Public Safety Alarm

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ECE 445 Project Proposal - Spring 2021
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1. Introduction:

1.1 Objective:

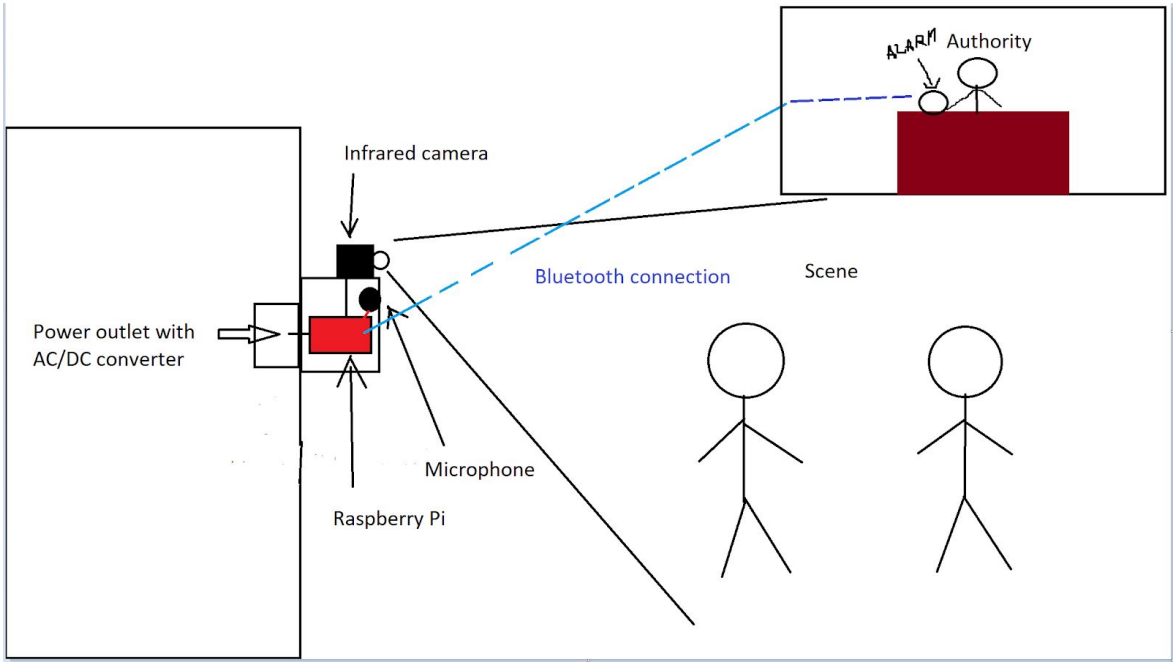
In the United States and all over the world, people are victimized in silence. Stigma, lack of evidence and lack of personnel remain an issue even in the safest of places. This is because it is simply not possible, even with an enormous amount of resources to patrol or monitor every single nook and corner of a community for possible violence or emergency. Our objective is to create a simple alarm system that could be installed in all locations and can alert authorities when a potentially dangerous situation is taking place without the need for constant surveillance.

To remedy this, we propose a simple alarm system that will aid in alerting authorities if a potentially dangerous situation is taking place. Our design features 2 main components. The first component of the system is the Monitoring Device. It will be designed to take in both the sounds and infrared video of the environment. It will be transmitting this data to the Supervisor Device, the second component of our system. The Monitoring System is intended to act as a stationary, powered device, similar to a fire alarm or a CCTV, which means portability would not be a priority. Multiple would be installed at different locations to monitor specific areas for safety concerns. The Supervisor Device is intended to also act as a stationary device, perhaps sitting on a police officer or gym teachers desk. It will be receiving the data fed to it from separate monitoring devices and constantly deciding if an emergency is occurring. Upon an emergent situation, an alert will sound in order to bring the situation to the supervisor's attention.

1.2 Background:

Currently, while there are surveillance systems in place in quite a few areas, they a) do not cover all possible public locations where crimes can occur b) require extensive manual surveillance which isn't always possible and c) cannot cover areas such as public restrooms where video surveillance is a serious violation of privacy. As a result, there are many areas that are left prone to criminal activity. There is no widely implemented automated surveillance system that addresses all of these concerns.

1.3 Physical Design:

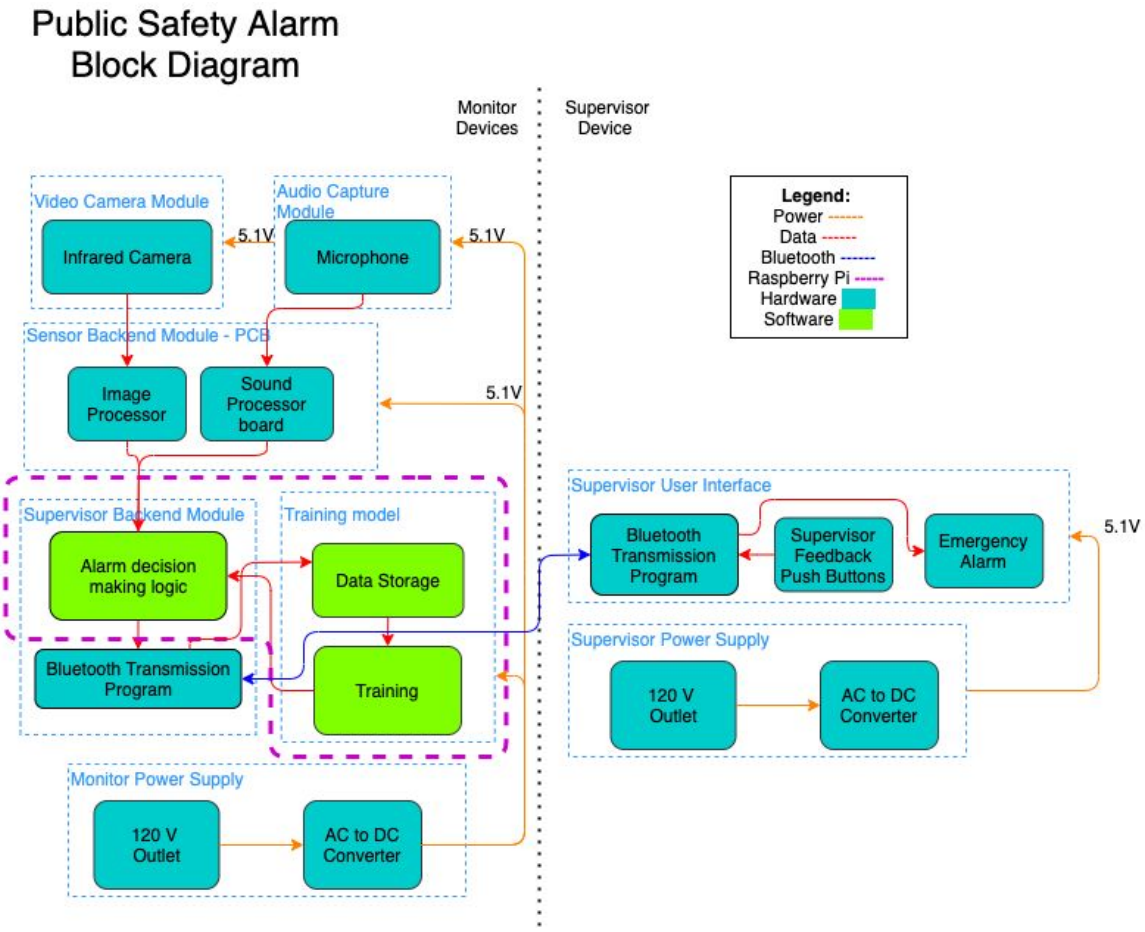


1.4 High Level Requirements:

1. Our system should be able to detect potentially dangerous situations with an accuracy of at least 60%. This means that given a situation, dangerous or not, the device will choose to either trigger or not trigger correctly over 60% of the time.
2. The false negatives of the system, as in not reporting a dangerous situation when one actually occurs, should occur less than 20% of the time. This means that given there is a dangerous situation, the supervisor device should alarm at least 80% of the time.
3. The response delay between the occurrence of alarming audio or video and the supervisor alarm sounding should aim to be less than 5 seconds. This means that given there is a dangerous situation, the supervisor device should alarm within 5 seconds of the first clear sign of a dangerous event.

2. Design:

2.1 Block Diagram:



2.2 Functional Overview:

Monitor Devices:

- Infrared Camera: This device records infrared video of the targeted location. It will allow the decision making logic to detect if there is anyone in the vicinity and also look for two bodies of heat interacting.
- Microphone: This device records the sounds at the targeted location. It allows the decision making logic to identify whether it sounds like an emergency situation is taking place.
- Image Processor: Processes and converts the image input to transmissible data
- Sound Processor: Processes and converts sound input to transmissible data.

- AC/DC Converter: Modulates power supply for the devices, converting from a wall outlet to usable DC Voltage.
- Bluetooth Transmission Program: Communicates information about whether the alarm must be triggered or not and then responds back to the monitor with feedback from the supervisor.

Raspberry Pi Monitor Attachment:

- Alarm Decision making logic: The alarm decision making logic will hold the most up to date machine learning model in order to make the best decision possible based on the video and audio being input from the camera and microphone. It would be initially created based on samples available online. Once implemented, it will classify the audio/video input as dangerous or not and decide whether or not to send the trigger signal to the alarm.
- Data Storage: Used to save the audio and video data that will be used when training the decision making model.
- Training: The training block will be what requires the Raspberry Pi's processing power. We will be using the Data stored in the data storage block in order to update the decision making model based on feedback from the supervisor feedback buttons in order for it to make better decisions as it acquires more and more data.

Supervisor Device:

- Bluetooth Transmission Program: Communicates information about whether the alarm must be triggered or not and then responds back to the monitor with feedback from the supervisor. This will be a very simple communication.
- Supervisor Feedback Push Buttons: Communicates feedback to the device regarding whether or not it's a false alarm.
- Emergency Alarm: Gets triggered via the bluetooth connection to the raspberry pi if a dangerous situation is detected
- AC/DC Converter: Modulates power supply for the devices, converting from a wall outlet to usable DC Voltage.

2.3 Block Requirements:

Monitor Block: The monitor block's main goal is to acquire the data from the scene and process it in order to allow our decision making model to decide if there's an emergency occurring. This block will consist of a lot of premade hardware, along with processors on a pcb
Raspberry Pi Monitor Attachment Block: This block's primary objective is to act as a control for all the other blocks. It receives audio/video input, hosts the decision making logic and sends the trigger signal to the alarm via bluetooth.

Supervisor Block: The sole purpose of the supervisor block is to alert the supervisor that there is an emergency taking place at the scene of the monitor. This allows the supervisor to then use this information to take action at the scene. The supervisor block is also designed to allow for feedback after the emergency occurs, in order to allow for improvement in the system.

2.4 Risk Analysis:

In order for our system to have a positive impact on society, it is imperative that the alarm decides to ring whenever sufficient evidence of an emergency is present. Because of this, we consider the alarm decision making logic to be the most important block of our project. We will be implementing machine learning and using as many samples as we can get our hands on in order to train this block to make the best decisions as possible. We will also be including a feedback loop allowing for the decision making to be ever-improving. Without an accurate decision making block, our entire system could cause more problems than it's solving by turning a blind eye to areas of high importance, because supervisors could be assuming the system is functioning correctly. On the flip side, an inaccurate decision making block could also create unnecessary work for a supervisor, requiring them to go to a scene where no emergency is occurring.

3. Ethics and Safety:

The main concern in terms of ethics is the storing of sensitive data when using it for improving models. Keeping data from for example, a locker room, could be highly sensitive matter, and not one we take lightly. To address this concern, any data we save will not be time stamped or labeled in any way. It will strictly contain the infrared video, audio and a binary assertion of whether or not the specific event was an emergency. On top of not labeling data, only a basic infrared camera will be used, which will not take the details of the people's faces, clothes or any other accessories. At most, there would be pixels where there is heat.