MINOR PROJECT

Smart Fall Detection and Daily Assistance System for Elderly People

Under the Guidance of Dr Krishna Pal Sharma Sir

Team Details

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Problem

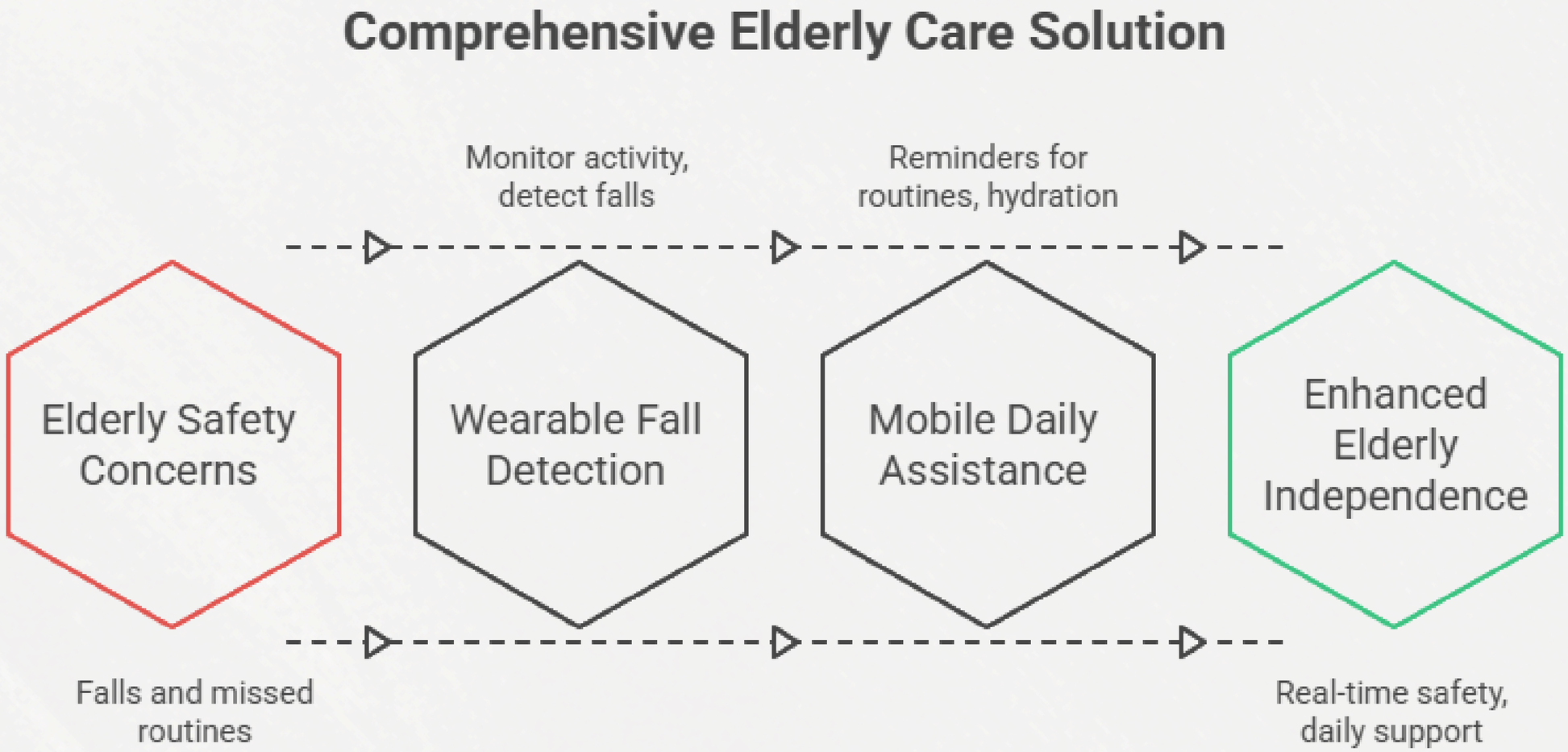
1. Falls are the leading cause of injury-related deaths among seniors aged above 65 and the second most common cause of unintentional injury mortality among adults of all ages.

2. In many cases, immediate medical help is not available, and delays in assistance can worsen the condition or lead to long-term complications.

3. Additionally, many elderly people live alone and struggle with daily tasks or emergencies, increasing their dependence on others.

4. There is a strong need for a smart wearable system that can automatically detect falls, send real-time alerts to caregivers, and offer daily activity assistance — ensuring timely help, safety, and independent living for the elderly population

Solution


Comprehensive Elderly Care Solution
Monitor activity, detect falls
Reminders for routines, hydration
Elderly Safety Concerns
Wearable Fall Detection
Mobile Daily Assistance
Enhanced Elderly Independence
Falls and missed routines
Real-time safety, daily support

Tools and Technologies Used

Hardware Components

- **ESP32 Microcontroller –** Main processing unit with built-in Wi-Fi for data analysis and cloud communication.
- **MPU6050 Sensor –** 6-axis accelerometer and gyroscope for motion, orientation, and fall detection.
- **Battery (9V) –** Power source for the wearable device.
- **Jumper Wires –** Used to connect MPU6050 to ESP32 through the I²C interface (SDA, SCL, VCC, GND).

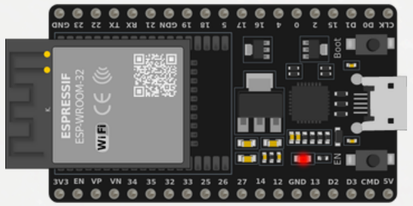
Software Tools

- **Arduino IDE –** Used for programming, compiling, and uploading Embedded C/C++ code to ESP32.
- **React Native Based Mobile App –** IoT platform for real-time monitoring, notifications, and device management.
- **Embedded C / C++ –** Language used to implement the fall detection algorithm and handle sensor communication.
- **Dataset:** WEDA Dataset is used to train Decision tree model.

Components	Quantity
ESP32	1
MPU6050	1
Battery	1
Jumper Wires	7

Components

MPU6050

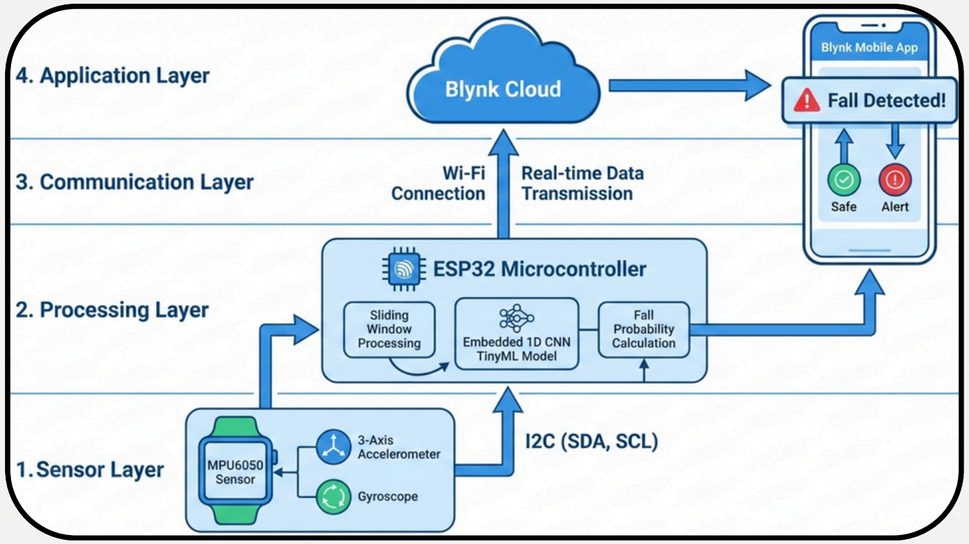


ESP32 Microcontroller

MODEL ARCHITECTURE

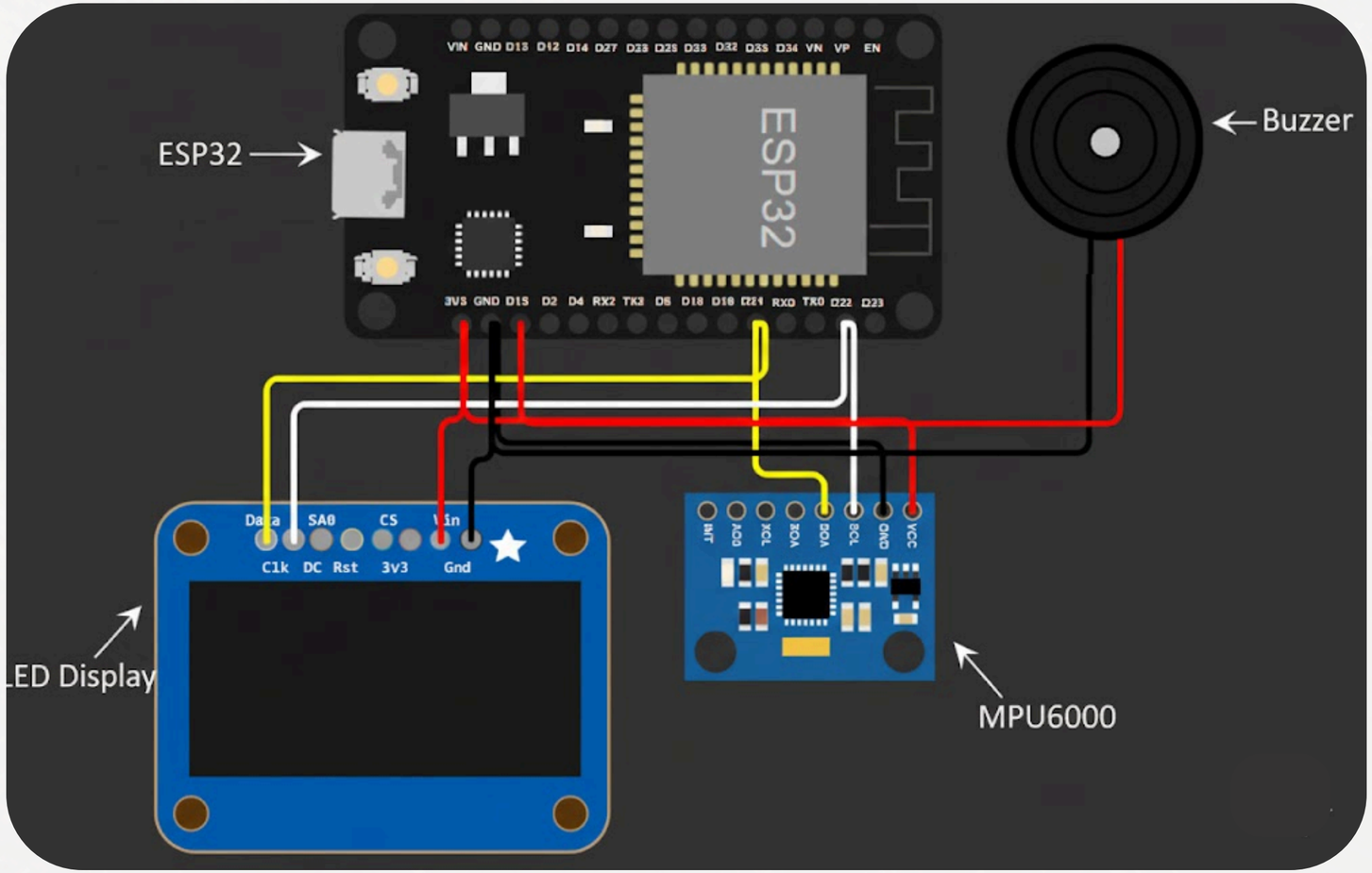
Fall Detection Model Architecture (1D CNN – TinyML)

- Input: 6-axis motion data
- (Ax, Ay, Az + Gx, Gy, Gz)
- Window Size: 100 samples (≈2 sec motion)
- Model Type: 1D Convolutional Neural Network
- Layers:
  - Conv1D + ReLU (extract motion spikes)
  - Conv1D + ReLU (detect fall patterns)
  - Flatten Layer
  - Dense Layer
- Sigmoid Output
- Output: Fall Probability (0–1)
- 0.90 → Fall
- ≤ 0.90 → Normal Activity
- Optimized using TensorFlow Lite (TinyML) for ESP32 deployment.



IMPLEMENTATION

SIMULATION OF PROPOSED HARDWARE SOLUTION:



WEDA-FALL DATASET

WEDA-FALL DATASET

Dataset Overview:

This comprehensive wrist-based dataset provides multi-sensor data specifically designed for fall detection research.

- Captured using Fitbit Sense Smartwatch
- Sampling Frequency Used: 50 Hz
- Sensors Included: Accelerometer (Ax, Ay, Az), Gyroscope (Gx, Gy, Gz), Orientation Sensor, Vertical Acceleration
- Multiple frequency versions available (50Hz, 40Hz, 25Hz, 10Hz, 5Hz)
- The file fall_timestamps.csv contains manually annotated start and end timestamps of actual fall events.

WHY WE CHOOSE 1D CNN + WEDA DATASET

- **Wrist-Based & Realistic**

Captured using a Fitbit Sense smartwatch, matching our device's wrist placement for practical and realistic deployment.

- **Includes Elderly Participants**

Age range 20 – 95 years, providing crucial real elderly movement data for accurate model training.

- **High-Quality Sensor Data**

50 Hz sampling frequency with 6-axis IMU data (Accelerometer + Gyroscope) provides precise fall phase timestamps.

- **Diverse Activities**

8 types of falls and 11 ADLs (Activities of Daily Living), designed to reduce false positives by mimicking fall-like motions.

PARTICIPANTS & DATA COLLECTION

- Two Groups: Young (age 20-40) and Elderly (age 60-95)
- Total Participants: 25 (with real elderly movement data)
- Note: Elderly participants performed only safe ADLs (no falls) for safety.
- Fall Signals (Young): 350
- ADL Signals (Young): 462
- ADL Signals (Elderly): 157
- Total ADL Signals: 619
- Data collected on mattress for fall safety simulation.

Weda dataset link:

https://github.com/joaojtmarques/WEDA-FALL

MODEL PIPELINE

Data Source – WEDA-FALL Dataset

- Wrist-based IMU data (50Hz)
- 6-axis input:
- Accelerometer (Ax, Ay, Az)
- Gyroscope (Gx, Gy, Gz)
- Window Size: 100 samples (2 seconds)
- Binary Labels:
- 0 → ADL
- 1 → Fall

Data Preprocessing

- Merge accelerometer + gyroscope
- Apply Sliding Window (100×6)
- Normalize using StandardScaler
- Train-Test Split (80:20)
- Handle imbalance using class weights

1D CNN Model Training

- Input Shape: (100, 6)
- Architecture:
- Conv1D (Feature Extraction)
- Conv1D (Pattern Learning)
- MaxPooling
- Global Average Pooling
- Dense Layer
- Sigmoid Output

Model Evaluation

- Accuracy: 91%
- Fall Recall: 0.91
- F1 Score: 0.85
- Confusion Matrix Analysis

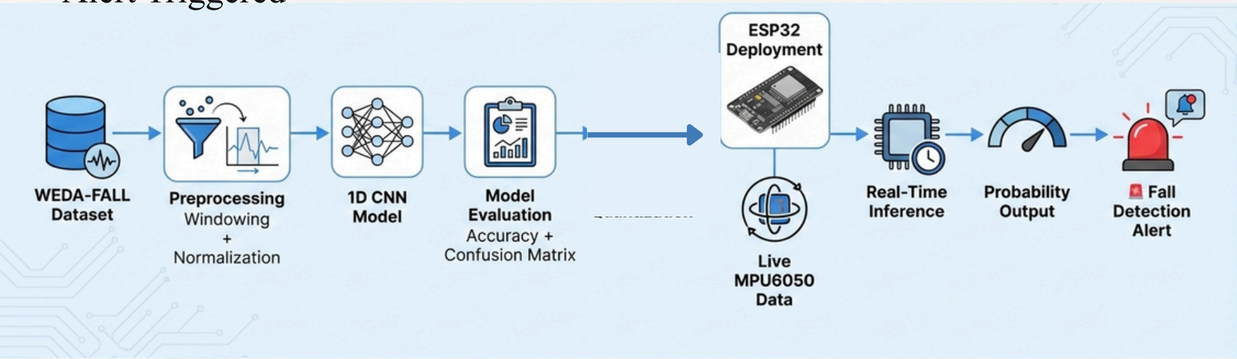
- High recall ensures fewer missed falls
- Balanced precision–recall tradeoff

TinyML Optimization

- Convert to TensorFlow Lite
- INT8 Quantization
- Final Model Size: ~8.8 KB
- Compatible with ESP32 memory constraints

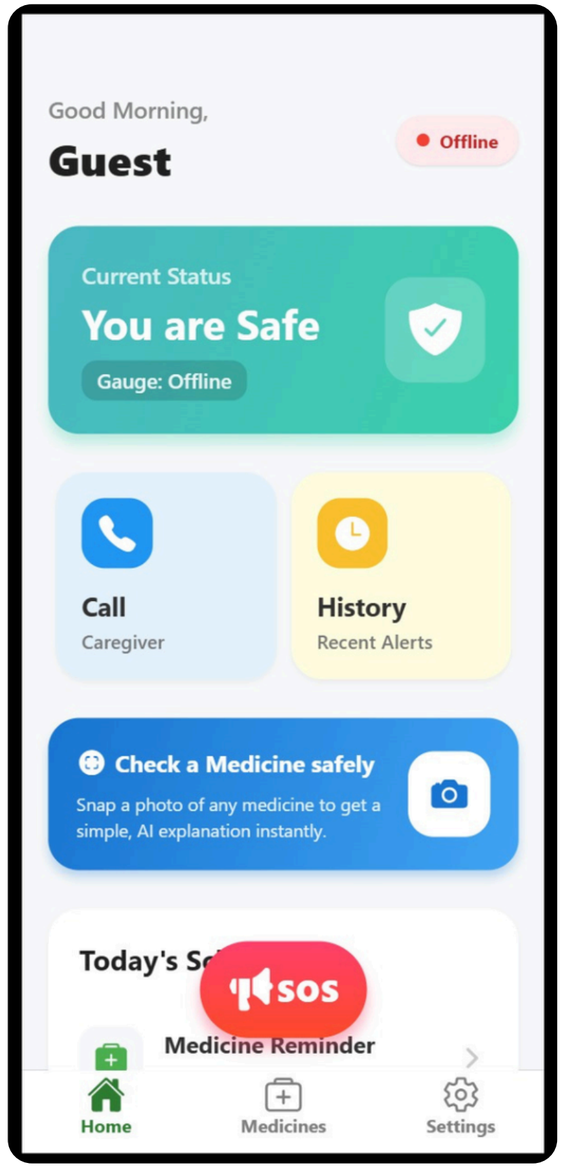
Real-Time Deployment

- MPU6050 Sensor →Collect 100 Samples →
- Normalize →Quantize →ESP32 Inference →
- Generate Fall Probability →Threshold Decision →
- Alert Triggered



Introducing..

CareGuard



CareGuard APP

React Native app for real-time monitoring & elderly assistance

Key Features

Fall Alert System – Detects falls and sends instant alerts

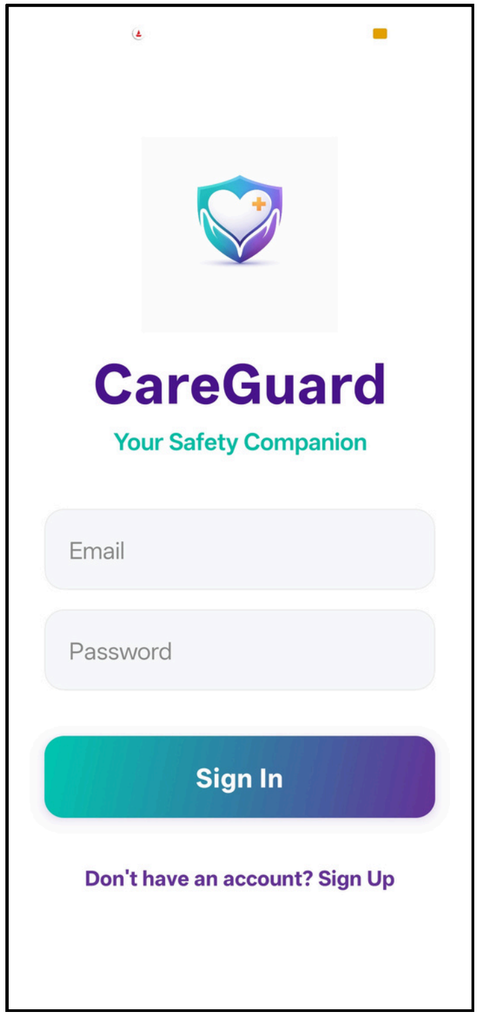
Medication Reminders – Ensures timely medicine intake

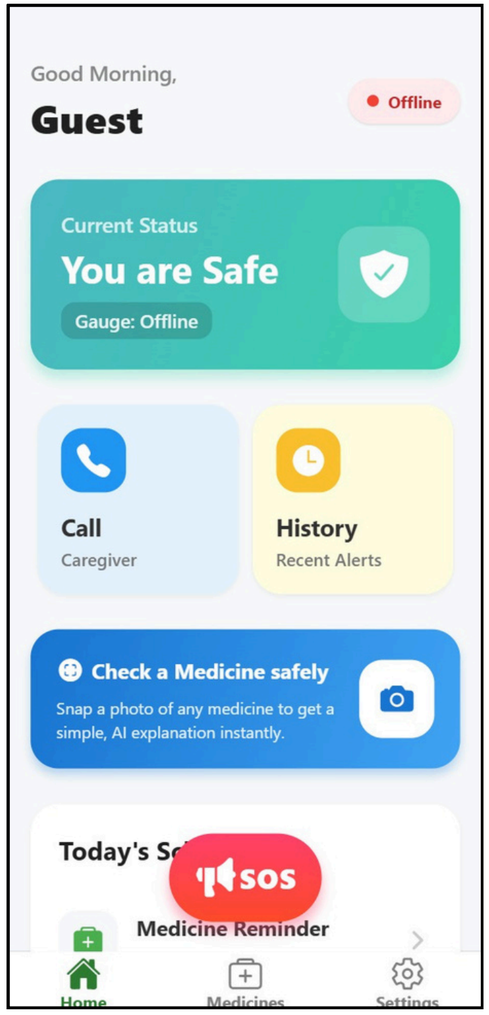
Hydration Alerts – Promotes regular water consumption

Health Dashboard – Tracks activity, fall history & alerts

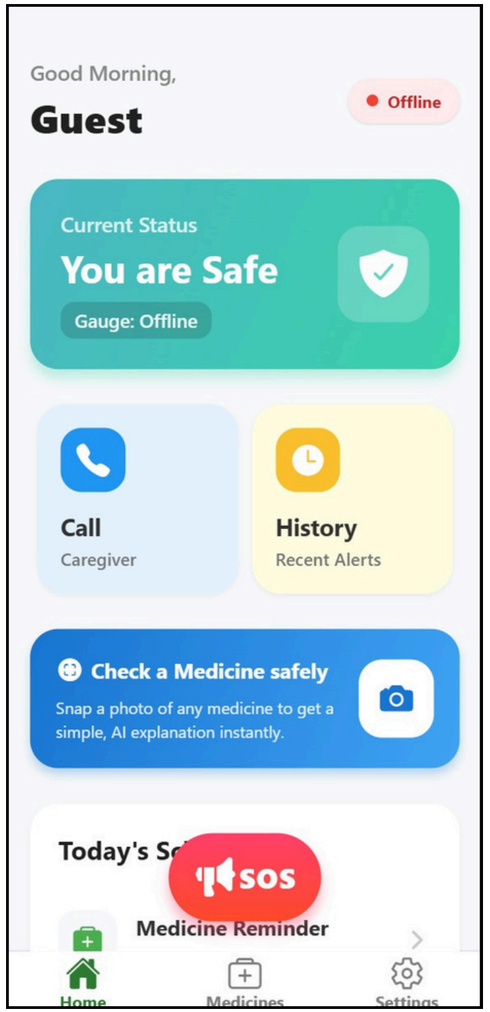
WhatsApp API – Enables scalable alert notifications

AI Prescription Assistant – Uses OCR + AI to simplify medicine instructions





Features


Good Morning,
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Current Status
You are Safe
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Call
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Check a Medicine safely
Snap a photo of any medicine to get a simple, AI explanation instantly.
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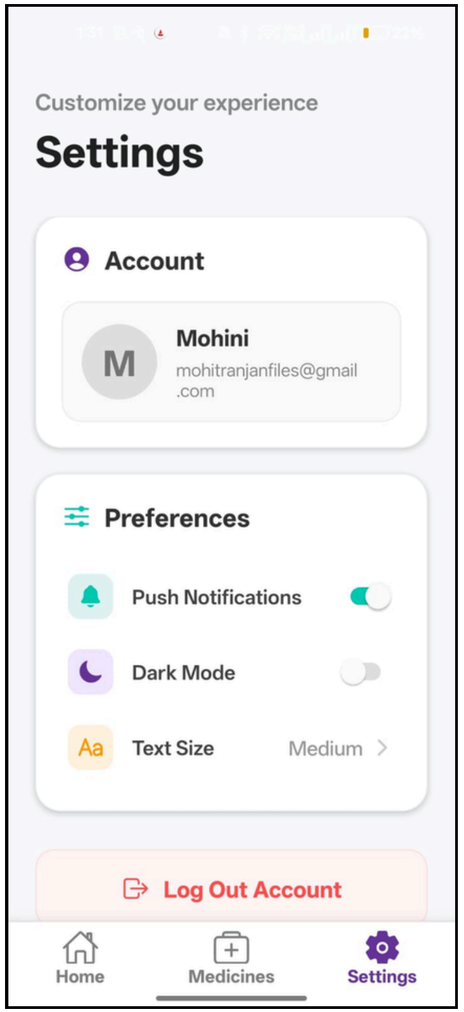
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1:31
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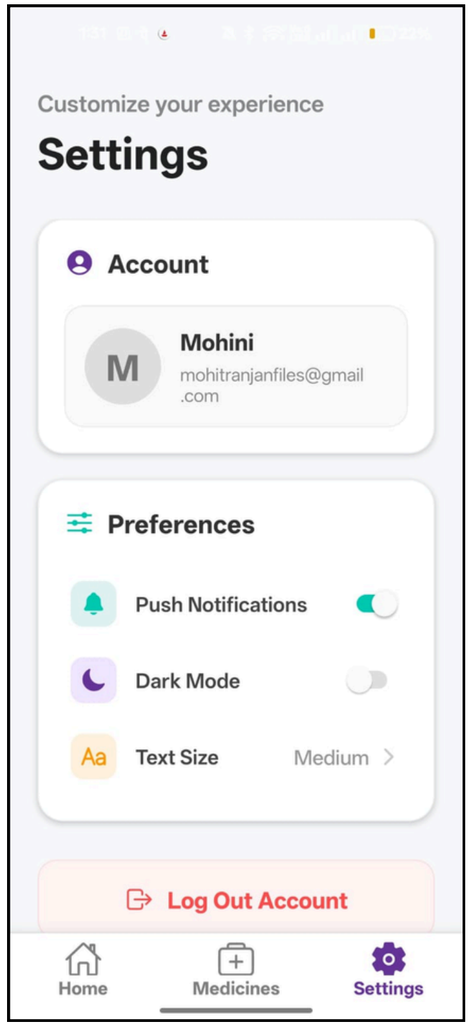
Stay on top of your daily health
My Prescriptions
AI Insights
Medicine: Crocin
Uses:
- Lowers fever
- Relieves mild to moderate pain such as headache, toothache, muscle ache
How to Take:
- Swallow with water
- Usually every 4-6 hours if needed
- Do not exceed 4 tablets in a day
Side Effects:
- Upset stomach
- Rash or itching
Close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CareGuard AI

Medicine Scanner Workflow

Image Capture – Photo taken & converted to Base64

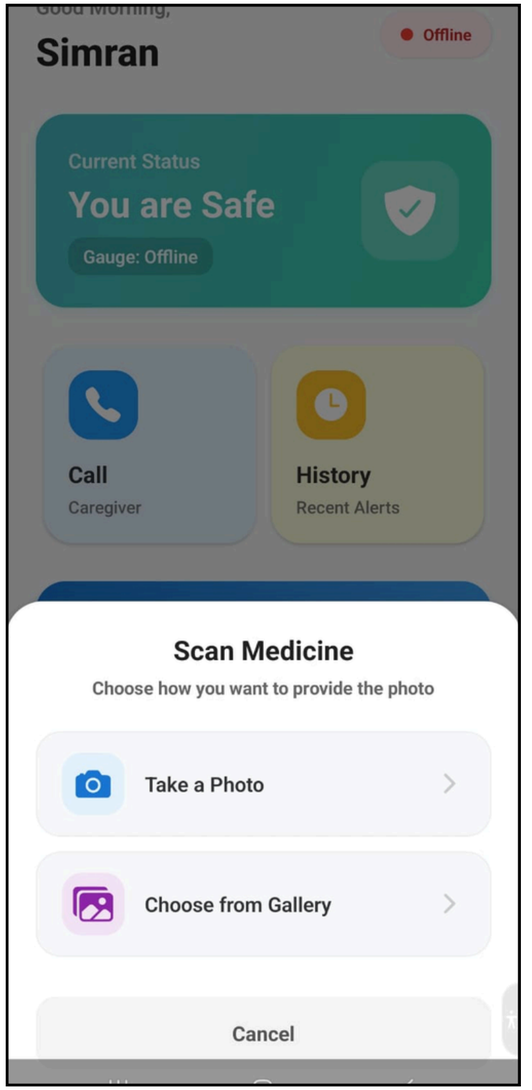
OCR Processing – Extracts text using OCR.Space (Engine 2)

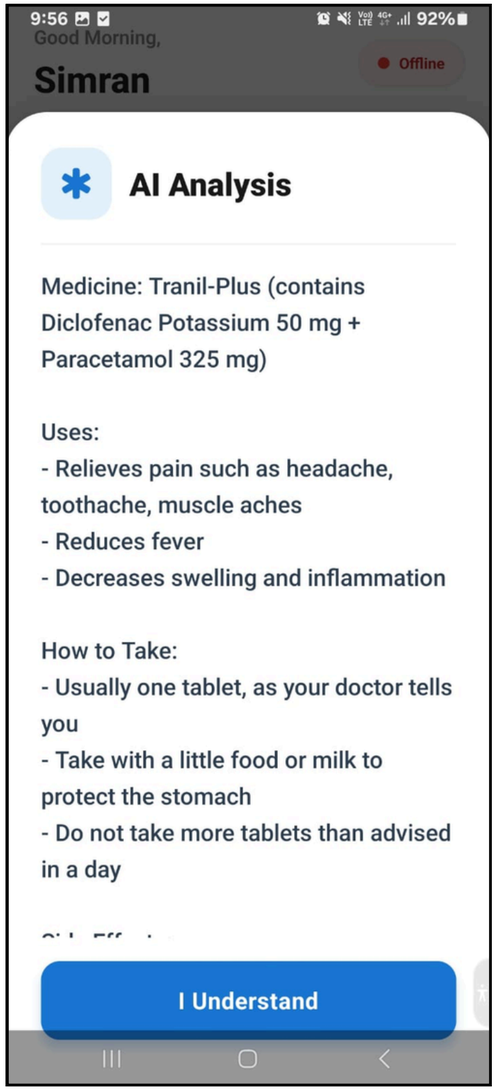
Text Cleaning – Removes noise from scanned text

AI Processing – Groq + GPT-OSS-120B interprets medicine details

Final Output – Simple, elderly-friendly explanation shown in app

CareGuard Ai





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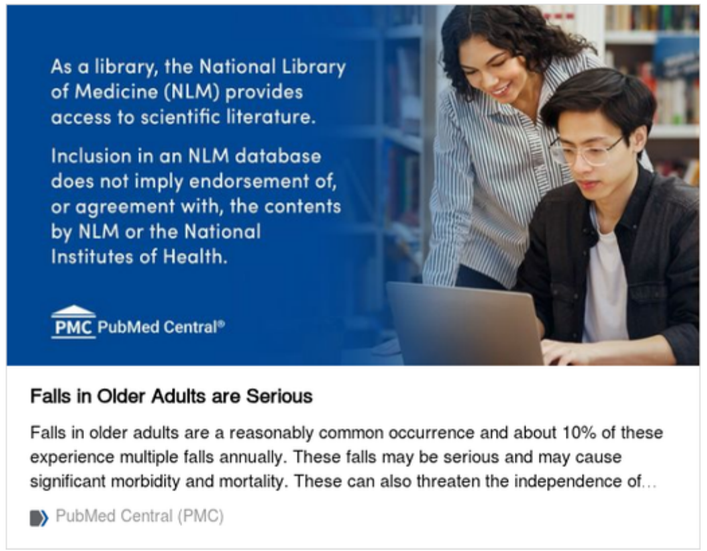

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- WEDA Dataset: https://github.com/joaojtmarques/WEDA-FALL

THANK YOU

FOR YOUR ATTENTION