1 Introduction

Human speech processing has been studied extensively over the last few decades. However, there is very little research on using sensing and computing technologies for recognizing and interpreting non-speech body sounds.
Our Project is also based on one such very important body sound known as "Korotkoff Sounds". Korotkoff sounds are the sounds that medical personnel listen for when they are taking blood pressure using a non-invasive procedure. They are named after Nikolai Korotkov.1 Korotkoff sounds have shown a relation to blood vessel Health.

2 Capturing Korotkoff sounds

We had to think of following design requirements which should be met while recording Korotkoff sounds:

- The prototype should capture mostly the Korotkoff sounds portion of the frequency spectra.
- The prototype should be robust against any external sound or ambient noise.
- The prototype should have mechanisms compensating friction noise due to user's body movement.

3 Specifications of the Products used

These are the specified material required:

Item name	Uses
LM393 sound module	To capture the Korotkoff sounds
Arduino	To process the captured data
Arduino Cable	To send data from Arduino to laptop for plotting
Adaptor box	To keep the Arduino and LM393 together and help the cables to avoid any external damage
Stethoscope	To capture the korotkoff sounds without external noises

4 System Implementation

The microphone within the LM393 sound module is housed inside the stethoscope pipe to eliminate external noise interference and ensure accurate sound capture. The sensitivity of the module is carefully adjusted to maximize the capture of sample points. The data from the module is then transmitted to the Arduino for processing. The processed data is subsequently sent to a laptop for analysis via an Arduino cable.

5 Code

```
Initialize empty lists for x_data and y_data
Set collecting_data flag to False
Set serial object ser to None

Define function start_collecting
    Set collecting_data flag to True
    Open serial port 'COM7' with baud rate 2000000 and assign to ser
    Start a new thread to run collect_data function

Define function stop_collecting
    Set collecting_data flag to False
    Close serial port ser
    Call plot_data function

Define function collect_data
    While collecting_data flag is True
        Read data from serial port ser
        Strip and decode the data
        Try to convert data to decibels and add to y_data
            Calculate data1 as ((int(data) / 1024) * 4) + 48
            Append length of x_data + 1 to x_data
            Append data1 to y_data
        Catch ValueError and print error message
    Catch serial.SerialException and print error message

Define function plot_data
    Plot x_data against y_data using matplotlib
    Set x-axis label to "Time"
    Set y-axis label to "Decibals"
    Set plot title to "Voltage vs. Sample number"
    Show the plot
```

```
Create tkinter window root

Create start button with text "Start" and command start_collecting
Add start button to root window

Create stop button with text "Stop" and command stop_collecting
Add stop button to root window

Run tkinter event loop
```

6 Why to choose our product?

- Our product is highly cost-effective. While similar stethoscopes available in the market range from 22,000 to 100,000 rupees, we offer to produce this device for under 1,000 rupees. Furthermore, bulk production could result in even lower costs.
- Market stethoscopes typically provide a sample rate of 4,000 points per second. However, our product offers a higher sample rate of 5,000 points per second, ensuring more detailed and accurate data collection.
- Simple to operate and ideal for middle-class families, our product only requires a blood pressure machine to apply pressure for measuring the sounds. Blood pressure machines are readily available in households and medical settings, making our product accessible and convenient for use by doctors and individuals alike.

7 Future advancements

- The Arduino can be equipped with a Bluetooth module, enabling direct transmission of data to a mobile phone.
- A specialized mobile application can be developed to display sound analysis, store data for future reference, and facilitate sending data to healthcare providers for analysis.
- Higher-performance microphones can be utilized to capture sound at an increased rate, while maintaining cost-effectiveness as a priority.

8 Final Product

Here are the final glimpse of our product:

Figure 1: Final image of the Product

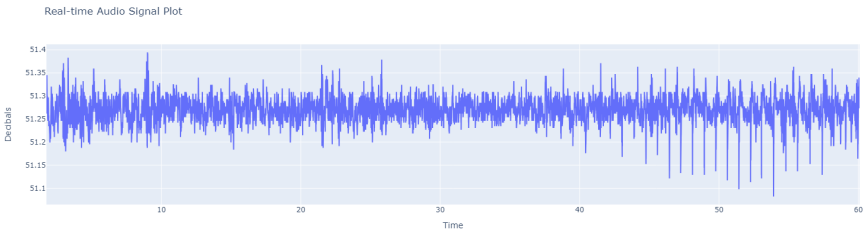

Figure 2: Captured sounds where the peaks in the shows the Korotkoff sounds

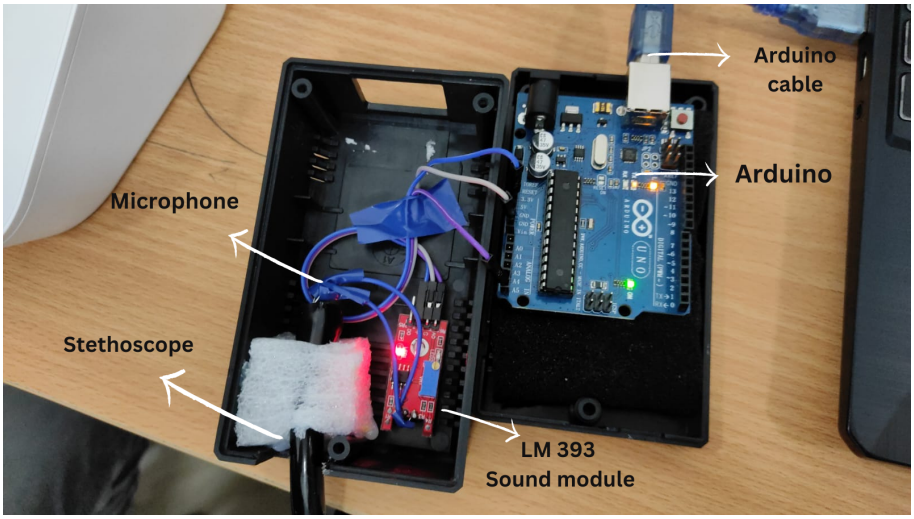

Figure 3: Circuital view inside the adaptor

Figure 4: Poster