and reading from device memory may be challenging as the write speed may not be fast enough to record the audio. Also, transferring the memory from the device to the phone may be difficult using the control unit as specific permissions must be bypassed to write to the phone without user interaction.

3 Ethics and Safety

Given that this product aims to help victims in providing evidence to the victim, it is important that the audio data recorded is not modified in any way by the device. This is in compliance with number 3 in the IEEE code of ethics in which we will be honest about the data used in the device [4]. We will keep this in mind during the development stage of the product. One-party consent recording is legal in 38

states, however 12 states still require all-party consent for audio recordings. If this device were to make it to market, this would need to be clearly stated so the user doesn't accidentally record audio illegally in certain states. This is in accordance with number 5 in the IEEE code of ethics in which we are urged to improve the understanding of individuals on the societal implications of our technology [4]. Additionally, in compliance with number 1 in the IEEE code of ethics, we will ensure that all safety precautions are taken in the construction of the device to ensure that there is very minimal risk of harm to the user, and if any such risk does exist, information would be provided to the user to inform them of the proper usage to avoid said risk. The outside of the wearable device will be an insulating casing that will make sure that no wires are exposed. This will minimize the risk the user faces when using the device in different conditions.

When working on developing this device, our group will take many precautions to ensure our safety and the safety of those around us. All members of the group have completed and passed the required lab safety training. We will make sure to not modify circuits while the power is connected, as well as be vigilant of any burning parts to make sure we do not start a fire. The lab will also be equipped with a fire extinguisher in case of emergency. Additionally, our group will have at least two members present when working in the lab to help prevent accidents. In the situation the group needs to work with equipment that the members of the group are unfamiliar with, we will ensure that there will be the necessary supervision to validate the proper usage of the equipment. Finally, the group will not use other individual's work without the proper citations, and certify that the idea and design of the project is original and unique [1].

References

[1] "Article 1, Part 4 - Academic Integrity Policy and Procedure." *Part 4, Article 1 " Student Code " Illinois*, Illinois.edu, studentcode.illinois.edu/article1/part4/1-402/. [Accessed: 12- Feb- 2020].

[2] "Campus Sexual Violence: Statistics." RAINN, RAINN, www.rainn.org/statistics/campus-sexual-violence. [Accessed: 12- Feb- 2020].

[3] "The Criminal Justice System: Statistics." RAINN, RAINN, www.rainn.org/statistics/campus-sexual-violence. [Accessed: 12- Feb- 2020].

[4]   Ieee.org, "IEEE IEEE Code of Ethics", 2020. [Online]. Available: http://www.ieee.org/about/corporate/governance/p7-8.html. [Accessed: 12- Feb- 2020].