Armed and Dangerous

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Sound Danger!

"Technology can be our best friend, and technology can also be the biggest party pooper of our lives"(Spielberg, 2019). Technology has been a huge factor for development in the 21st century and has been helpful and convenient for everyday tasks. However, there are more things that can be applied to a certain group of people in the world: deaf people. This group of people has a very hard time in dangerous areas because their reaction time will be limited. Additionally, in order to help these people, a system can be created to send a notification to their phone, which can be easily accessible whenever danger is near. This will use many different concepts, including a text to speech converter, danger detection, a microphone, decibel levels. Also, in order for the code to work, it is valuable to learn about Arduino, artificial intelligence, MIT app inventor, and GPS. Text to speech will be essential to the project because it will allow for the deaf to understand what the person is saying. The main cause of this project is to detect the danger using a microphone which will also be explained. In addition, the microphone will be able to detect decibel levels as well. On the software side of the project, Arduino a module that allows easy coding and compatibility will be used to efficiently create the project. Artificial intelligence also could be influential to the usefulness of the module because it can sense on its own when it is necessary to alert and when it is not. Finally for coding the Arduino it will be essential to code using MIT App Inventor. Finally, GPS will be helpful for the AI to calculate whether the person should be alarmed. Discussing the past research done on this topic and discussing variables involved will be necessary for testing. This device will be able to see the relationship between the decibel level and location and time which will then be able to alert the user to the sound based on these variables. There is much importance to the development of this technology because it will really help improve the lifestyle of deaf people on a daily basis.

The deaf will be able to react to things they can't see much faster and lives could be saved. The device should aim to help people be alerted to their surroundings no matter where they are. The problem in the world today is that these people don't realize something is happening unless they see it themselves.

One way that people with a hearing disability can overcome this challenge is to use speech to text for social communication. The first form of speech to text was invented in 1837, where Issac Pitman invented the first system of shorthand based on a scientific analysis of sounds that comprise speech (Bruno, 1998, p. 164). There are many devices in the world already, such as the thousands of Google devices, which help people communicate. Speech-to-text software is a type of software that takes audio content and transcribes it into written words in a word processor or other display destination. This type of speech recognition software is extremely valuable to anyone who needs to generate a lot of written content without a lot of manual typing. It is also useful for people with disabilities that make it difficult for them to use a keyboard. Most modern speech recognition systems rely on what is known as a Hidden Markov Model (HMM). This approach works on the assumption that a speech signal, when viewed on a short enough timescale (say, ten milliseconds), can be reasonably approximated as a stationary process—that is, a process in which statistical properties do not change over time. In a typical HMM, the speech signal is divided into ten-millisecond fragments (Amos, n.d.).The power spectrum of each fragment, which is essentially a plot of the signal's power as a function of frequency, is mapped to a vector of real numbers known as Cepstral coefficients. To decode the speech into text, groups of vectors are matched to one or more phonemes—a fundamental unit of speech. This calculation requires training, since the sound of a phoneme varies from speaker to speaker, and even varies from one utterance to another by the

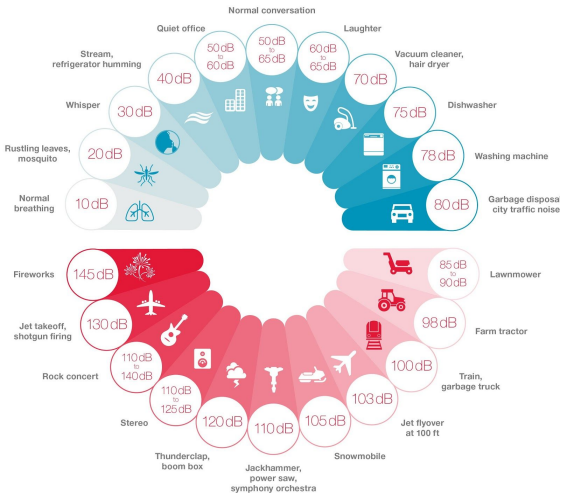
same speaker. A special algorithm is then applied to determine the most likely word (or words) that produces the given sequence of phonemes (Amos, n.d.).

Arduino acts as a handler in this device as it collects the data from the Sound Level Meter and passes it to the phone. The Arduino is a programmable logic controller or an open-source electronics prototyping platform. In other words, it is a little computer that you can program to do things. It interacts with the world using electronic sensors, lights, and motors ("What Is an Arduino?," n.d.). Most people use the official integrated development environment (IDE), a software application that provides comprehensive facilities to computer programmers for software development (CodeAcademy) to program the Arduino, but it can also be programmed in Javascript. Because it was made using Java, it is compatible with a variety of platforms: Windows, Mac, and Linux. Arduino is a brand name, but most of the hardware and software are open source, meaning that the Ardunio can be replicated. The Arduino can operate either independently, connected to a computer, or connected to other Arduinos, or other electronic devices and controller chips (Bruce, 2011).

Deaf people cannot hear the dangers of their environment so they cannot be aware as fast as other people. So based on the sound intensity of a certain environment the hearing impaired person can be warned and aware, just as fast as a person with regular hearing. To measure the sound intensity, an analog sound level meter is used. An Analog Sound Level Meter takes in the electric current from the microphone and analyzes it to measure the sound intensity. The Analog Sound Level Meter is a basic noise measurement device that is compatible with the Arduino. It can accurately measure the decibel levels of its surroundings. Since it uses an instrument circuit and a low noise microphone it is also highly precise (“Gravity Analog,” n.d.). Sound is an oscillation in the

air that travels in the form of pressure waves. It increases and decreases as it moves through the air and the strength of the pressure waves determines the volume of the sound. Sound is measured in terms of Decibels (dB) and it increases logarithmically. High volume sounds have so much wave pressure that they can damage human eardrums. Sound Level Meters have microphones that create an electrical current which is measured and converted to a numerical display ("How Does," n.d.).

The microphone and Analog Sound Level Meter receive and analyze sound, so if a certain level of sound intensity is reached a warning is sent out. The microphone converts sound energy into electricity that can be stored, used, or analyzed. When a sound is created the waves carry energy toward the microphone. Then the diaphragm and the coil inside the microphone move back and forth when it is struck by a sound wave. A permanent magnet produces a magnetic field that cuts through the coil. As the coil moves back and forth through the magnetic field an electric current flows through it. Lastly, the electric current flows to an amplifier or a sound recording device ("How Do Microphones," n.d.).



("What Are Decibels," n.d.)

Decibels play an important role in this project as the device detects danger based on the sound intensity of the user's surroundings. A decibel (dB) is used to measure the intensity of a sound. The higher the decibel level, the louder the sound. Each decibel level increase of 10 means that a sound is actually 10 times more intense. High decibel levels for a long period of time can lead to hearing loss ("What Are Decibels," n.d.).

Artificial intelligence is a branch of computer science that aims to create intelligent machines. It has become an essential part of the technology industry. Research associated with artificial intelligence is highly technical and specialized. The core problems of artificial intelligence include programming computers for certain traits such as knowledge, reasoning, problem-solving, perception, learning, planning, and the ability to manipulate and move objects. Machine learning is also a core part of AI ("Artificial Intelligence," n.d.). Learning without any kind of supervision requires an ability to identify patterns in streams of inputs, whereas learning with adequate supervision involves classification and numerical regressions. To create artificial intelligence there are some steps that are necessary. The first is reasoning, which is the application of knowledge. There are two types: shallow/heuristic reasoning and deep reasoning. The shallow reasoning uses past experience and makes easy-to-use logical or practical rules from it. The deep reasoning analyzes knowledge, expertise, or a problem to find out its basic structure (Thro, 1993, p. 57-58).

Bluetooth is a short-range (10m) wireless communication technology that allows devices to transmit data to each other. Typically, people might use it to send photos or files to other devices, to connect a mouse without a wire, etc. The Bluetooth is a tiny part of a chip of a device that interacts with other nearby modules sharing data using little energy. Bluetooth uses radio waves to transmit information (specifically in the 2.4GHz spectrum) and also uses a special technique called frequency

hopping (Beckman, n.d.). Frequency hopping is a method of transmitting radio signals by rapidly switching a carrier among many frequency channels. Older devices can be converted to work with Bluetooth using plug-in extensions/adapters. The power of the transmitter determines the range of the Bluetooth connection. Devices fall into three classes: class 1 are the most powerful and can operate up to 100m (330ft), class 2 (the most common kind) operate up to 10m (33ft), and class 3 are the least powerful and have a range about 1m (Patkar 2018).

To be able to code this project, we will need to use the coding website called MIT App Inventor. It is an intuitive, visual programming environment that allows everyone, even those with no prior coding experience, to build fully functional applications for smartphones and tablets. The tool allows anyone to program more complex, impactful apps in significantly less time than with more traditional programming environments ("What Is App Inventor?", n.d.). The program created will be installed on the computer and connected to the Arduino module and sound detector to be able to detect noise. For the speech to text converter, there is already an in-built function that does the function already. For this to be accessed, it will be necessary to use a button or a slider to activate. Next, for the decibel level and GPS to be used by the AI, a GPS location sensor can also be added as well. The decibel level comes analyzed from the Arduino, which can be coded and analyzed once again by the code using a loop for testing and data collection. After being tested over and over again, the AI will be able to adapt to the way the code needs to react to the incoming data. Finally, Java that will be incorporated into the Arduino that will be able to send signals from the Arduino to the vibration motor. The JArduino (Java-Arduino) library, provides a Java API to control Arduino using

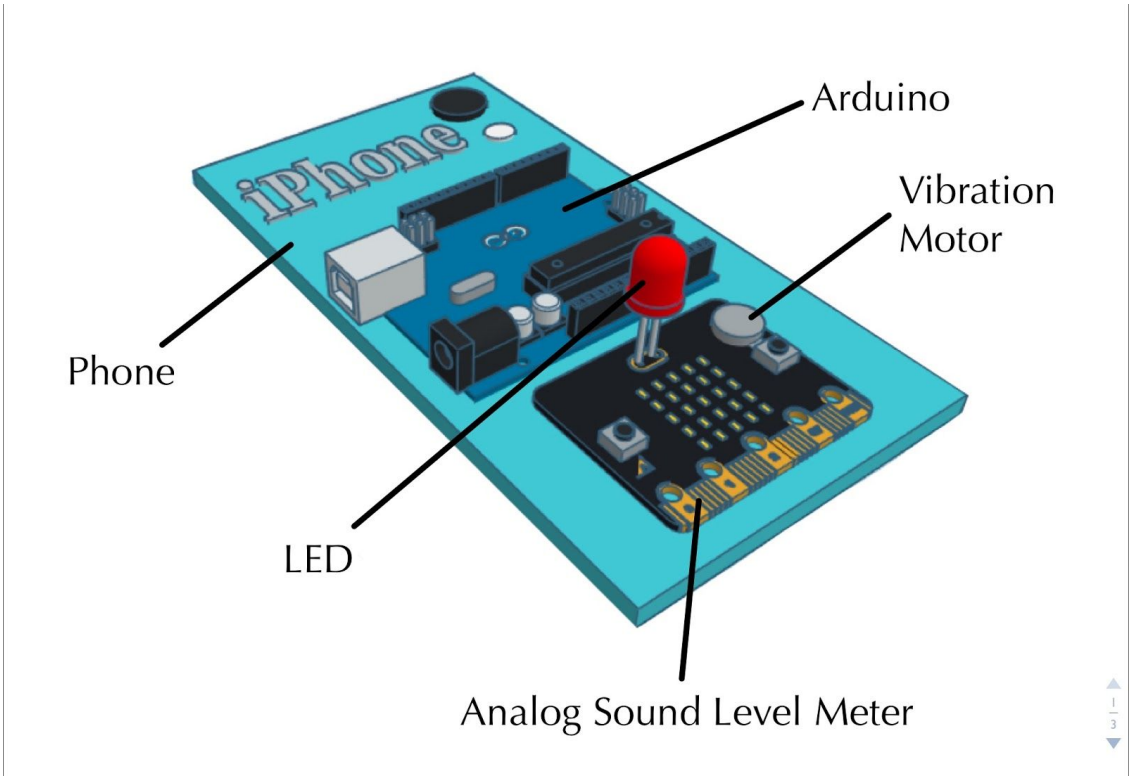
a serial port (using a USB cable, or wireless devices behaving as serial ports from a software point of view), UDP (via an ethernet shield).

The project will also be utilizing the location of the user in order to see if the user should be alerted. GPS satellites circle the Earth twice a day in a precise orbit. Each satellite transmits a unique signal and orbital parameters that allow GPS devices to decode and compute the precise location of the satellite. GPS receivers use this information and trilateration to calculate a user's exact location. Essentially, the GPS receiver measures the distance to each satellite by the amount of time it takes to receive a transmitted signal. With distance measurements from a few more satellites, the receiver can determine a user's position and display it electronically ("What Is GPS?," 2017).

Past inventions for this project include Apple's Siri and Amazon's Alexa. They instantly became famous for their incredible ability to accurately process natural phrases. Their success brought speech recognition technology to the forefront of innovation and technology. With the ability to respond using natural language and to 'learn' using cloud-based processing, Siri started the birth of other like-minded technologies such as Google's Google Voice and Microsoft's Cortana ("Speech Recognition," 2018). There are also some other types of devices created to make alert deaf people in different scenarios such as alarm clocks, fire/carbon monoxide detectors, and doorbell signalers (Jones, 2019). However, these are different from the device that will be created. The Sound Danger device will alert to any type of sound made and choose whether it is a real threat or not.

The project will need to use four variables: vibration, decibel level, the user's location, and time of day. These will be related because the vibration will be the dependent variable. So it will vibrate based on the other three variables. The decibel level, user's location, and time of day will be independent variables. They are going to be changed at each trial of the experiment when gathering

data. For example, if there was a plane noise at the airport, the person would not be alerted because that would be a normal noise that would happen at that location. However, if that were to happen at a house, that is not normal so the sound detector and Arduino would send a signal to the vibration motor to make a vibration.


iPhone
Arduino
Vibration Motor
Phone
LED
Analog Sound Level Meter


iPhone
Armed and Dangerous?
Sumer Shinde
Sathvik Vadanapartiri

When it comes to saving lives, it becomes a very serious discussion. The thought that an invention that can save even one life is successful. This “invention” has the capability to make that dream happen. It starts with the speech to text converter. Although this is already invented, it will be useful and relevant to this audience. Firstly, the GPS location and decibel level, which will be caught and analyzed by the microphone and arduino, to tell whether, based off of these variables, if there is a danger. This goes hand in hand with artificial intelligence which knows when to send the signal to the vibrating motor which will alert the person to the danger. Additionally, the bluetooth connectivity between a phone and the module will allow it to not only vibrate but to also send an alert as a precaution to the vibrator. Using this, lives can be saved and everyone will be Armed and Dangerous.

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