AI-Driven Emergency Alert System Using ECG Signal Classification and Voice Assistance

Prepared By

SNEKHA R - 220701282
SNEHA SAJEEVAN - 220701281

Introduction

This project is an AI-powered wearable safety system designed to protect women and elderly people. It continuously monitors heart activity, detects emergencies, and provides instant voice guidance and alerts to ensure safety and quick assistance.

Problem Statement

- Sudden emergencies like heart attacks or distress can happen anytime, without warning.
- Women and elderly people may not be able to call for help quickly during such emergencies.
- Delayed detection and response can increase health risks and safety threats.
- Existing devices like simple SOS buttons or fitness bands are limited — they need manual activation and don't give advice.
- There is a lack of real-time monitoring, automatic detection, and instant guidance in one single system.

Existing Solution

- Simple SOS buttons or panic alarms.
- Wearable fitness bands that only track basic heart rate.
- Mobile apps for safety alerts (manual activation needed).
- Limited in giving real-time advice or automatic detection.

Proposed Solution

- AI-powered wearable system that monitors ECG signals continuously.
- Automatically detects abnormal heart activity or distress.
- Uses voice analysis to detect if user is calling for help.
- Provides instant voice guidance to user (stay calm, precautions).
- Sends live location and emergency alerts to family/caregivers.

Modules in project

1.ECG Sensor

Collects heart signals.

2.AI Module (ECG Model)

Detects if heart activity is abnormal.

3.Mic & Speech Recognition

Listens if user speaks distress words.

4.Gemini AI (NLP)

Understands the user speech meaning.

5.Voice Guidance Module

Gives advice (e.g., "Stay calm") to user

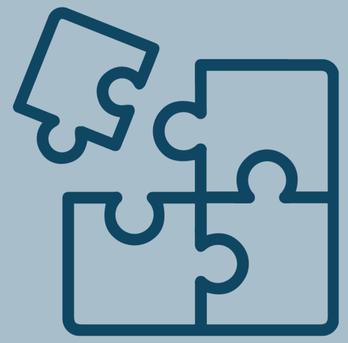
6.Alert Module (SMS & Location)

Detects if heart activity is abnormal.

Project Objectives

Analysis Phase

- Study and understand common safety threats and health emergencies faced by women and elderly people.
- Identify gaps in existing safety systems .



Strategy Development

- Design an AI-based system that combines ECG monitoring, voice detection, and emergency alerts.
- Plan how to give simple, clear voice guidance and send location-based alerts automatically.

Implementation Plan

- Develop and integrate modules for ECG anomaly detection, speech analysis, voice advice, and alert system.

Methodology

Data Collection & Preparation

- Collect ECG signal data (normal and abnormal cases).
- Preprocess ECG signals (filter noise) and clean audio data for clarity.

ECG Signal Processing & Model Training

- Apply bandpass filter to remove unwanted frequencies from ECG signal.
- Segment ECG data into smaller windows for model input.
- Train a CNN model to classify normal vs abnormal ECG segments.

Real-Time ECG Monitoring & Anomaly Detection

- Continuously monitor live ECG signals from the user.
- Use the trained CNN model to detect abnormal heart patterns instantly.
- If abnormality is detected, trigger the next step: audio recording for distress check.

Speech Recording & Distress Detection

- Activate microphone to record user's voice (only after abnormal ECG).
- Transcribe the recorded voice using Whisper (speech-to-text).
- Use Gemini AI to analyze speech for distress/emergency words.
- Classify speech as “Distress” or “No distress” based on AI analysis.

Voice Guidance & User Advice

- Provide instant voice guidance to the user using Text-to-Speech.
- Give simple, clear health advice (e.g., “Stay calm, sit down, help is coming”).
- Reassure and guide the user while waiting for assistance.

Alert & Notification System

- If distress or emergency is detected, send SMS alert to emergency contacts.
- Include live location of the user in the alert using Google Maps API.
- Ensure alert is sent automatically without manual action.

Technical Stack

Data Collection & Preparation

- WFDB »→ To read and process ECG signal data.
- NumPy »→ For numerical operations and data manipulation.
- Matplotlib »→ To visualize ECG signals.

ECG Signal Processing & Model Training

- SciPy »→ For bandpass filtering (butter, filtfilt).
- TensorFlow / Keras »→ For building and training the CNN model.
- Scikit-learn »→ For train-test split and evaluation.

Real-Time ECG Monitoring & Anomaly Detection

- TensorFlow / Keras »→ To load and use the trained CNN model (load_model).
- NumPy »→ For reshaping and processing real-time ECG segments.

Speech Recording & Distress Detection

- sounddevice ⇢ For recording user's voice through microphone.
- scipy.io.wavfile ⇢ To save recorded audio as WAV file.
- Whisper (OpenAI Whisper API) ⇢ For speech-to-text transcription.
- google-generativeai ⇢ To access Gemini AI for analyzing transcribed text.

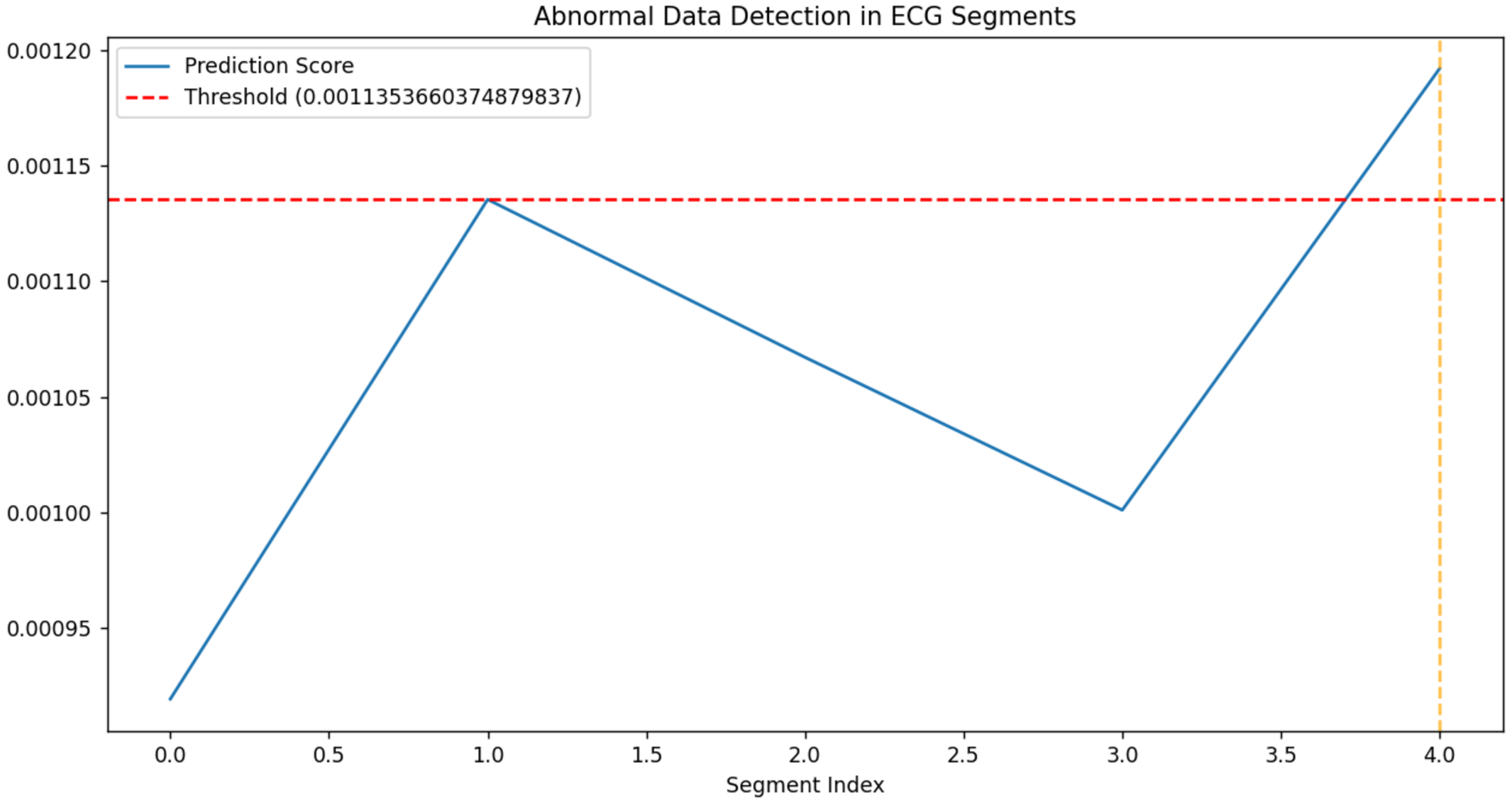
Voice Guidance & User Advice

- gTTS (Google Text-to-Speech) ⇢ To convert advice text to voice output.
- os ⇢ To play the generated audio file (system commands).

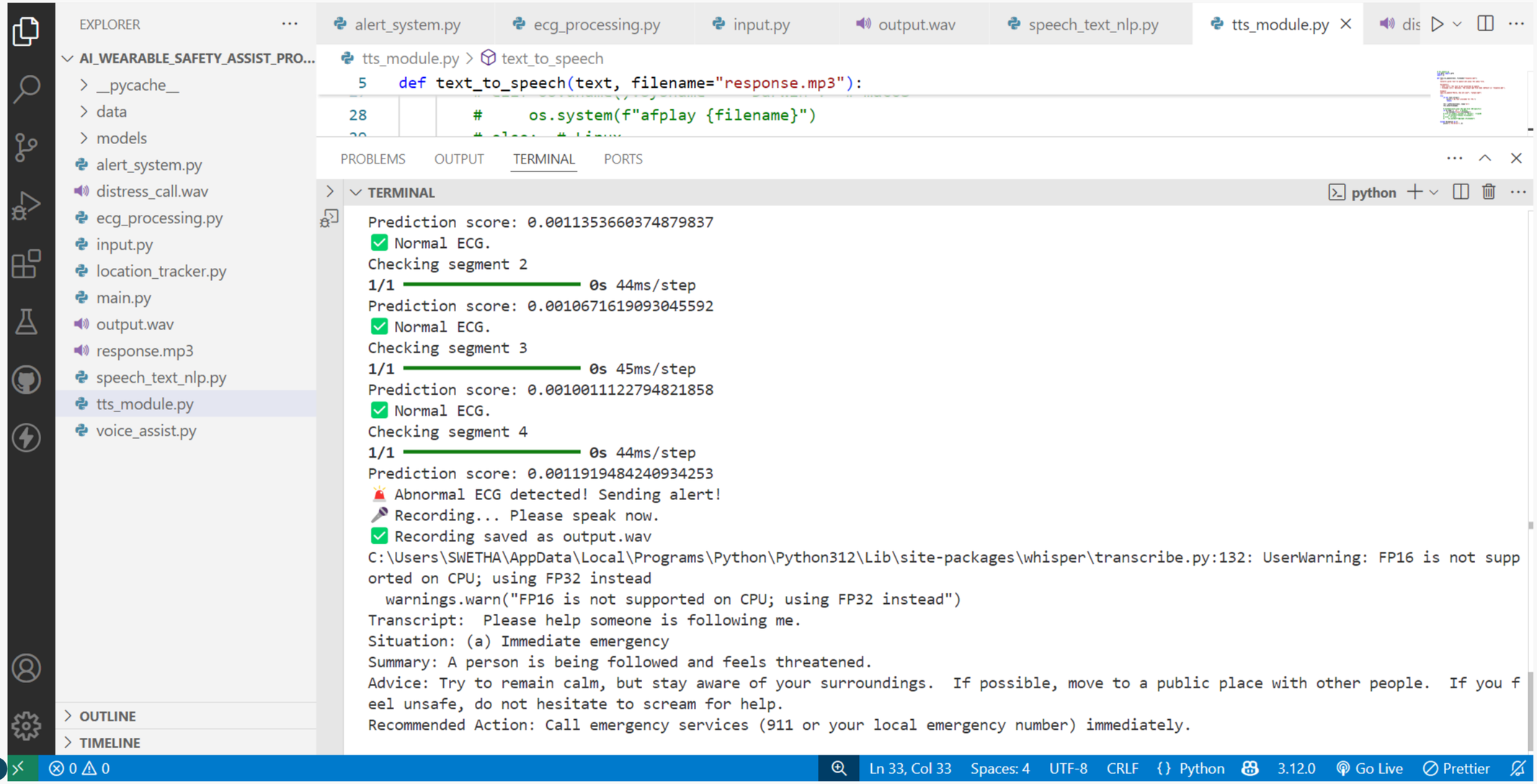
Alert & Notification System

- Twilio ⇢ To send SMS alerts to emergency contacts.
- Google Maps API ⇢ To generate and share live location link.
- Geopy (optional) ⇢ For location handling (if used).

Analysis phase



Output Screenshots



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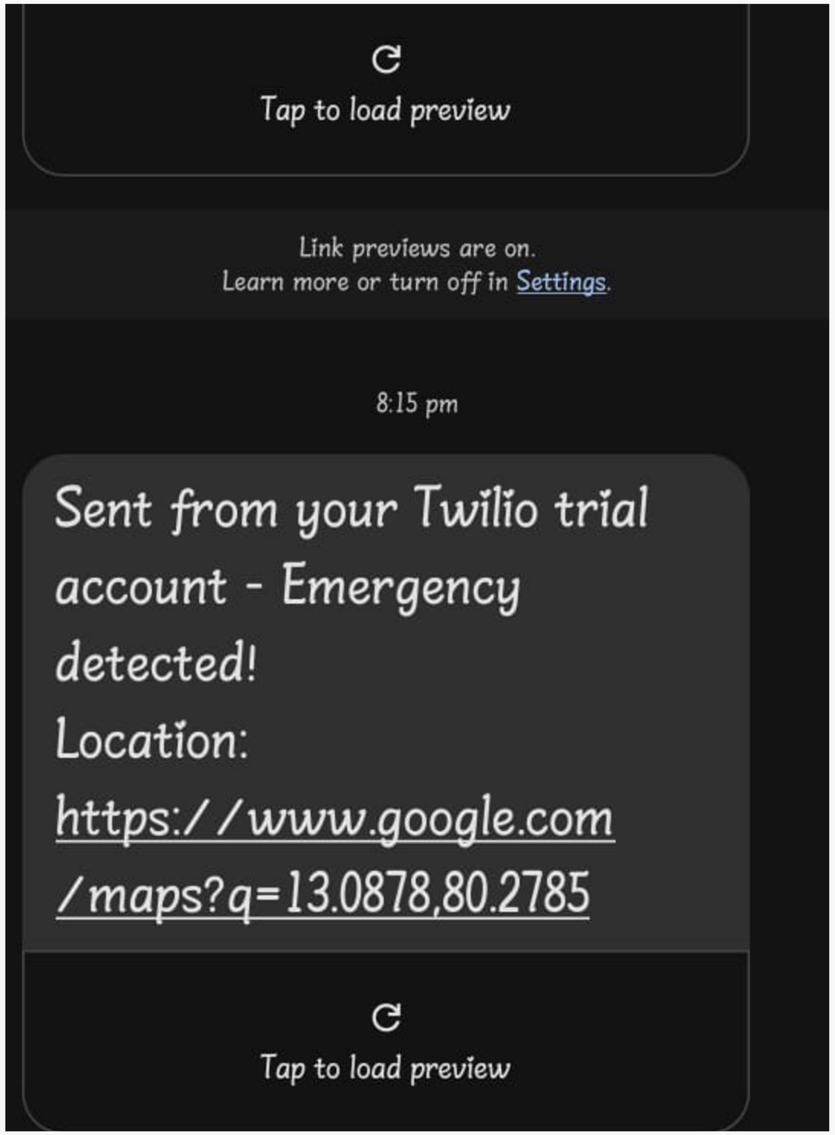

Conclusion

The AI-driven wearable safety assistance system enhances personal safety by monitoring ECG signals and providing real-time alerts for health emergencies. With integrated AI, GPS, and communication features, it ensures quick responses to critical situations, improving user well-being.

Thank you