



TRIWIZARDAT HON 1.0

Team Name : **Binary Broomsticks**

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Problem Statement : **Mentis Mirror** “A Cognitive Digital Twin for Real-Time Emotion & Stress Detection”
Combining IoT + AI for Human-Centric Wellness, Safety & Productivity

Team Members

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PROBLEM STATEMENT

✖ **The Core Problem:** Modern individuals — especially students, developers, drivers, factory workers, and healthcare professionals — often suffer from **hidden cognitive fatigue, stress, and emotional burnout**, without clear external signs.

PROBLEM STATEMENT

Millions suffer from stress, burnout, and cognitive fatigue without realizing it.

Most existing systems can't detect these states in real-time

This leads to poor productivity, mental health issues, and communication breakdown



★ Why It Matters



🧑 **Invisible Decline in Mental Health**
People don't realize when their cognitive load becomes dangerous until performance drops, mistakes happen, or health suffers.



🧑 **Lack of Real-Time Monitoring**
Current solutions (like wearables or wellness apps) are mostly reactive, not real-time, and focus only on physical vitals — not emotional well-being.



🔒 **No Integration into Daily Life or Digital Ecosystems**
Even if mood is tracked, there's no seamless way to make apps, calendars, or smart devices adapt to the user's cognitive state.

⚠ Consequences


🕒 **Missed productivity opportunities** due to unrecognized mental fatigue

💬 **Poor communication** in remote teams due to unnoticed stress

🚑 **Burnout-related health issues** go undetected until it's too late

🔄 **Non-personalized digital experiences** — no tech understands how you actually *feel*

PROPOSED SOLUTION

 **Overview:** Mentis Mirror is a **Neuro-AI powered IoT system** that creates a **digital twin of your emotional and cognitive state** in real-time by continuously analyzing **bio-signals, facial expressions, voice tone, and environmental factors**. It's a complete **emotion-aware platform** designed to enhance **well-being, productivity, and human-computer interaction**.

Key Capabilities

- **Facial micro-expression detection** using DeepFace/Azure Face API
- **Voice tone analysis** to understand emotional intensity (calm, tense, angry, etc.)
- **Heart rate variability (HRV)** and **GSR (sweat)** analysis to detect stress
- **Skin and ambient temperature sensing** for physiological context
- Fuses data into a **time-series model** to understand:
 - Mood
 - Focus
 - Fatigue
 - Stress
- Generates a **real-time cognitive state vector**, e.g.:
Mood: Low | Focus: Medium | Stress: High | Suggestion: Take a Break
- Smart alerts via:
 - App notifications
 - Buzzer/vibration module
 - Dashboard suggestions
- Responds with **adaptive actions**:
 - Reschedules meetings via Microsoft Graph API
 - Suggests music, break, lighting changes
 - Logs behavior for long-term patterns
- Data synced through **Azure IoT Hub**
- Emotional state modeled with **Azure Digital Twins**
- **Azure ML** optionally handles large-scale inference
- Connects to **Microsoft Graph API** to interact with the user's digital ecosystem (e.g., Outlook, Teams)

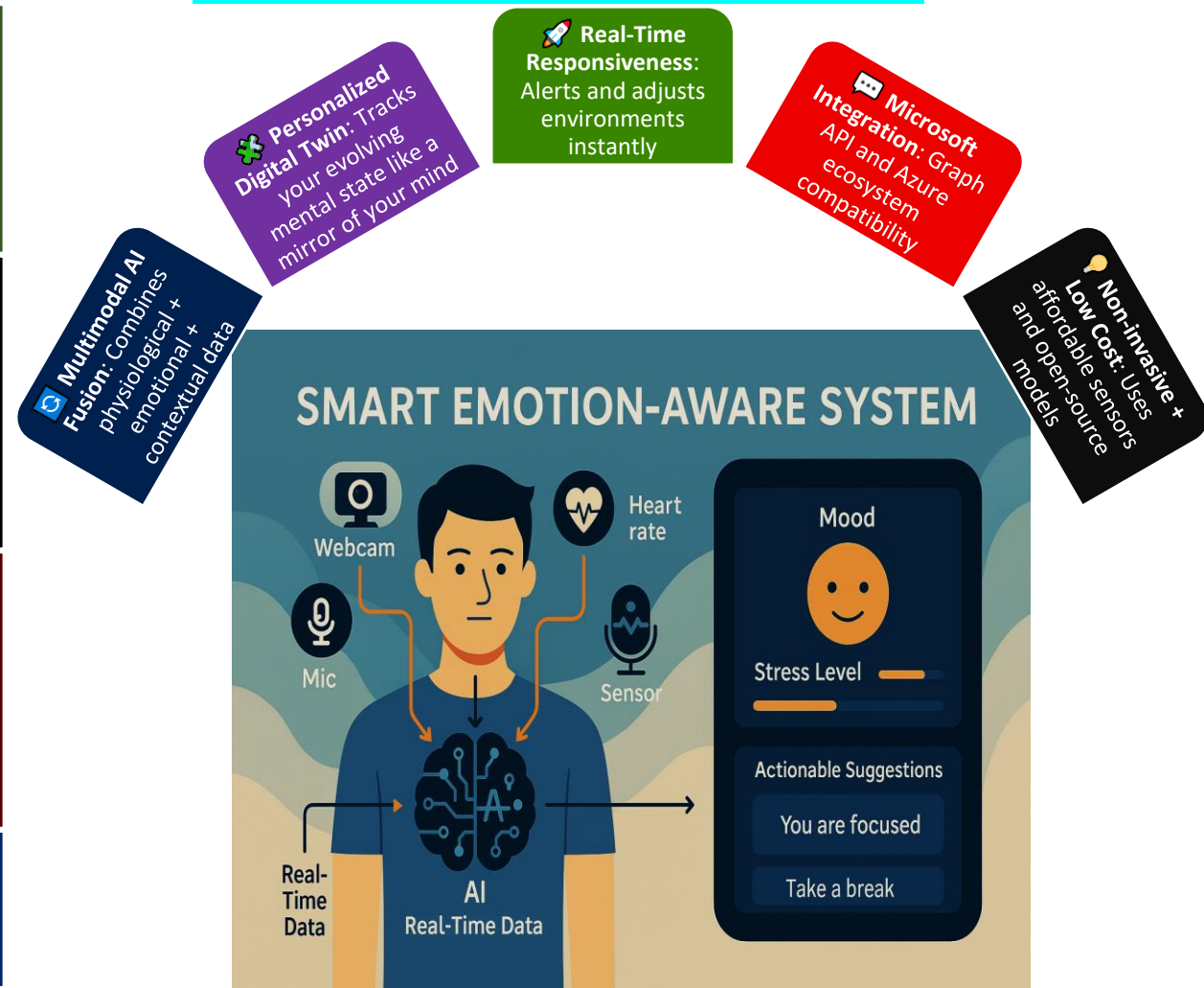
1. Multimodal Sensing

2. Cognitive State Estimation

3. Real-Time Feedback Loop

Azure-Powered Cloud Integration

What Makes SynapSync Different?



KEY COMPONENTS

Facial Emotion Detection (Webcam + DeepFace)

- Captures micro-expressions, stress cues
- Runs locally or via Azure Face API
- Outputs emotions like Happy, Sad, Angry
- Real-time emotion sensing from face

Heart Rate Sensor (MAX30102)

- Measures HR + HRV
- Detects hidden stress/cognitive load
- Internal stress indicator

GSR Sensor

- Tracks sweat gland activity
- High GSR = high emotional arousal
- Validates stress state

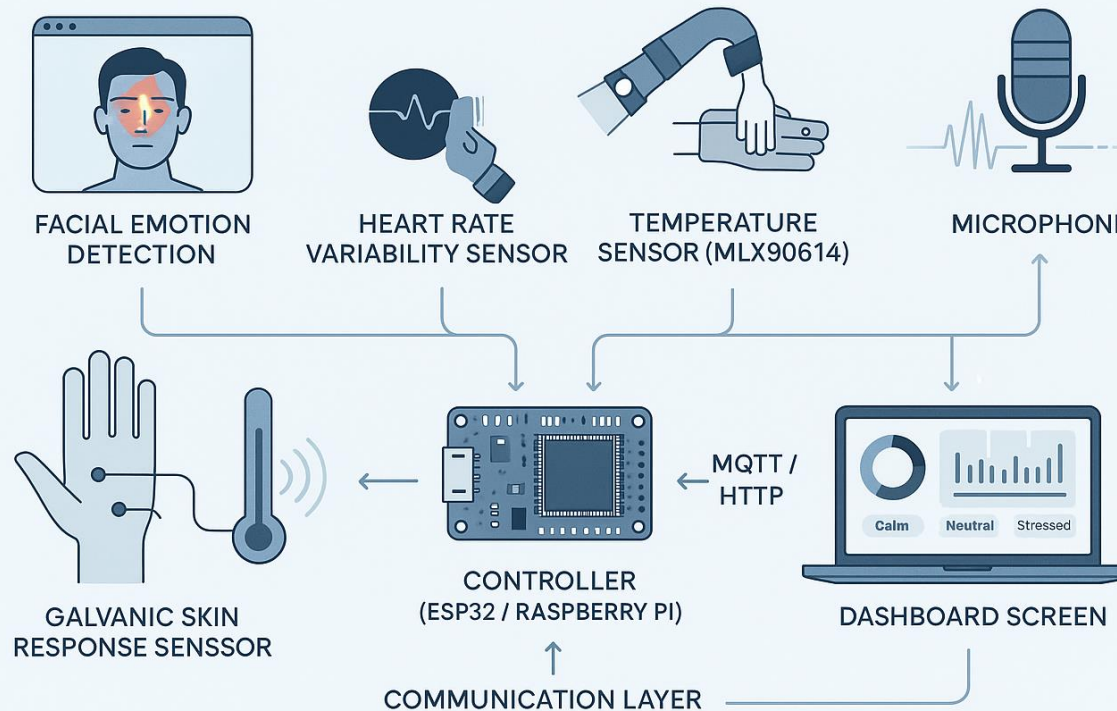
Temp Sensor (MLX90614)

- Monitors ambient & skin temp
- Adds comfort/fatigue context
- Often overlooked but vital input

Mentis Mirror (Latin: Mirror of the Mind):- Reflects your cognitive state instead of desires. "Gaze into it, and it gazes into you."

Mentis Mirror

A Neuro-AI Based Digital Twin of Human Emotion



Voice Sentiment (Mic + Whisper)

Detects mood from tone, pitch, tempo

Works even without camera

Passive emotion recognition

ESP32 / Raspberry Pi

Collects sensor data

Sends to API / processes locally

Real-time embedded processing

Data Layer (Flask + MQTT)

Aggregates signals

Generates live Digital Twin (JSON)

Central logic + model host

Dashboard (Streamlit/Flutter)

Live mood/focus/stress view

Logs trends + gives smart suggestions

User-facing insights & feedback

SYSTEM ARCHITECTURE

Detailed Flow

Provides a clear breakdown of each layer:

Data Acquisition – webcam, MAX30102, GSR, MLX90614, microphone

Processing & Fusion – ESP32/Pi → Flask/FastAPI → ML

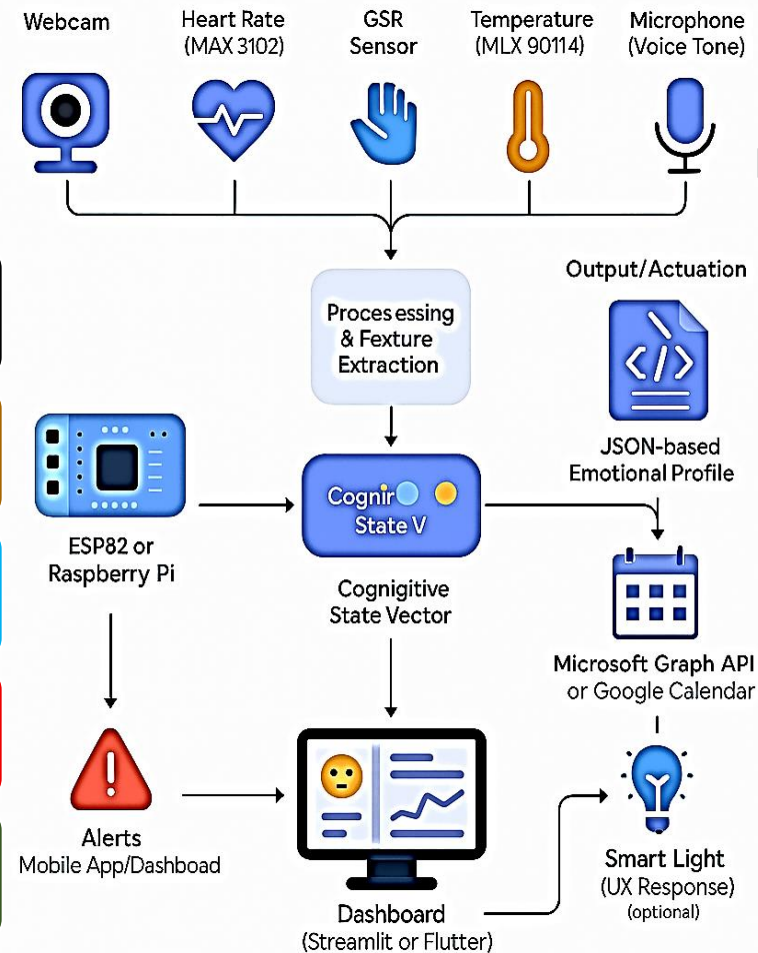
Digital Twin – JSON-based emotional profile with optional cloud sync

Output & Actuation – Alerts, calendar/smart environment integration

Visualization – Real-time dashboard with mood/stress/focus analytics

Simplified View

High-impact version for this architecture:



Sensors collect multimodal data

ESP32/Pi sends it to ML backend

ML produces a JSON “cognitive twin”

Dashboard shows live trends & alerts

Optional calendar sync and smart adaptation

The **Mentis Mirror** system architecture consists of sensor modules (facial, heart rate, GSR, temperature, voice) connected to an ESP32 or Raspberry Pi, which transmits data to a backend for processing and emotion classification. A machine learning model fuses these signals into a real-time cognitive state, which is visualized through a dashboard and triggers smart alerts or adaptive actions.

ML & AI MODELS – THE BRAIN BEHIND MENTIS MIRROR

1. Facial Emotion Classification

- DeepFace or CNN detects expressions like Happy, Sad, Angry, etc.
- Real-time emotion detection from webcam feed.

2. Voice Tone Analysis

- Uses Whisper + sentiment classifier (e.g., SVM/LSTM).
- Extracts emotion from pitch, tone, tempo of speech.

3. Physiological Stress Detection

- HRV (heart rate variability), GSR, and temperature analyzed.
- ML model (Random Forest / LSTM) classifies stress levels.

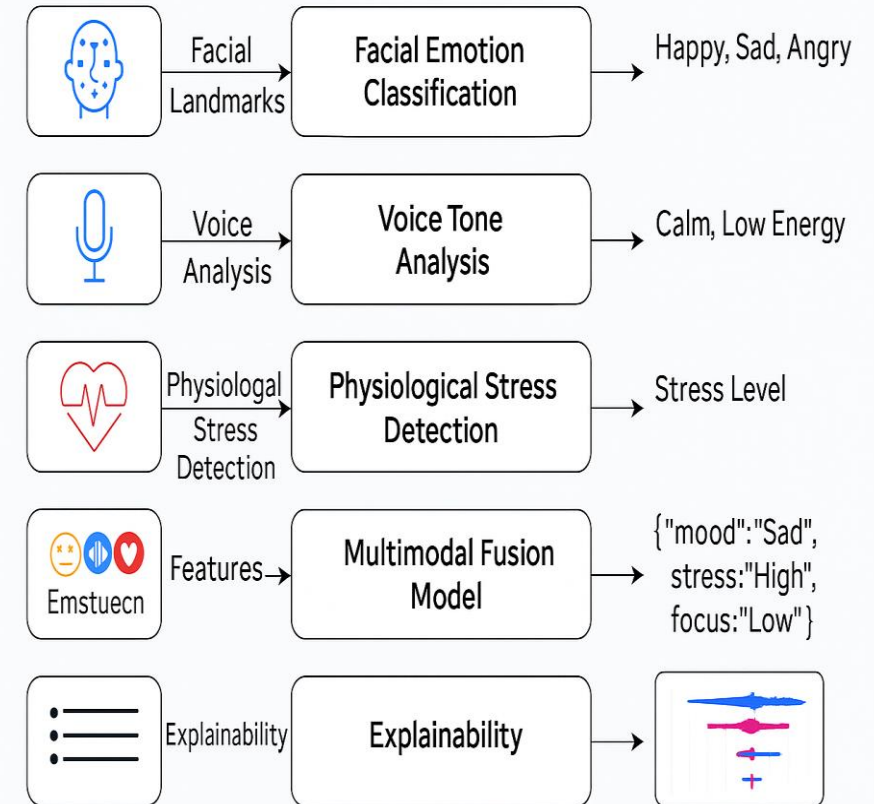
4. Multimodal Fusion

- Combines all data streams into a Cognitive State Vector.
- Generates a JSON-based digital twin of emotional state.

5. Explainability

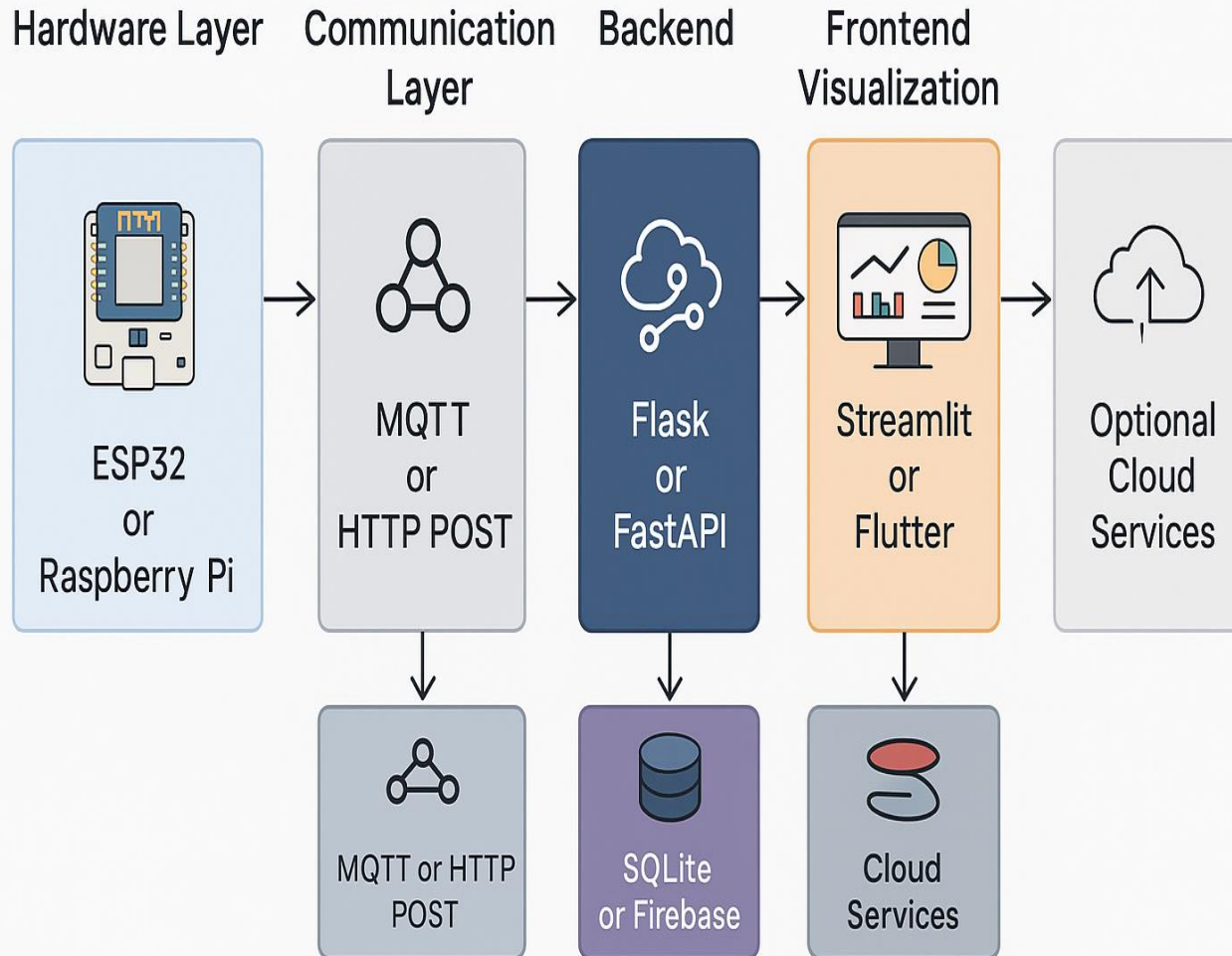
- SHAP (SHapley Additive) explains feature importance.
- Builds trust and interpretability into emotional predictions.

ML & AI Models



DEPLOYMENT STACK

Deployment Stack



1. Hardware: ESP32 or Raspberry Pi collects sensor data

2. Communication: MQTT or HTTP POST sends data to backend

3. Backend: Flask or FastAPI handles data + ML inference

4. Database: SQLite or Firebase logs emotional states

5. Frontend: Streamlit or Flutter shows live cognitive insights

6. Cloud (Optional): Integrate with IoT Hub or Graph API


COST BREAKDOWN (PROTOTYPE)

COST BREAKDOWN
(PROTOTYPE)



Component	Unit Cost (INR)	Qty	Total Cost (INR)
 ESP32 Dev Board	₹ 300	1	₹ 300
 MAX30102 Heart Rate Sensor	₹ 250	1	₹ 250
 GSR Sensor Module	₹ 150	1	₹ 150
 MLX90614 IR Temp Sensor	₹ 400	1	₹ 600
 USB Webcam Facial emotion detection (via DeepFace)	₹ 600	1	₹ 600
 Microphone Module	₹ 150	1	₹ 150
 Jumper Wires + Breadboard + Misc	₹ 200	1 set	₹ 200
 Power Supply (Battery/Adapter)	₹ 250	1 set	₹ 250
TOTAL COST		₹ 2,300	

Component	Unit Cost (INR)	Qty	Total Cost (INR)	Purpose
ESP32 Dev Board	₹300	1	₹300	Controller for sensors and communication
MAX30102 Heart Rate Sensor	₹250	1	₹250	HR & HRV detection
GSR Sensor Module	₹150	1	₹150	Stress detection via skin conductivity
MLX90614 IR Temp Sensor	₹400	1	₹400	Skin & ambient temperature sensing
USB Webcam	₹600	1	₹600	Facial emotion detection (via DeepFace)
Microphone Module	₹150	1	₹150	Voice tone/emotion input
Jumper Wires + Breadboard + Misc	₹200	1 set	₹200	Wiring & prototyping accessories
Power Supply (Battery/Adapter)	₹250	1	₹250	Powering ESP32 and sensors

 **Software/Cloud Costs (₹0 – All Free/Open Source):**

☐ DeepFace / Whisper: Open-source

☐ Flask / FastAPI / Streamlit: Free

☐ Google Calendar API / Firebase (Free Tier): ₹0

☐ MQTT (Mosquitto): Free broker (can run locally)



KEY FEATURES & IMPACT

✓ Key Features

🧠 Real-Time Emotion Detection

Uses facial cues, voice tone, and physiological signals for live mood analysis.

❤️ Multimodal Stress Detection

Combines heart rate variability, GSR, and temperature to improve accuracy.

📱 Smart Cognitive Twin Modeling

Creates a digital replica of emotional state using AI-powered fusion.

📊 Intuitive Dashboard & Alerts

Visualizes trends in stress, focus, and fatigue with real-time feedback.

🔌 Edge + Cloud Ready

Works fully offline or can scale to Azure/Firebase for cloud-based use.

🗣️ Passive Monitoring via Voice/Camera

Continuously senses user state without requiring active input.

💬 Explainable AI

SHAP-based model transparency to build trust and accountability.

Key Features & Impact

Key Features



Real-Time Emotion Detection

Uses facial cues, voice tone, and physiological signals for live mood analysis



Smart Cognitive Twin Modeling

Creates a digital replica of emotional state using AI-powered fusion



Multimodal Stress Detection

Combines heart rate variability, GSR, and temperature to improve accuracy



Edge + Cloud Ready

Works fully offline or can scale to Azure/Firebase for cloud-based use



Intuitive Dashboard & Alerts

Visualizes trends in stress, focus, and fatigue with real-time feedback



Passive Monitoring via Voice/Camera

Continuously senses user state without requiring active input

Impact



Industrial Safety

Prevents fatigue-related accidents in factories, drivers, and shift workers



Productivity Optimization

Personalized nudges improve focus, break timing, and work-life balance



Mental Health Monitoring

Early detection of emotional burnout for students, employees, and healthcare workers



Scalable for Smart Workplaces & IoT Hubs

Adaptable for enterprise-scale use with minimal cost

🌍 Impact

🏭 Industrial Safety

Prevents fatigue-related accidents in factories, drivers, and shift workers.

🧑🏫 Mental Health Monitoring

Early detection of emotional burnout for students, employees, and healthcare workers.

🎓 Educational Wellness

Helps track cognitive load in students during learning or exams.

💼 Productivity Optimization

Personalized nudges improve focus, break timing, and work-life balance.

🌐 Scalable for Smart Workplaces & IoT Hubs

Adaptable for enterprise-scale use with minimal cost.

CONCLUSION

What is Mentis Mirror?

An AI-powered cognitive digital twin that detects emotional states in real time using facial expressions, voice tone, and physiological signals — enhancing safety, wellness, and productivity.

Core Features

Real-time facial, voice & stress-based emotion detection

Multimodal AI fusion model with SHAP explainability

Offline + cloud-ready architecture (ESP32, Pi, Flask, Streamlit)

Smart alerts, trend visualizations & personalized insights

Impact Areas

Industrial Safety: Prevents fatigue-based accidents

Mental Health: Early burnout detection for professionals/students

Productivity: Data-driven nudges to optimize daily performance



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😊 THANK YOU 😊