

TAPSHIELD

"Tap. Trigger. Trust."

Team: Runtime Terror

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Heckathon: Triwizardathon 1.0

“Not everyone can scream for help - some can only tap.”

PROBLEM STATEMENT:

In moments of **abduction** , **domestic violence**, **elderly medical emergencies** , or **panic attacks**, victims may be **unable to speak** , **reach their phone**, or **press a panic button**.

⚠️ Current emergency systems rely on **voice commands**, **smartphone apps**, or **visible devices** - all of which **fail** when the person is physically restrained, muted , unconscious, or offline.

⚠️ Vulnerable groups such as **women**, **children**, **the elderly**, and **disabled individuals** are often left **without a safe** , **silent**, and **discreet way** to ask for help.

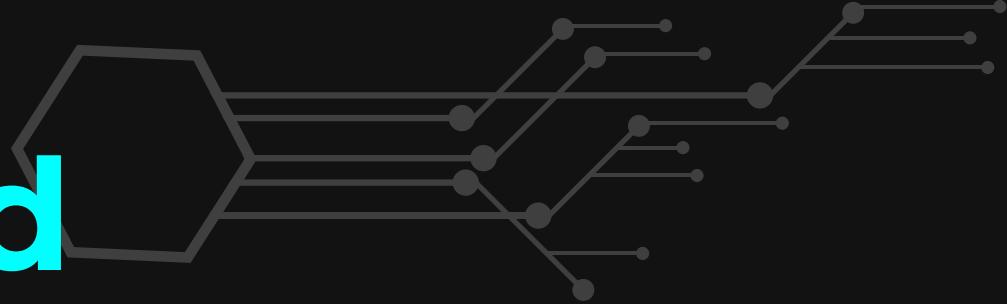
⚠️ There is an urgent need for an **invisible**, **intelligent**, and **reliable way to signal distress** - even in the darkest moments.



“When speaking isn’t an option, safety shouldn’t be either.”

Our Solution - TapShield

"Discreet. Offline. Life-saving."



TapShield is a **wearable emergency alert device** designed for people who cannot speak , scream or access a phone during critical situations.

With just a **simple tap pattern** on the wristband or ring ,TapShield uses **on-device AI** to recognize distress signals and immediately sends an **SOS alert via GSM**, without needing internet or voice input.

It is discreet, offline, and life-saving - ideal for women, elderly, children, or disabled individuals in **dangerous or medical emergencies**.



AI-Powered Tap Recognition

Learns and identifies custom tap patterns using on-device TinyML models.



Offline GSM Alert System

Sends SOS alerts via SIM module - works without internal or app.



Silent, Discreet Activation

No buttons. No voice. Just a tap - ideal in restrained or high-risk situations.



Low-Cost & Portable

Built with affordable components(Arduino Nano, Piezo , SIM8000L) and wearable as a wristband or Ring.



Made for Vulnerable Groups

Designed to protect women, elderly, disabled individuals in emergency scenarios.

HOW IT WORKS ?

"From Tap to rescue - under 2 Seconds"



Tap Detected



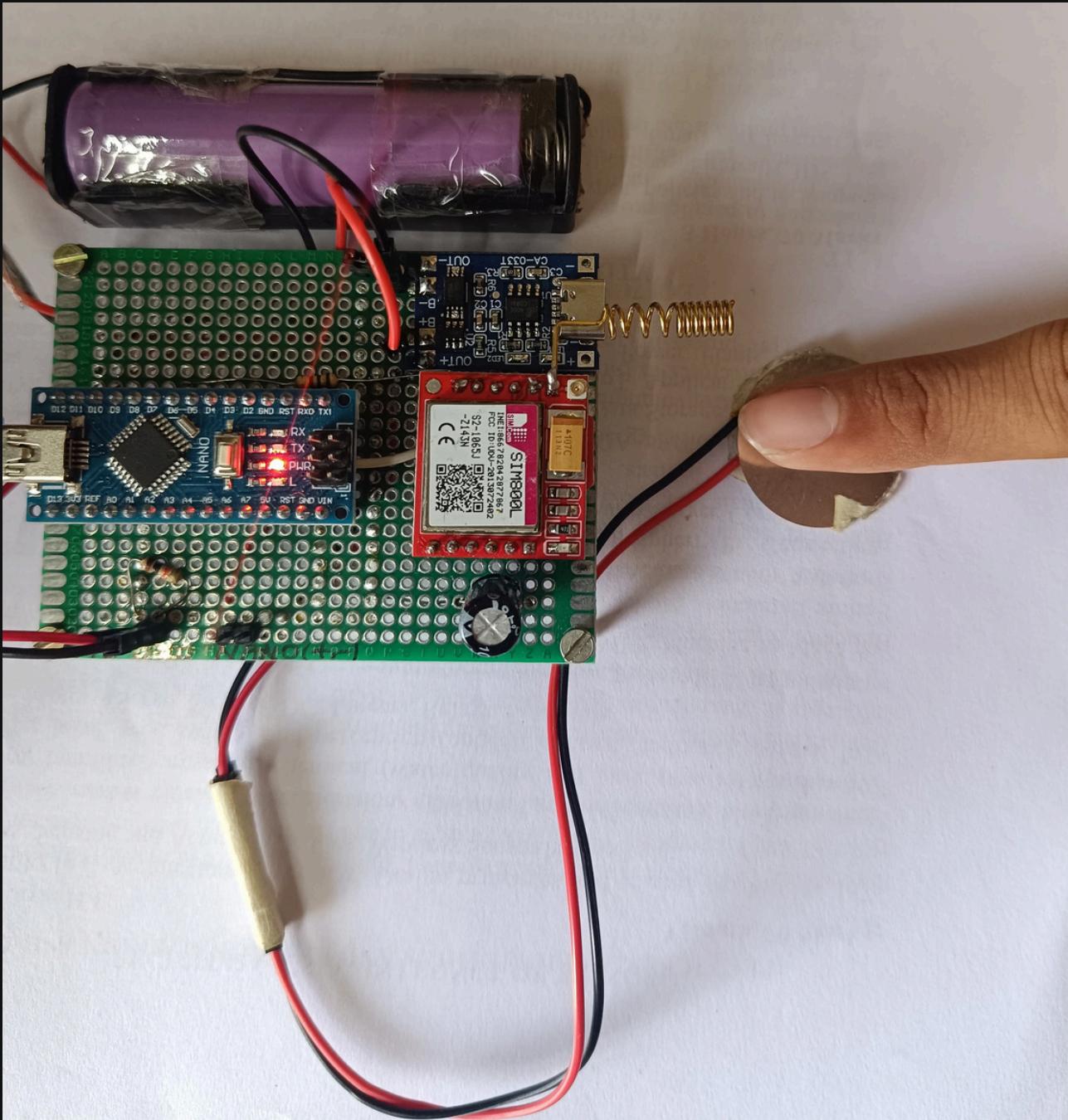
AI Recognition



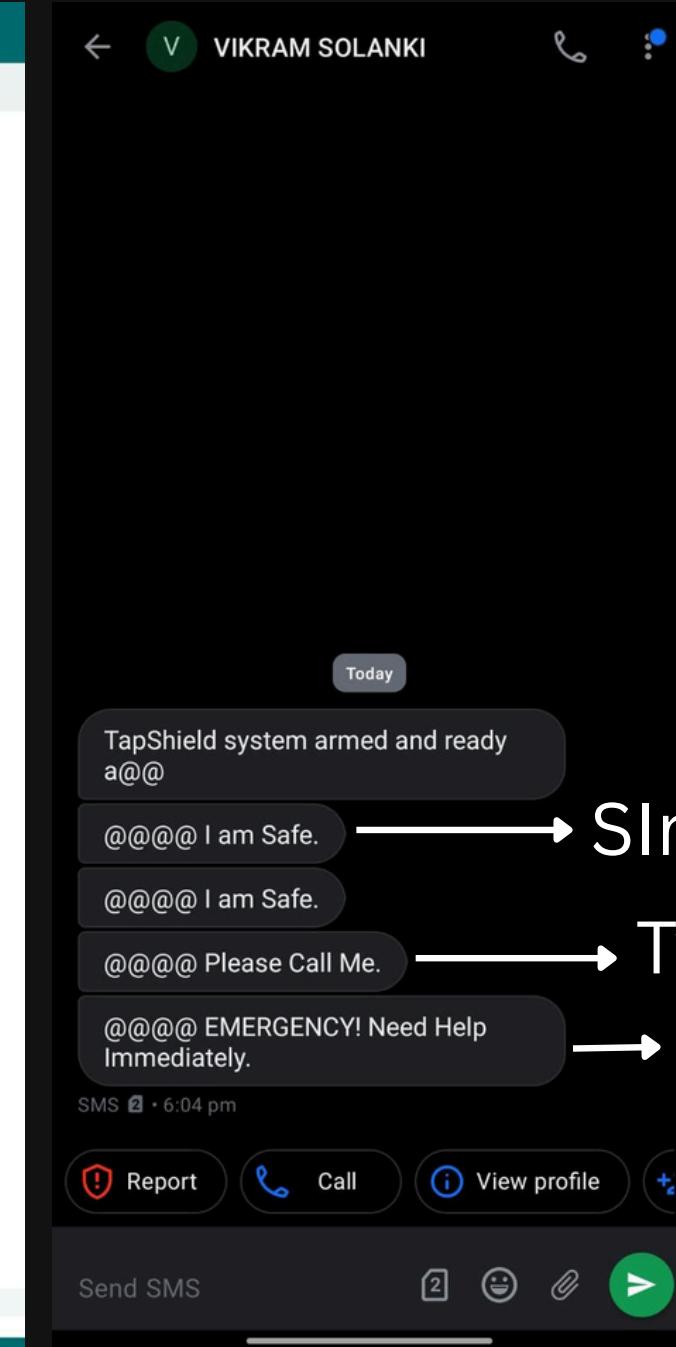
GSM Triggered



Emergency Help



```
sketch_jul24a.ino
1 #include <TapShield_inferencing.h>
2 #include <SoftwareSerial.h>
3
4 #define PIEZO_PIN A0
5 #define BUFFER_SIZE 100
6
7 float signalBuffer[BUFFER_SIZE];
8
9 #define SIM_TX 8
10 #define SIM_RX 7
11 SoftwareSerial sim800(SIM_TX, SIM_RX);
12
13 int getSignalData(size_t offset, size_t length, float *out_ptr) {
14     memcpy(out_ptr, &signalBuffer[offset], length * sizeof(float));
15     return 0;
16 }
17
18 void setup() {
19     Serial.begin(9600);
20     sim800.begin(9600);
21     pinMode(PIEZO_PIN, INPUT);
22     delay(3000);
23
24     Serial.println("⌚ TapShield ML System Started...");
25     sendSMS("+91XXXXXXXXXX", "🔔 TapShield armed and ready!");
26 }
27
28 void loop() {
29     for (int i = 0; i < BUFFER_SIZE; i++) {
30         signalBuffer[i] = analogRead(PIEZO_PIN);
31         delay(10);
32     }
33     ei_impulse_result_t result;
34     signal_t signal;
35     signal.total_length = BUFFER_SIZE;
36     signal.get_data = &getSignalData;
37
38     EI_IMPULSE_ERROR res = run_classifier(&signal, &result, false);
39     if (res != EI_IMPULSE_OK) {
40         Serial.print("✖ Inference failed: ");
41         Serial.println(res);
42         return;
43     }
44     String detectedLabel = "";
```

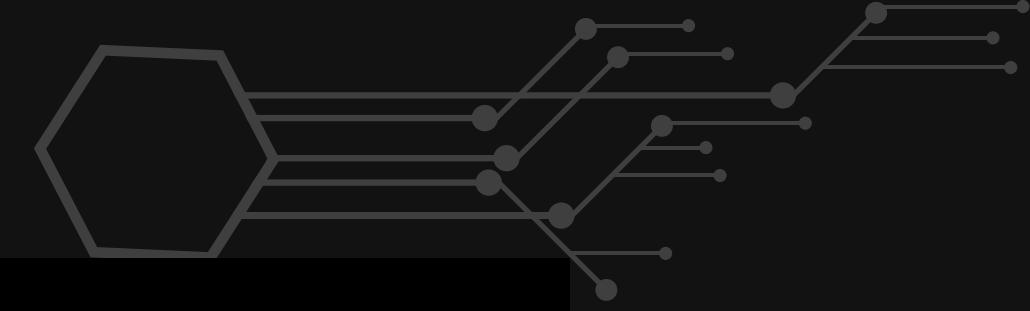


→ Single time press

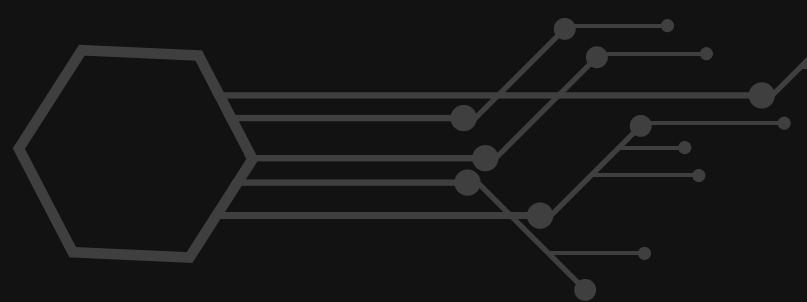
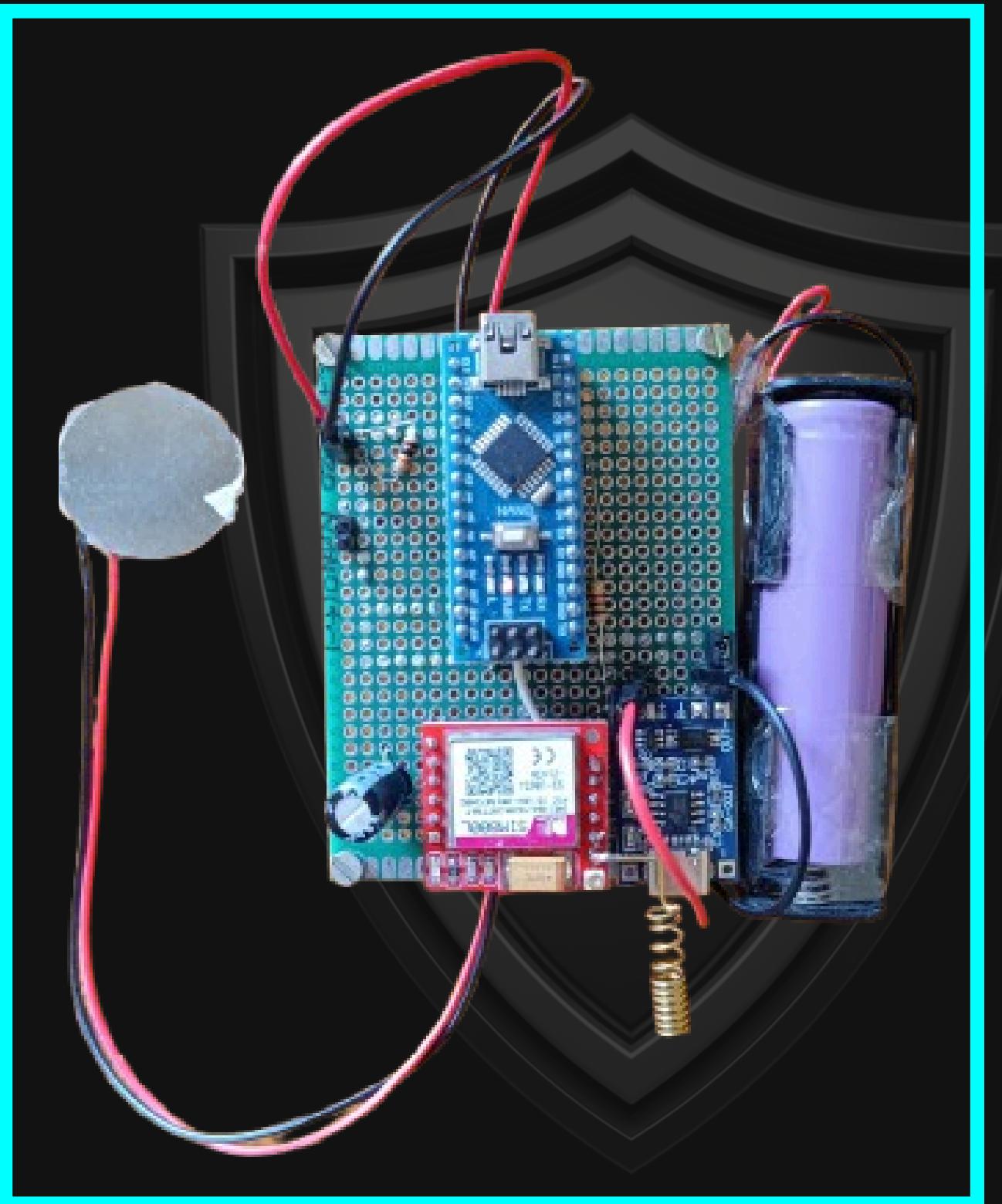
→ Two time press

→ Three time press

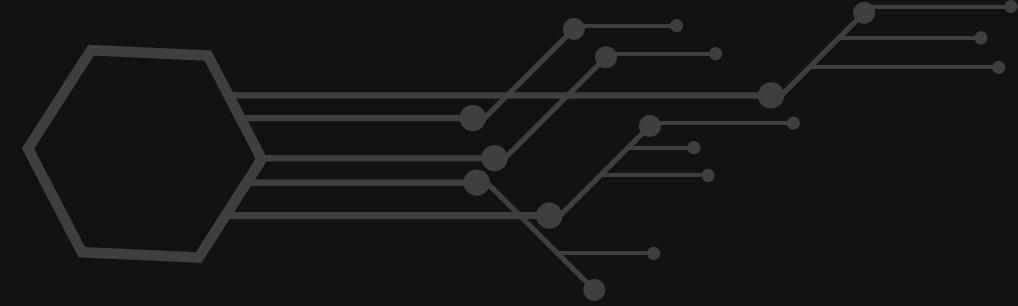
Live Demo



PROTOTYPE



CIRCUIT

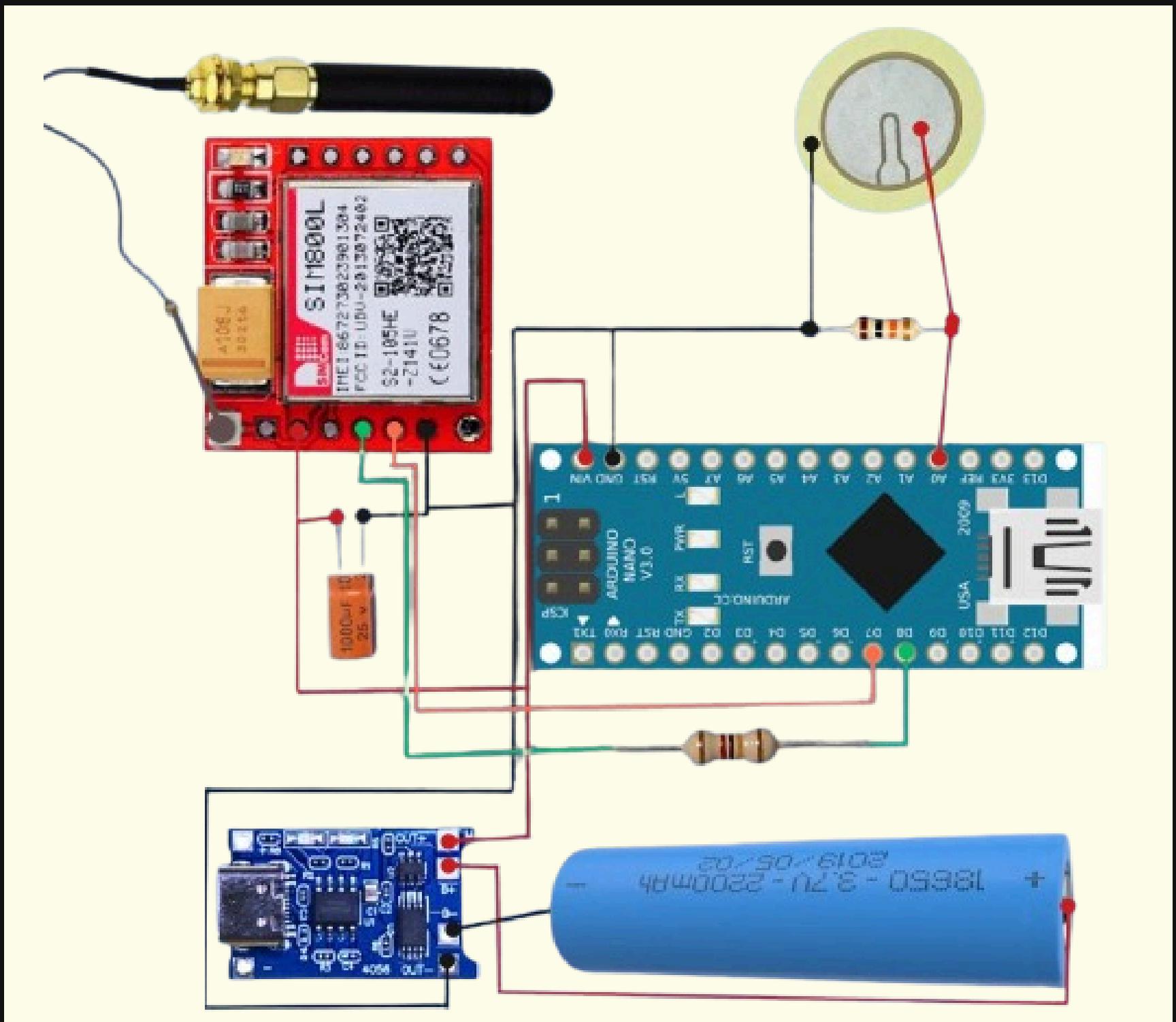


Arduino Nano

- It is a small microcontroller board based on the ATmega328 chip.
- It controls and connects all sensors and modules in the circuit.

Piezo Sensor

- It detects vibrations or taps on a surface.
- It sends a signal to the Arduino when Tap is detected.



SIM800L GSM Module

- It allows sending SMS or making calls using a SIM card.
- It communicates with the Arduino to send alerts remotely.

Li-ion Battery

- It provides portable power to the whole circuit.
- It can be recharged safely with a charging module.

TapShield: TinyML-Powered SOS System

"Tap Pattern Detection using Edge Impulse"

► Input: Tap Detection

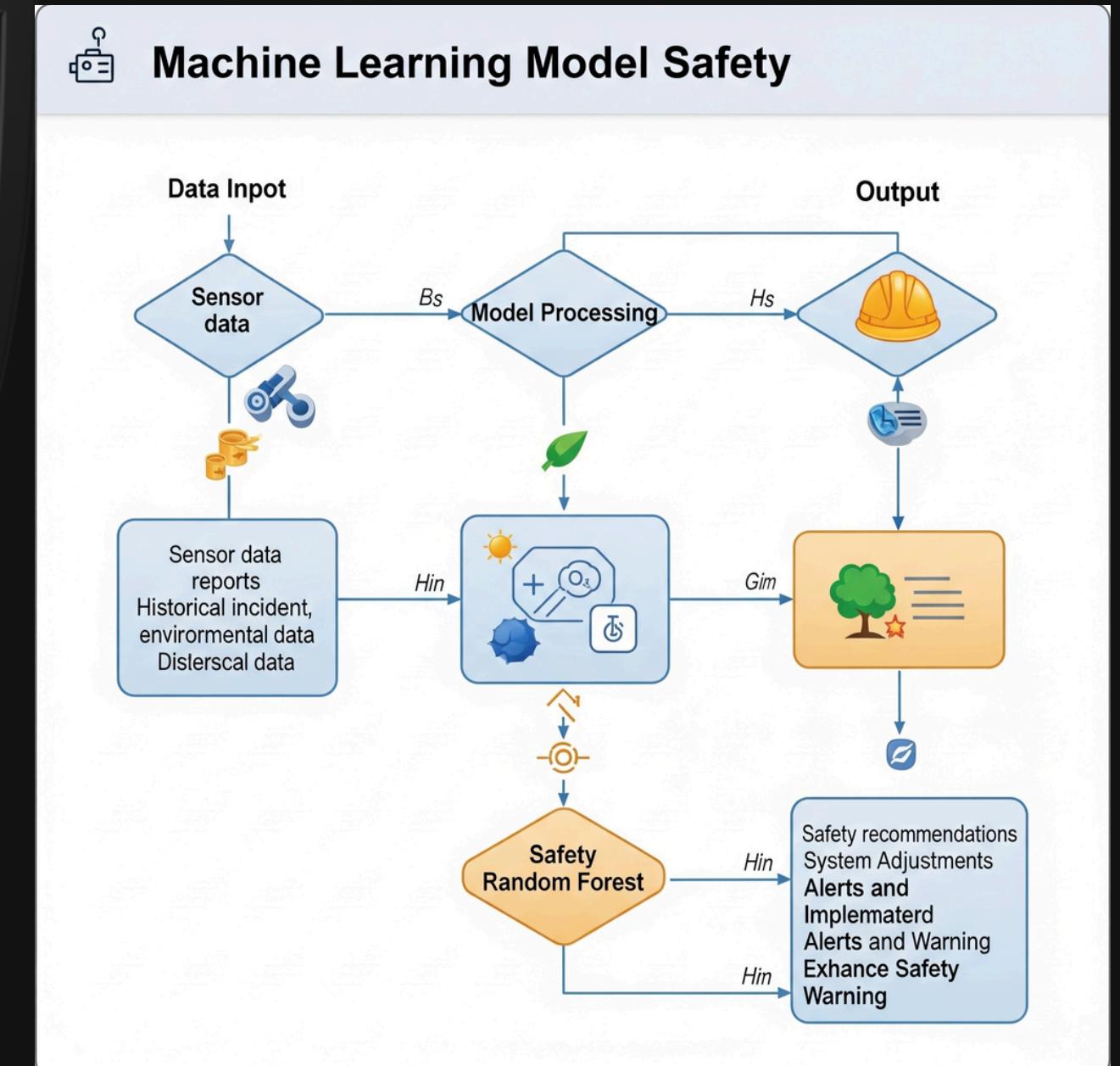
- Piezo sensor captures analog signals from physical taps
- Mounted on wearable or small surface

► Processing: Signal Analysis + ML

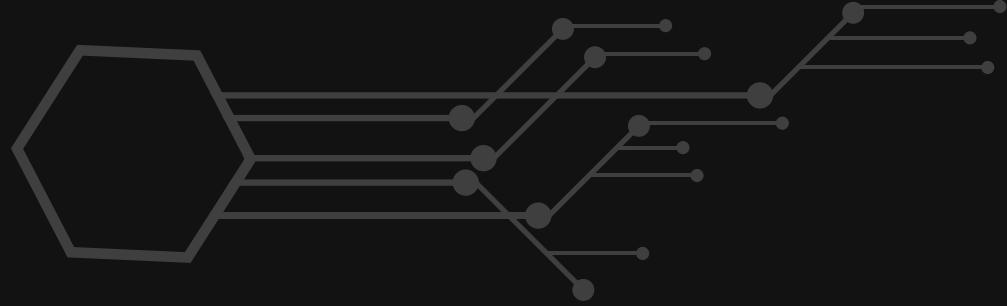
- Arduino collects signal over time window (e.g., 1 sec)
- TinyML model (trained using Edge Impulse) runs locally
- Classifies pattern (e.g., Single / Double / SOS Tap)

► Output: Emergency Action

- If SOS tap is detected, sends SMS using SIM800L
- SMS is pre-configured (e.g., "HELP! Send assistance.")
- No internet required - works offline



ROLE OF ML IN TAPSHIELD



✗ Traditional methods can't handle:

- Noise in tap signal
- Variable tap speed & strength
- User differences (e.g., finger pressure, surface)

✓ ML helps to:

- Learn patterns from real-world tap signals
- Classify multiple tap types accurately (e.g., single, double, SOS)
- Run locally on microcontrollers via TinyML
- Adapt to human variation (even noisy or fast taps)

BUILDING THE ML MODEL IN EDGE IMPULSE



Data Acquisition

- Collected tap signals from Arduino
- Labeled as one_tap, two_tap, three_tap, none

Signal Processing

(Impulse Design)

- Applied Raw Data or Spectral Features (FFT)
- Normalized values for consistency

ML Model Design

- Chose Neural Network (Keras) classifier
- Tuned input layer size = 100 samples
- Added Dense + ReLU layers

Model Training

- Training/Validation split: 80/20
- Monitored accuracy, loss, and confusion matrix

Testing & Evaluation

- Verified predictions on new live data
- Adjusted training if misclassified

Deployment

- Converted model to C++ Arduino Library (.h/.cpp)
- Included in Arduino project for live inference

GLIMPSE OF ML MODEL



one_tap_8	one_tap	Jul 21 2025, 1...	80ms	⋮
one_tap_1	one_tap	Jul 21 2025, 1...	80ms	⋮
one_tap_7	one_tap	Jul 21 2025, 1...	80ms	⋮
one_tap_10	one_tap	Jul 21 2025, 1...	80ms	⋮
one_tap_3	one_tap	Jul 21 2025, 1...	80ms	⋮
one_tap_9	one_tap	Jul 21 2025, 1...	80ms	⋮
one_tap_6	one_tap	Jul 21 2025, 1...	80ms	⋮
one_tap_5	one_tap	Jul 21 2025, 1...	80ms	⋮
one_tap_4	one_tap	Jul 21 2025, 1...	80ms	⋮

Time series data

Input axes: piezo

Window size: 2,000 ms.

Window increase (stride): 1,000 ms.

Frequency (Hz): 100

Zero-pad data: checked

Flatten

Name: Flatten

Input axes (1): piezo

Classification

Name: Classifier

Input features: Flatten

Output features: 4 (none, one_tap, three_tap, two_tap)

Output features: 4 (none, one_tap, three_tap, two_tap)

Save Impulse

Parameters Generate features

Raw data

Show: All labels three_tap_4 (three_tap)

Raw features: 158, 96, 61, 36, 23, 13, 10, 8, 158, 93, 56, 35, ...

Label: three_tap

DSP result

Processed features: 5.4200, 0.0000, 158.0000, 22.2702, 21.6005, 5.1581, 28.6076

State: None for these settings

On-device performance: PROCESSING TIME 1 ms, PEAK 844 Bytes

none - correct

one_tap - correct

three_tap - correct

two_tap - correct

Training output

Model: Model version: Quantized (int8)

Last training performance (validation set)

Accuracy: 100.0%

Loss: 0.35

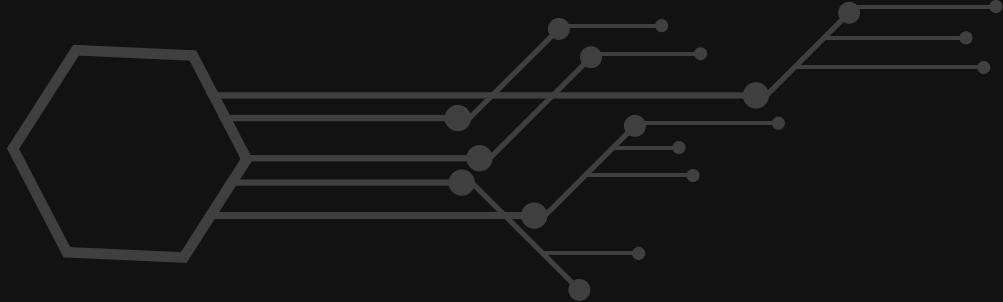
Confusion matrix (validation set)

	NONE	ONE_TAP	THREE_TAP	TWO_TAP
NONE	100%	0%	0%	0%
ONE_TAP	0%	100%	0%	0%
THREE_TAP	0%	0%	100%	0%
TWO_TAP	0%	0%	0%	100%
F1 SCORE	1.00	1.00	1.00	1.00

Metrics (validation set)

- Area under ROC Curve: 1.00
- Weighted average Precision: 1.00
- Weighted average Recall: 1.00
- Weighted average F1 score: 1.00

TECHNOLOGY STACK



Hardware

- Arduino Nano
- Piezo Sensor
- SIM800L GSM Module
- Vibration motor



Software & AI

- Edge Impulse
- TinyML Inference Code
- C++ (Arduino IDE)
- Serial Monitoring

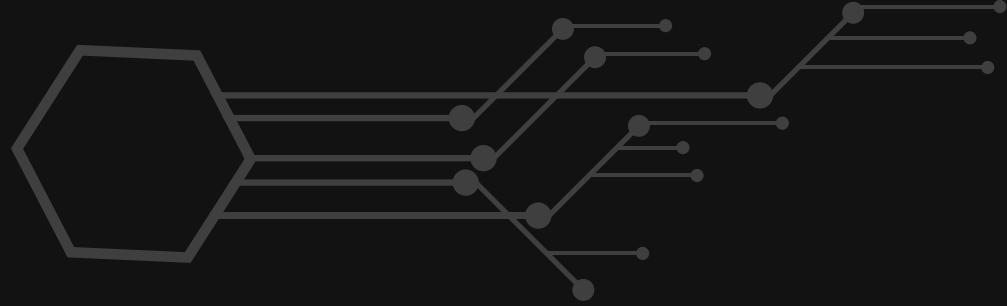


Power System

- LiPo 3.7V Battery
- TP4056 Charging Module
- Voltage Regulator(5V)

"Built for real-world emergencies - simple, scalable, and smart."

INNOVATION & IMPACT



What Makes TapShield Innovative ?

 **On-device AI** - Works without internet or cloud

 **Tap-to-alert** - No voice, no button, just tap

 **Silent Activation** - Discreet for dangerous situations

 **GSM-based SMS** - Works in remote areas, no app needed



Real-World Impact



Women under threat (stalking, abuse)



Elderly during medical emergency



Disabled people with limited mobility or speech



Remote areas with poor signal / internet

"A single tap can be the difference between silence and survival."

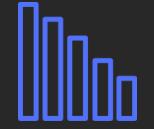
FUTURE SCOPE

now

future



Real-time tap input → AI model inference



Successful GSM message test with SIM800L



Preview of SMS received with live location



GPS Integration - Send location along with SOS



Battery Optimization - For 5+ days standby



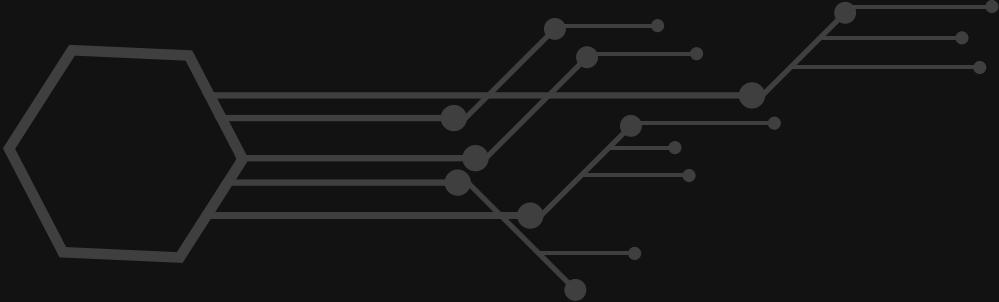
Companion App - For setup, contacts & pattern management



Voice Activation Backup - For optional voice trigger



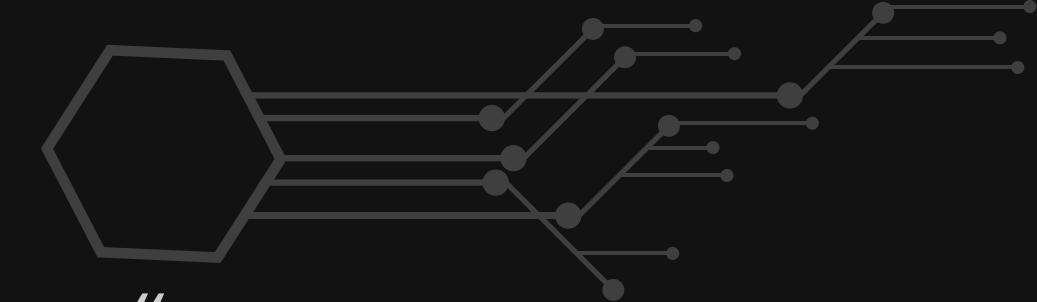
Community SOS Network - Auto-alert nearby volunteers



"TapShield is more than a prototype - it's platform for silent safety."

THANK YOU!

“ Silent safety. Smart protection. One tap at a time. ”



T



Vikram Solanki

- AI model , ML, GSM and Arduino

E



Vikas

- Circuit Design , Pitch and Presentation

A



Rahul Tak

- AI & ML , Pitch and Presentation

M



Sheshkaran

- ML and Web development



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Triwizardathon 1.0 - Hackathon 2025