🧩Problem Statement:

"Real-Time Identification and Localization of Urban Noise Pollution Sources"

Urban areas suffer from increasing levels of noise pollution due to traffic, construction, industrial activity, and human gatherings. This environmental noise negatively affects public health, contributing to stress, sleep disorders, cardiovascular issues, and reduced quality of life. Despite regulations, most cities lack effective real-time monitoring systems capable of identifying, localizing, and quantifying specific noise sources.

Current noise monitoring setups typically rely on distributed single-point microphones that only measure sound pressure levels. These systems cannot distinguish between different noise types (e.g., a jackhammer vs. a car horn) or pinpoint their exact location, limiting their usefulness for enforcement, urban planning, or citizen complaints.

🛠️ Proposed Solution:

Phased Array Microphones enable a smarter, directional approach to urban noise monitoring. By using beam-forming and spatial filtering, such systems can:

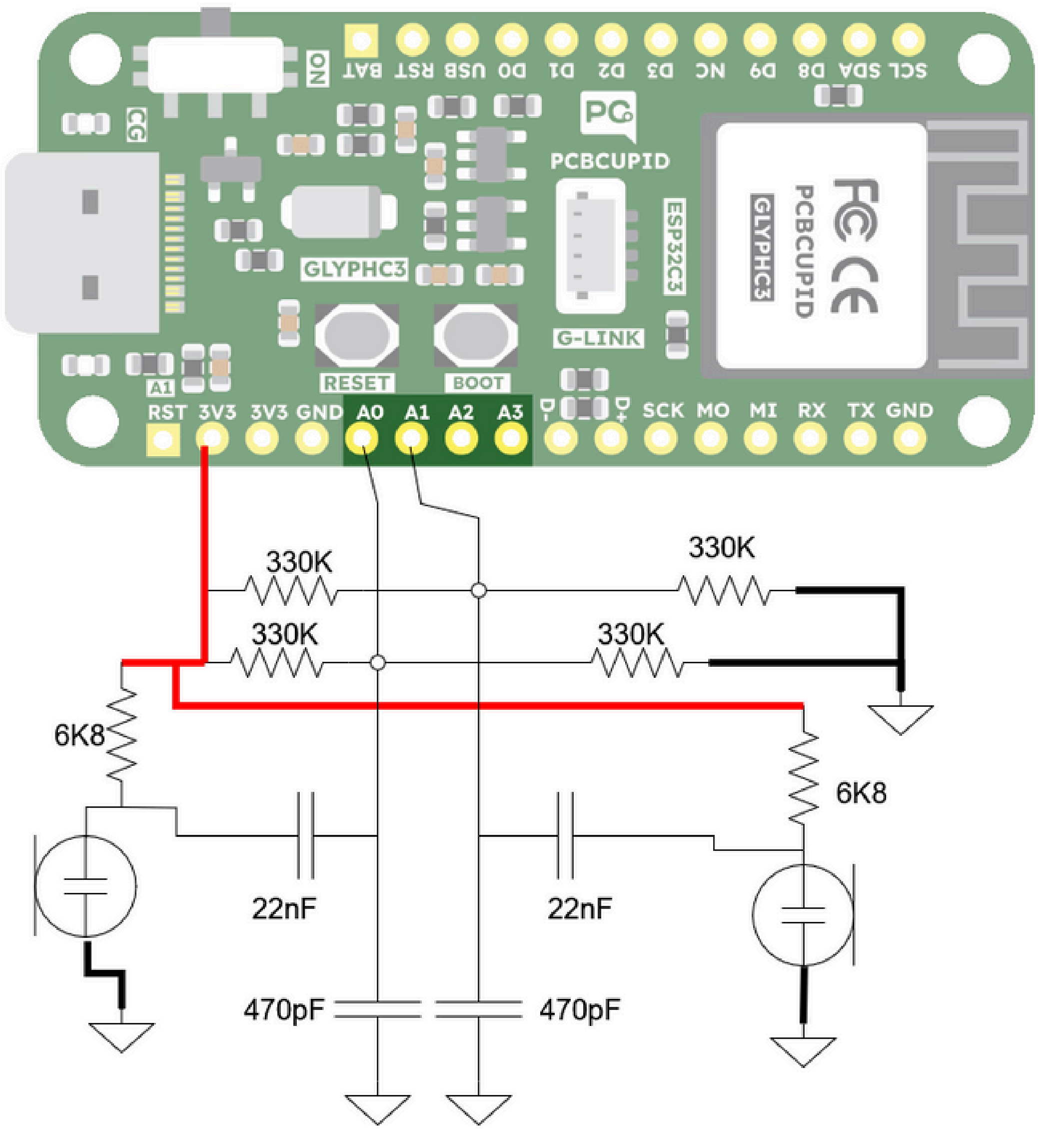
- Accurately localize and classify different noise sources in real time
- Create acoustic "maps" of city soundscapes
- Distinguish between overlapping sounds (e.g., construction noise vs. traffic)
- Support smart city infrastructure for dynamic noise regulation and enforcement

This technology can empower city planners, environmental agencies, and public health researchers with actionable insights to design quieter, healthier urban spaces.

LIST OF COMPONENTS

NPN Transistors (BC547)	10
Capacitor Box	1
Condenser Mic	4
Red Wires multi-strand (1M)	1meter
Black wire multi-strand (1M)	1meter
GLYPH C3 – ESP32C3 DEV Board (Non Soldered)	1
FR4 – High Quality Zero board PCB (Perfboard)	2
Resistor Box	1

Connection Diagram



Code

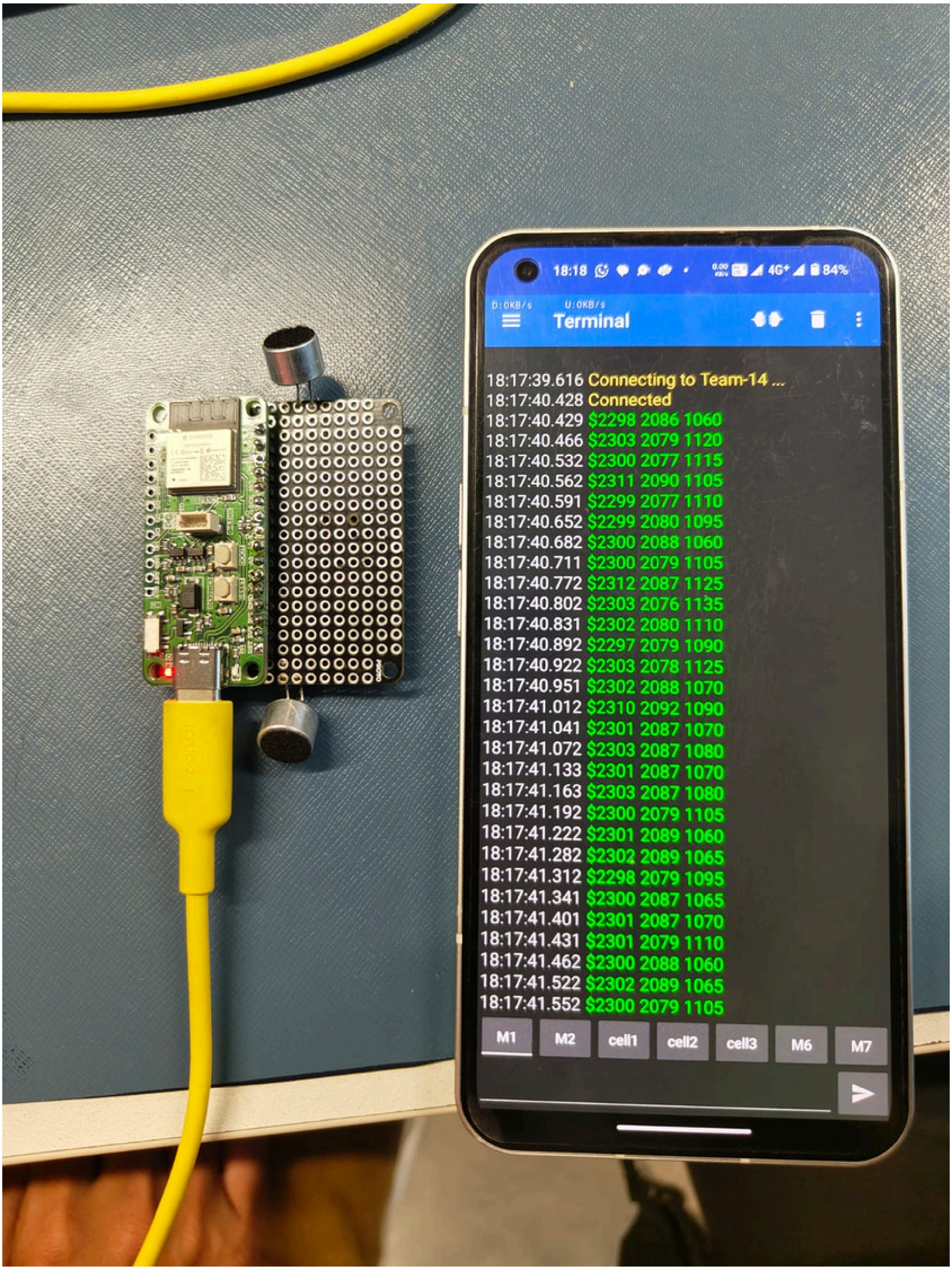
Main Snippet, Takes care of Sampling, Peak detection, and transmitting Raw Data to Host.

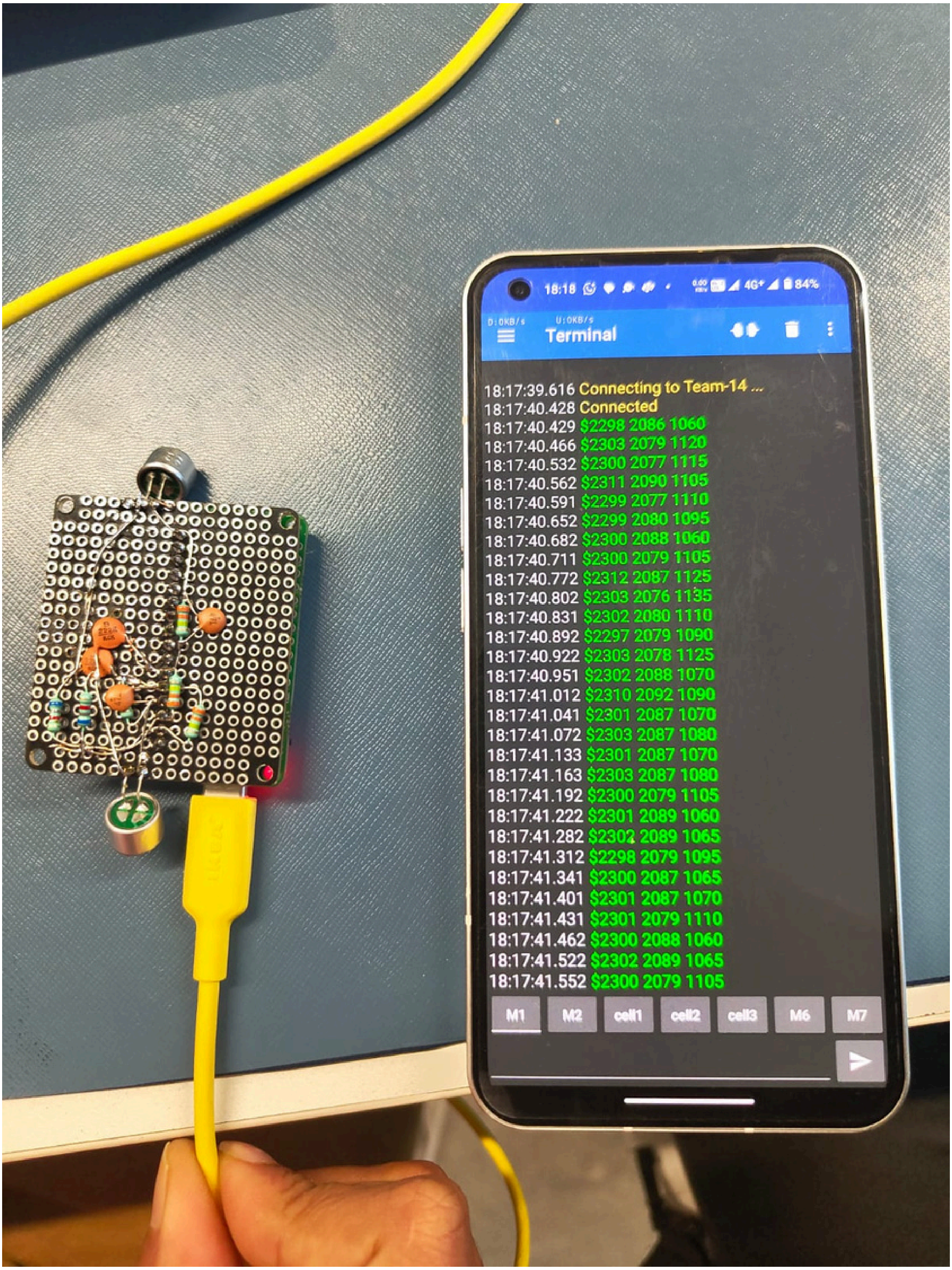
```

 // Sampling here
delayMicroseconds(10);
sensorValue0 = analogRead(sensorPin0);
delayMicroseconds(10);
sensorValue1 = analogRead(sensorPin1);

//peak detector scheme
 if(sensorValue0>peakLeft)
 {
 peakLeft = sensorValue0;
 }
 else if (sensorValue0<(peakLeft-20)) // Peak detection with Hysteresis
 {
  peakLeft = sensorValue0;
 }

 if(sensorValue1>peakRight)
 {
 peakRight = sensorValue1;
 }
 else if (sensorValue1<(peakRight-20))
 {
  peakRight = sensorValue1;
 }

 sensorValue2 =abs(sensorValue0 - sensorValue1)*5;// Amplified waveform coommon on ba=oth channel.
 sprintf(bufferb, "$%d %d %d %d %d;", sensorValue0,sensorValue1,sensorValue2, peakLeft,peakRight);// prepare buffer
 Serial.printf(bufferb);// print to PC

}
```

Software & Tool

- Arduino,
- Serial Port Plotter
- Soldering Iron, Tweezers, Cutter,

Prototype

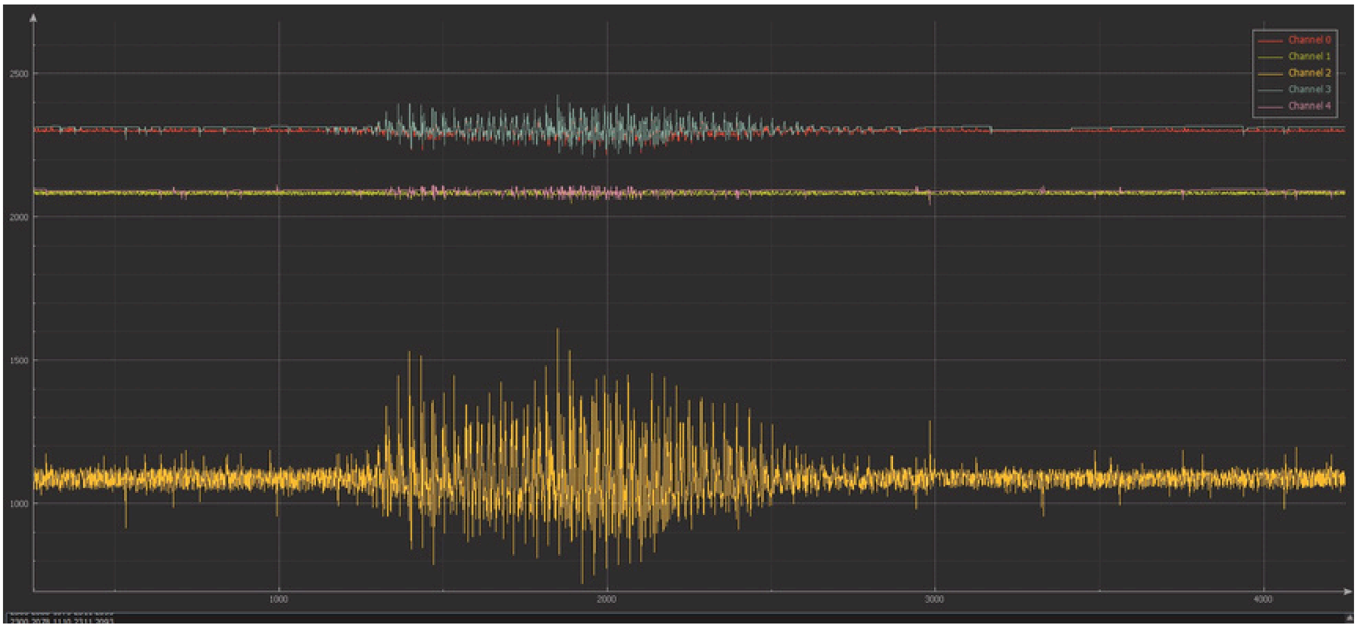



18:18
84%
D:0KB/s
U:0KB/s
Terminal
18:17:39.616 Connecting to Team-14 ...
18:17:40.428 Connected
18:17:40.429 $2298 2086 1060
18:17:40.466 $2303 2079 1120
18:17:40.532 $2300 2077 1115
18:17:40.562 $2311 2090 1105
18:17:40.591 $2299 2077 1110
18:17:40.652 $2299 2080 1095
18:17:40.682 $2300 2088 1060
18:17:40.711 $2300 2079 1105
18:17:40.772 $2312 2087 1125
18:17:40.802 $2303 2076 1135
18:17:40.831 $2302 2080 1110
18:17:40.892 $2297 2079 1090
18:17:40.922 $2303 2078 1125
18:17:40.951 $2302 2088 1070
18:17:41.012 $2310 2092 1090
18:17:41.041 $2301 2087 1070
18:17:41.072 $2303 2087 1080
18:17:41.133 $2301 2087 1070
18:17:41.163 $2303 2087 1080
18:17:41.192 $2300 2079 1105
18:17:41.222 $2301 2089 1060
18:17:41.282 $2302 2089 1065
18:17:41.312 $2298 2079 1095
18:17:41.341 $2300 2087 1065
18:17:41.401 $2301 2087 1070
18:17:41.431 $2301 2079 1110
18:17:41.462 $2300 2088 1060
18:17:41.522 $2302 2089 1065
18:17:41.552 $2300 2079 1105
M1
M2
cell1
cell2
cell3
M6
M7

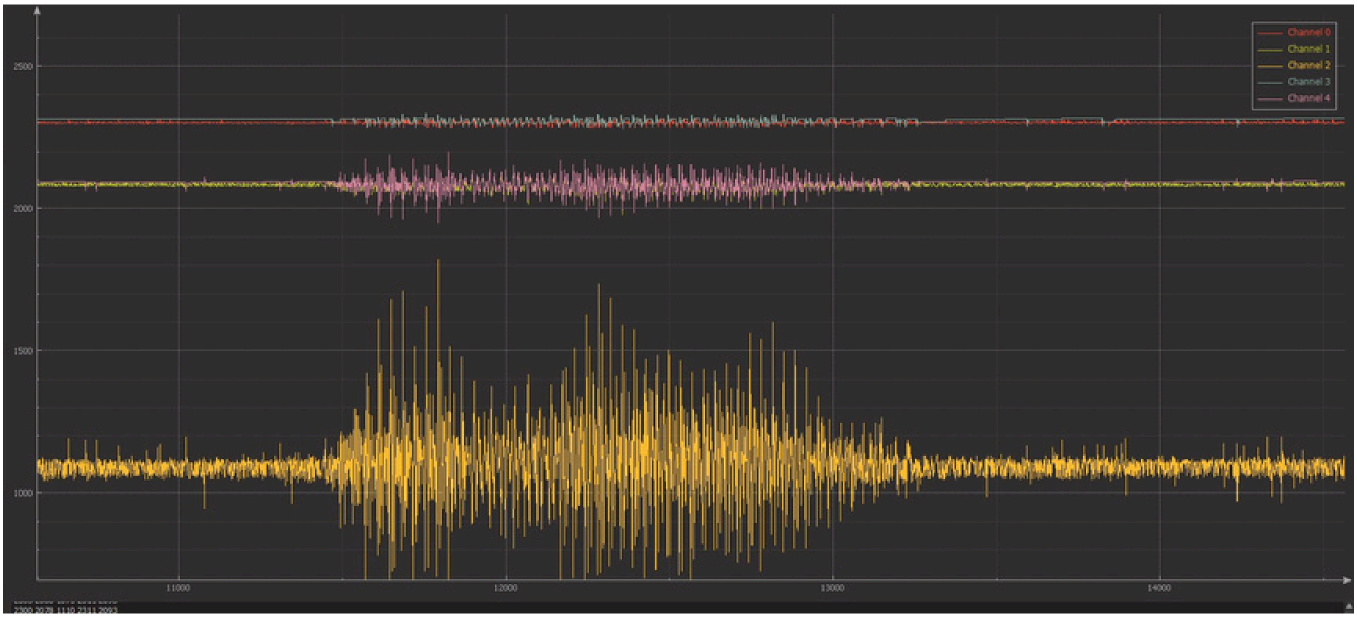
Working

Microphone results in an Amplitude proportional to the sound incoming, The resistor of 6K8 Ohms value limits and Bias the Amplifier inside the electret microphone, Then the DC block Capacitor allows AC signal to pass to next stage,
Next Stage consists of Voltage divider formed by 330K resistors, which sets the input voltage to around 1.5V i.e. 3v3 / 2.
Another capacitor (470pF) between the signal and ground path forms the Low pass filter.
When the signal incoming on Right & Left are equal the Amplitude detected on both channel is matched, when there is a mismatch between the incoming audio strength, the Received channel are then Observed to pick the difference and hence amplify this. (Yellow Trace)

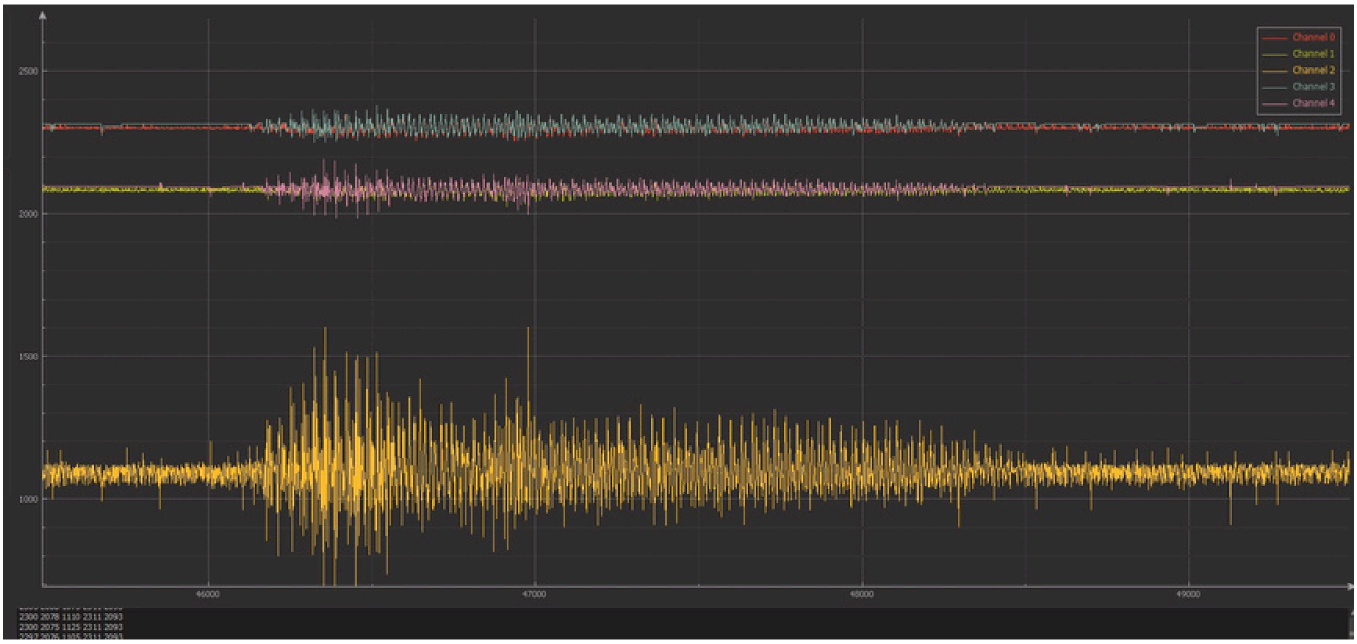
RIGHT CHANNEL STRENGTH



LEFT CHANNEL STRENGTH



BOTH CHANNEL RECEIVING from Front.



APPLICATIONS

1)Motion sensor
2)Accurate Sound Source Localization in Noisy or Reverberate Environments
3)Monitoring and Identifying Unauthorized Drones Using Acoustic Signatures