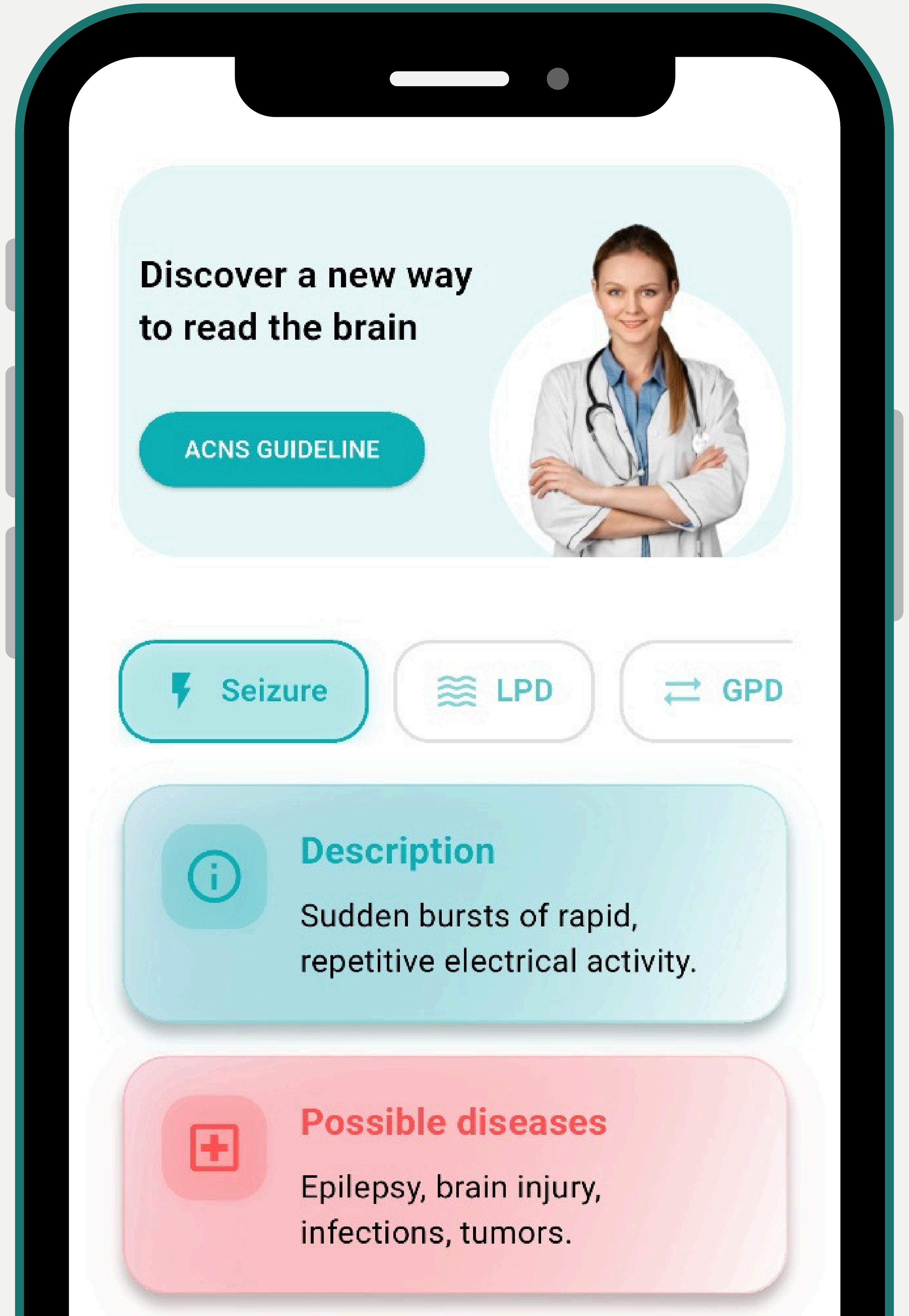
BRAIN PULSE



LABTRONIC

Incubated by

M.E.T
MISR ENGINEERING & TECHNOLOGY

Powered by

CREATIVA
مراكز إبداع مصر الرقمية

Pre-Incubated by

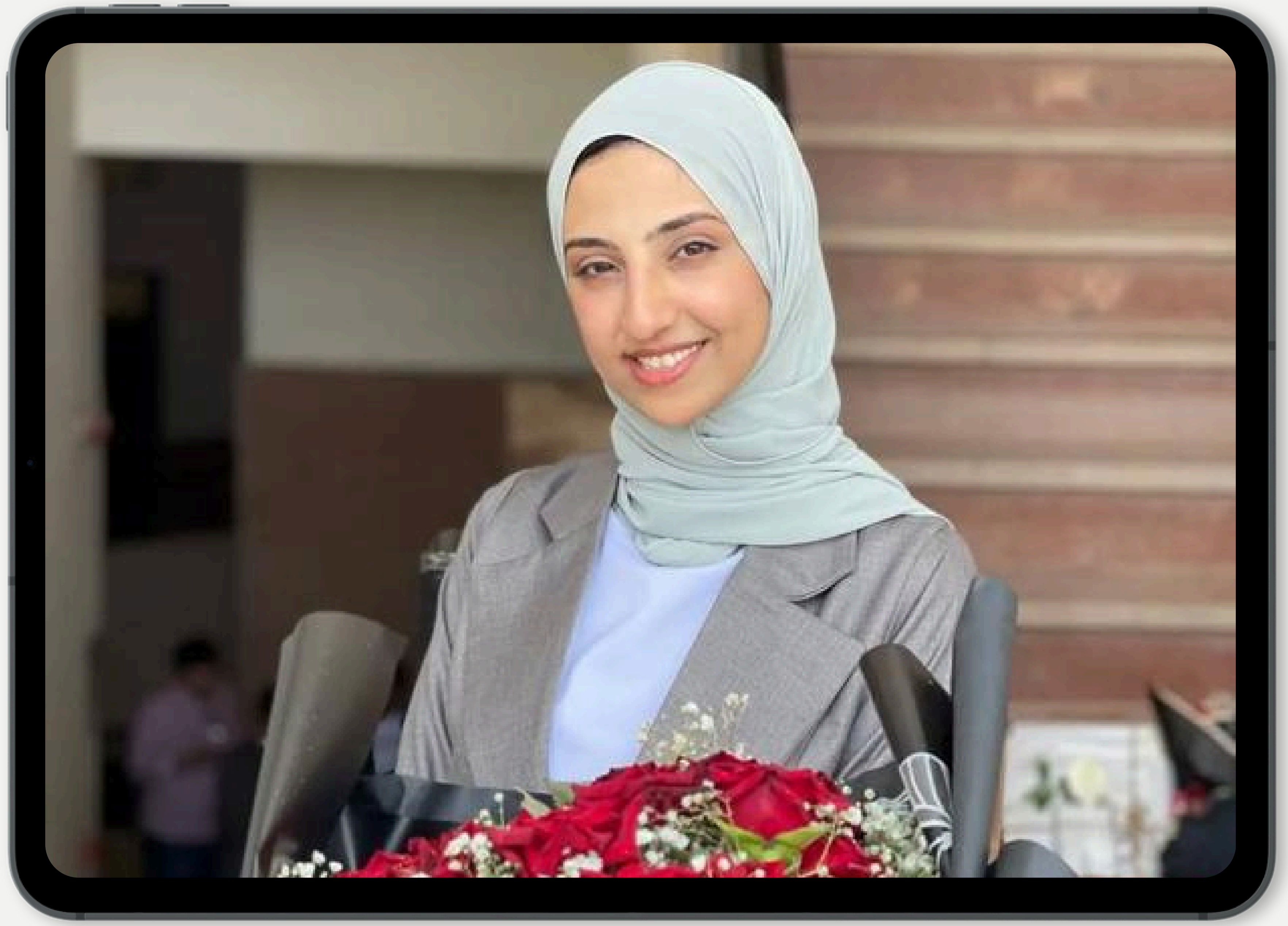
SUPERVISOR

ASSOC. PROF. MOHAMED MOAWED

ASSOCIATE PROFESSOR, HEAD OF COMPUTER AND SYSTEMS ENGINEERING DEPARTMENT, FACULTY OF ENGINEERING, MANSOURA UNIVERSITY

BRAIN PULSE

MENTOR



ENG. AYA SAAD

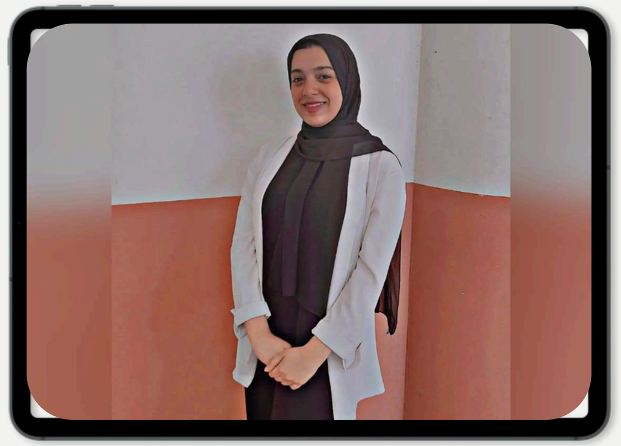
BACKEND ENGINEER

BRAIN PULSE

GP TEAM

MOHAMED RAJAB
DATA SCIENCE

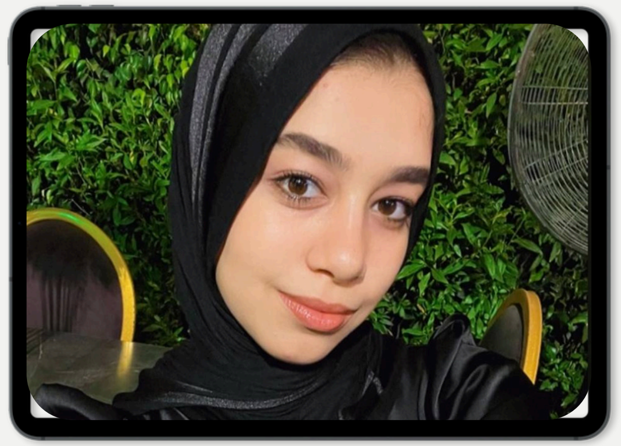
MOHAMED ALAA ELSAYYAD
AI



ESRAA ALI
AI

MOHAMED AYMAN
HARDWARE

MOHAMED ALAA ELBOSATY
FLUTTER



DONIA OSAMA
FLUTTER

MINA EHAB MOHEB
BACKEND

IBRAHIM AHMED
FLUTTER

DOHA MOHAMED
HARDWARE

YOSSEF SABRY
HARDWARE

AMIRA ELSAYED
HARDWARE

AHMED ELSHERBINY
BACKEND

BRAIN PULSE

TABLE OF CONTENT

BRAIN PULSE

PROBLEM STATEMENT

Around 30% of epilepsy cases are either misdiagnosed or completely missed.
This means thousands of patients receive the wrong treatment or no treatment at all.

Standard EEG recordings detect **less than 40%** of actual seizure activity.
Short sessions often miss abnormal brain patterns that occur outside the recording window.

Epilepsy affects approximately 5 to 12 per 1,000 people in Egypt above the global average.

PROBLEM STATEMENT

Delayed or inaccurate **Up to 30%** of epilepsy cases are misdiagnosed leading to delayed treatment and avoidable complications.

Over 80% of patients lack proper access to diagnosis and treatment, especially in rural and underserved areas

Over 500,000 people in Egypt are estimated to be living with epilepsy yet most lack access to smart diagnostics.

KEY CHALLENGES

1.0

There is a significant shortage of trained neurologists and EEG technicians, especially in rural and underserved areas.
This limits access to proper diagnosis and increases patient wait times.

2.0

Most clinics lack access to affordable, **AI-assisted diagnostic tools.**
This limits doctors' ability to make fast, data-driven decisions especially in resource-constrained environments.

3.0

Manual interpretation of EEG data can take 30 to 60 minutes per patient, depending on complexity.
This slows down the clinical workflow and increases pressure on specialists.

4.0

Many clinics and hospitals outside major cities **lack the infrastructure** needed for proper neurological diagnosis such as EEG labs, trained personnel, and advanced software tools.

BRAIN PULSE

OUR SOLUTION

We developed an integrated solution that bridges the gap between complex brain diagnostics and accessibility. Our system combines a custom-designed EEG wearable device with an AI-powered mobile application, providing doctors with a seamless, accurate, and real-time tool for detecting brain abnormalities anytime, anywhere.

ACCURACY	COST REDUCTION	REDUCE EPILEPSY
90%	50%	40%

DATA DRIVEN
DECISION MAKING FRAMEWORK

In modern healthcare technology, impactful innovation requires more than technical solutions it demands decisions rooted in real, measurable data. That's why our entire product development strategy was guided by a structured data-driven framework.

DESCRIPTIVE ANALYSIS

What happened?
Used to understand the current state, collect and interpret raw EEG data, and identify clinical gaps.

PREDICTIVE ANALYSIS

What might happen?
Utilized to forecast neurological events like seizures using AI-based EEG classification.

PRESCRIPTIVE ANALYSIS

What should be done?
Provides doctors with supportive diagnostic suggestions, eventually evolving toward smart medical recommendations.

TRANSLATING DATA ANALYSIS INTO MVP FEATURES

ANALYSIS	GENERATION 1	GENERATION 2
DESCRIPTIVE ANALYSIS	Export EEG data as CSV Basic analog filtering circuits Display basic EEG POINTS in app Initial signal quality check Collect basic session metadata	Data visualization dashboard Trend analysis across patients Longitudinal tracking
PREDICTIVE	AI model for EEG classification Support for EEG or image input Manual data upload	Risk scoring & case prioritization Probability output per class
PRESCRIPTIVE	Show doctor consensus Explainable recommendation logic	Passive recommendation Auto-prioritization of patient list

Why Agile
Methodology

We chose Agile because & Agile Fits Us Because

- Quickly test new ideas
- Adapt based on feedback

- Deliver working versions step by step
- Fail Fast, Learn Faster

- We're building both hardware & software
- We involve stakeholders in every stage

- We need to learn fast and adjust even faster
- low risk and improve quickly through structured sprints and continuous feedback.

PROTOTYPE EVOLUTION
3 KEY VERSIONS

BRAIN PULSE

01.

Prototype 1 – Early Concept

In our first prototype, we combined a basic EEG helmet with a simple mobile application to test core functionality. This version allowed us to verify signal collection and confirm the technical feasibility of our concept. Although it was a rough and early-stage build, it played a crucial role in shaping

03.

Prototype 3 – BrainPulse Gen 1 (Current)

We resumed hardware development with a refined, buildable design that addressed earlier limitations. This version features full integration between the EEG helmet and the mobile application, allowing for real-time data collection, visualization, and storage. It is currently being piloted in partner clinics, where it has been approved by doctors and proven to be both effective and user-friendly — making it the most stable and usable version to date.

02.

Prototype 2 – Software-Only Pivot

Based on market research, we discovered that several key hardware components were either unavailable or too expensive to source reliably. As a result, we made a strategic decision to pause hardware development and shift our focus toward building a software-only solution. During this phase, the application was adapted to support EEG data from external devices, allowing us to continue development and testing without being limited by hardware availability. This pivot was a calculated response to real-world market constraints.

SPRINT OVERVIEW

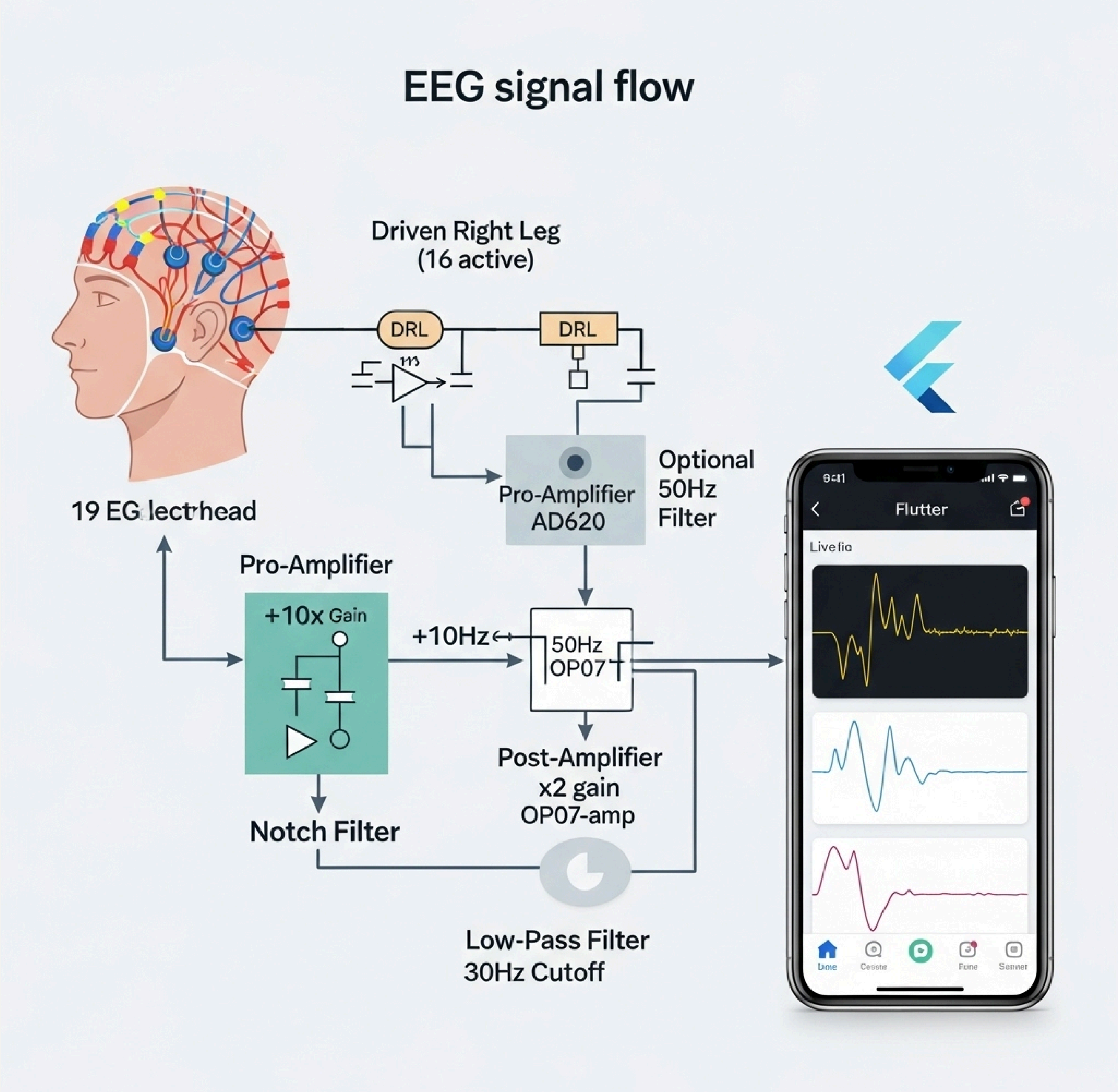
Sprint	Focus	Key Outcomes
Sprint 0	Planning & Setup	Define MVP, create backlog, wireframes, team tools ready
Sprint 1	Core Prototype	Connect helmet to app, live signal, save sessions
Sprint 2	Signal Processing	Filter noise, store sessions, show history
Sprint 3	Reporting & Feedback	gather clinic feedback

HARDWARE

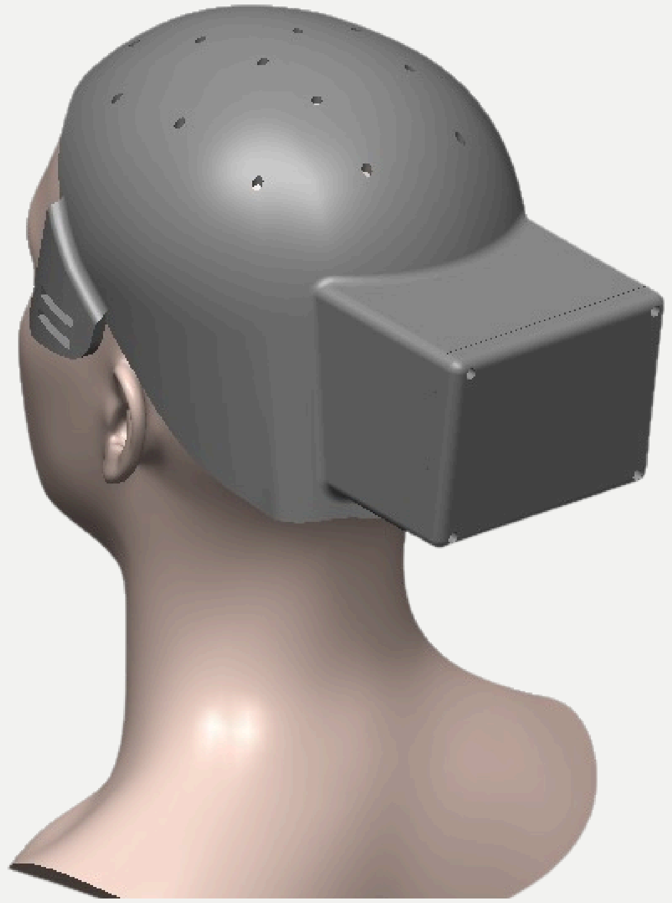
BRAIN PULSE

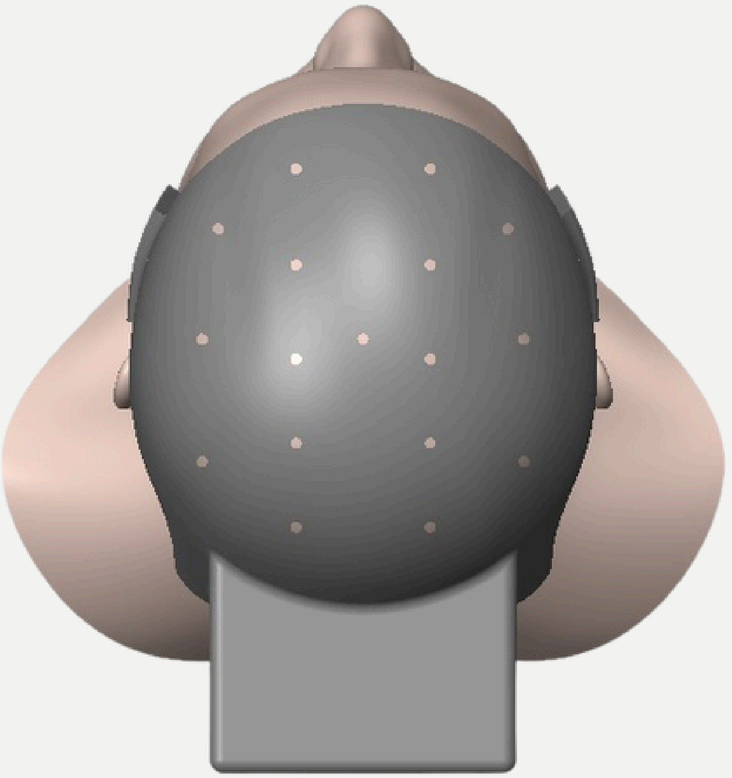
OVERVIEW

BRAIN PULSE



HELMET DESIGN &
ELECTRODE INTEGRATION





3D-printed
flexible helmet

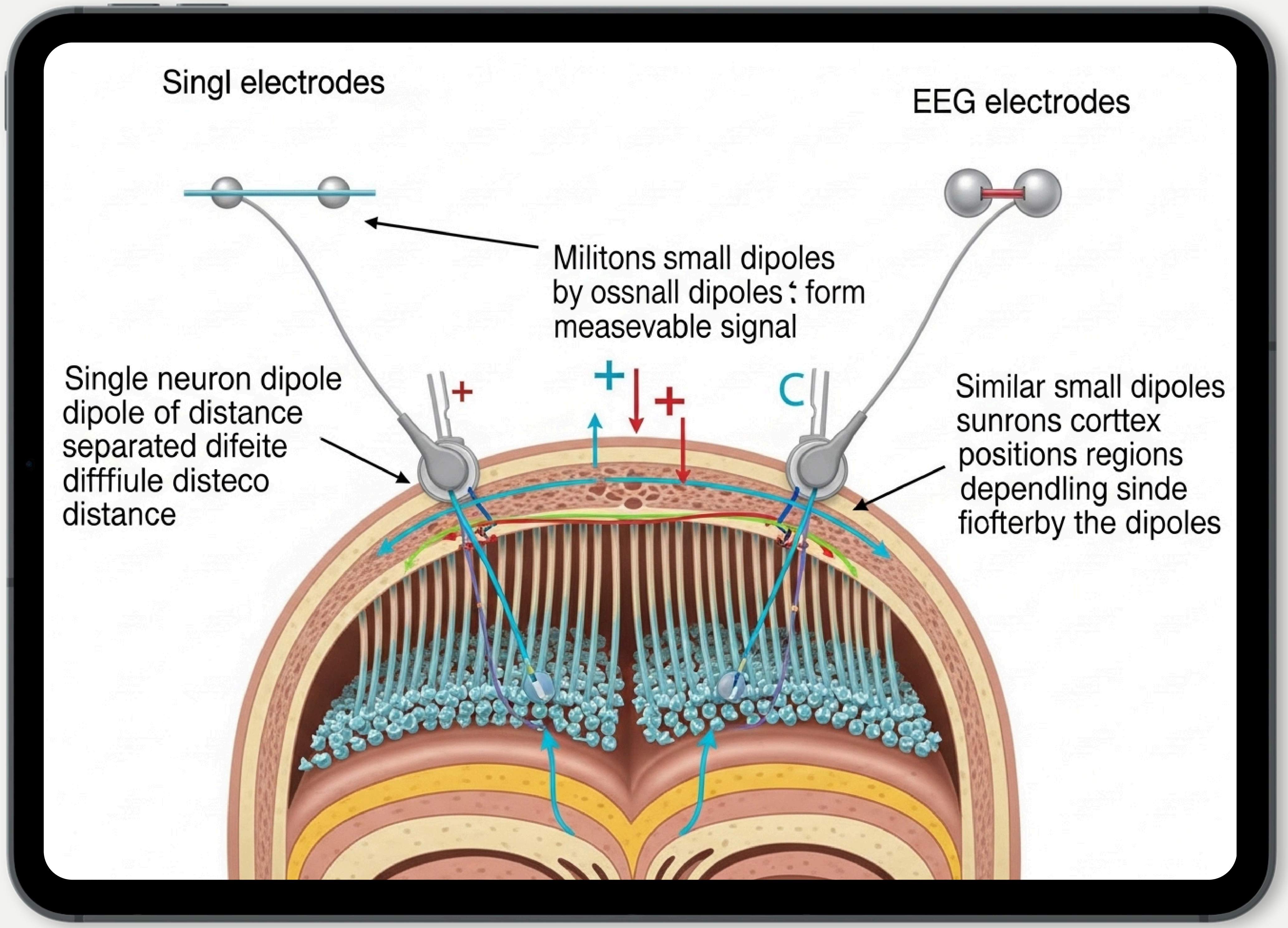
Custom EEG helmet printed with flexible material (PLA/TPU)

Includes 20electrode sockets

Holds electrodes firmly in place without movement

Internal wire channels for organized and safe routing

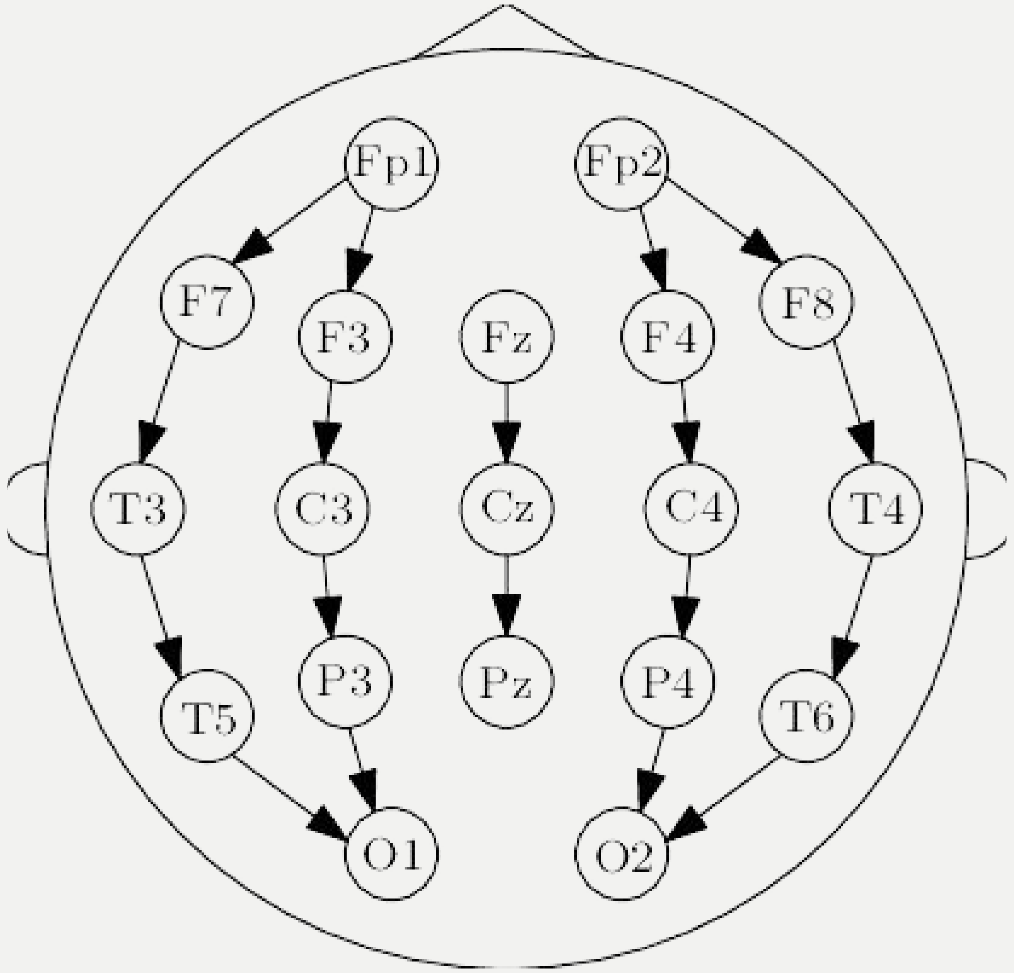
HOW THE BRAIN'S ELECTRICAL SIGNAL IS GENERATED



Electrodes

19 Golden-Plated Cup Electrodes (DIN 1.5mm)

- 16 active-1 reference (ear)
- 1 ground (forehead/leg)
- 2 spare/expansion



BRAIN PULSE

Saline Solution for Better Signal Quality

- To reduce skin-electrode impedance and improve signal clarity
- Applied directly to the scalp at each electrode site

Used:

- Enables better signal acquisition and stable long-term contact

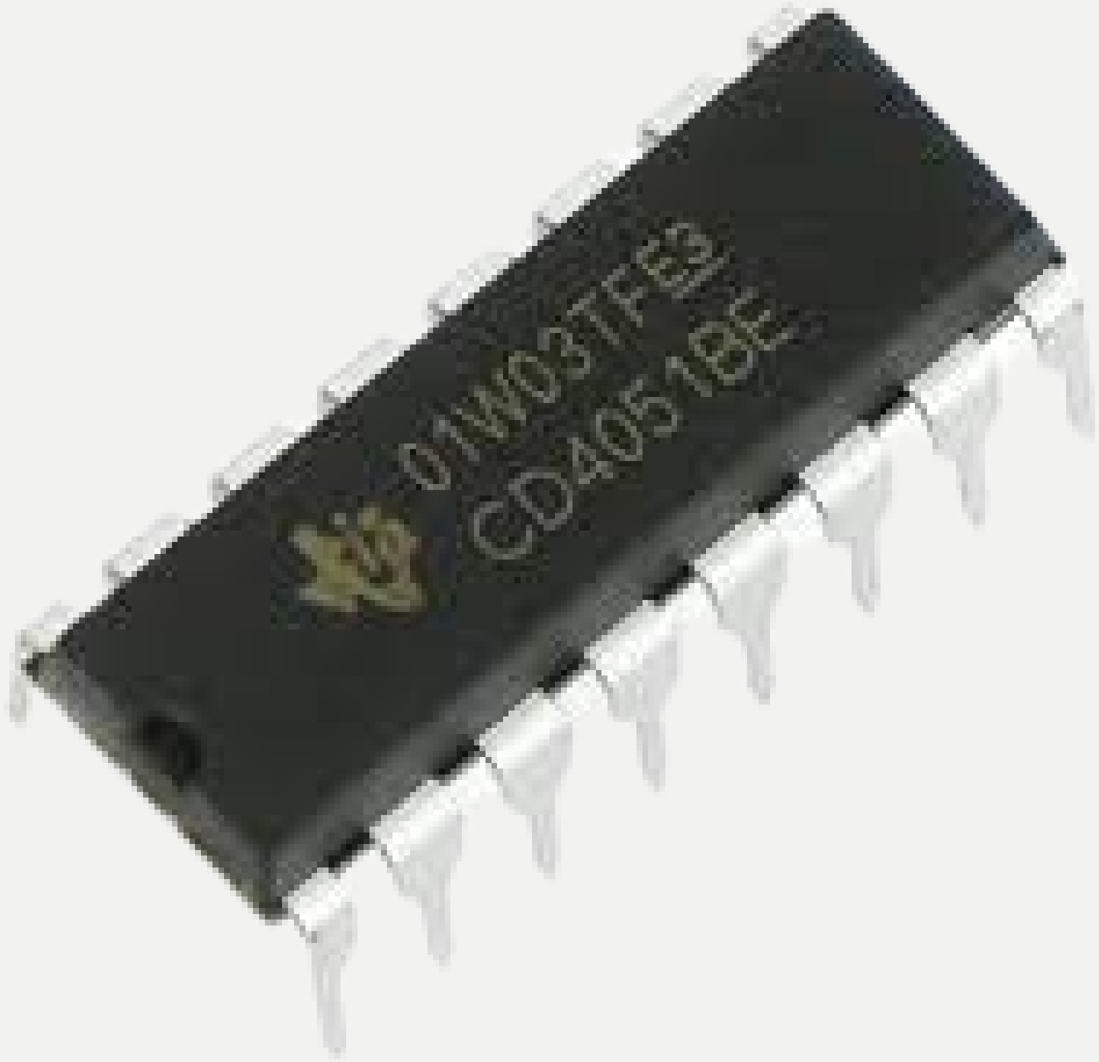
SIGNAL ACQUISITION & MULTIPLEXING

BRAIN PULSE

2x CD4051 analog multiplexers

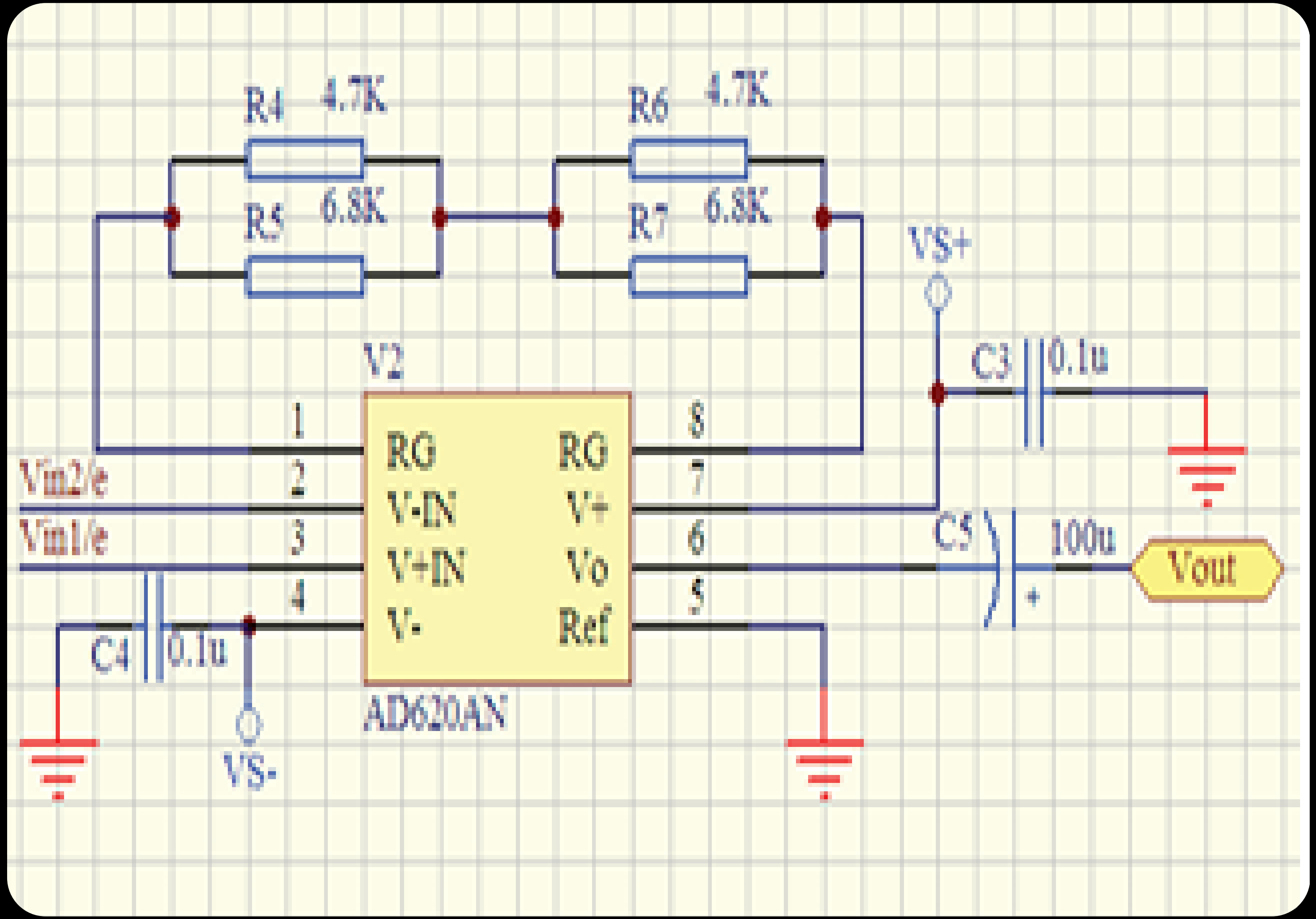
ESP32 controls channel switching (GPIO A/B/C)

One analog output is passed to the amplifier chain



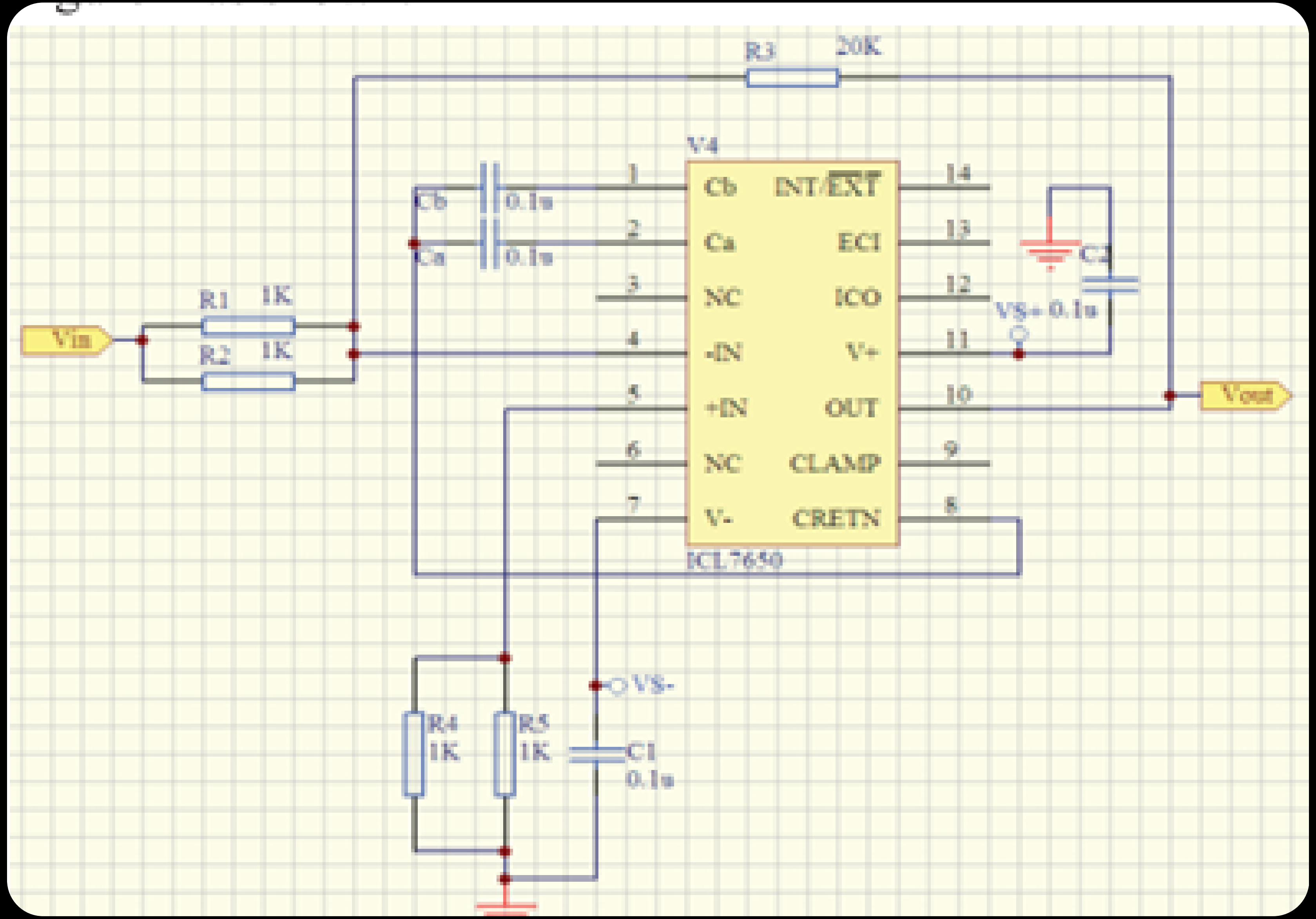
AMPLIFICATION STAGES

AD620 instrumentation amplifier High CMRR, Gain ≈ x10 (Rg ≈ 5.6kΩ)



AMPLIFICATION STAGES

2x OP07 post-amplifiers
Gain per stage: x40 → total ≈ x1600



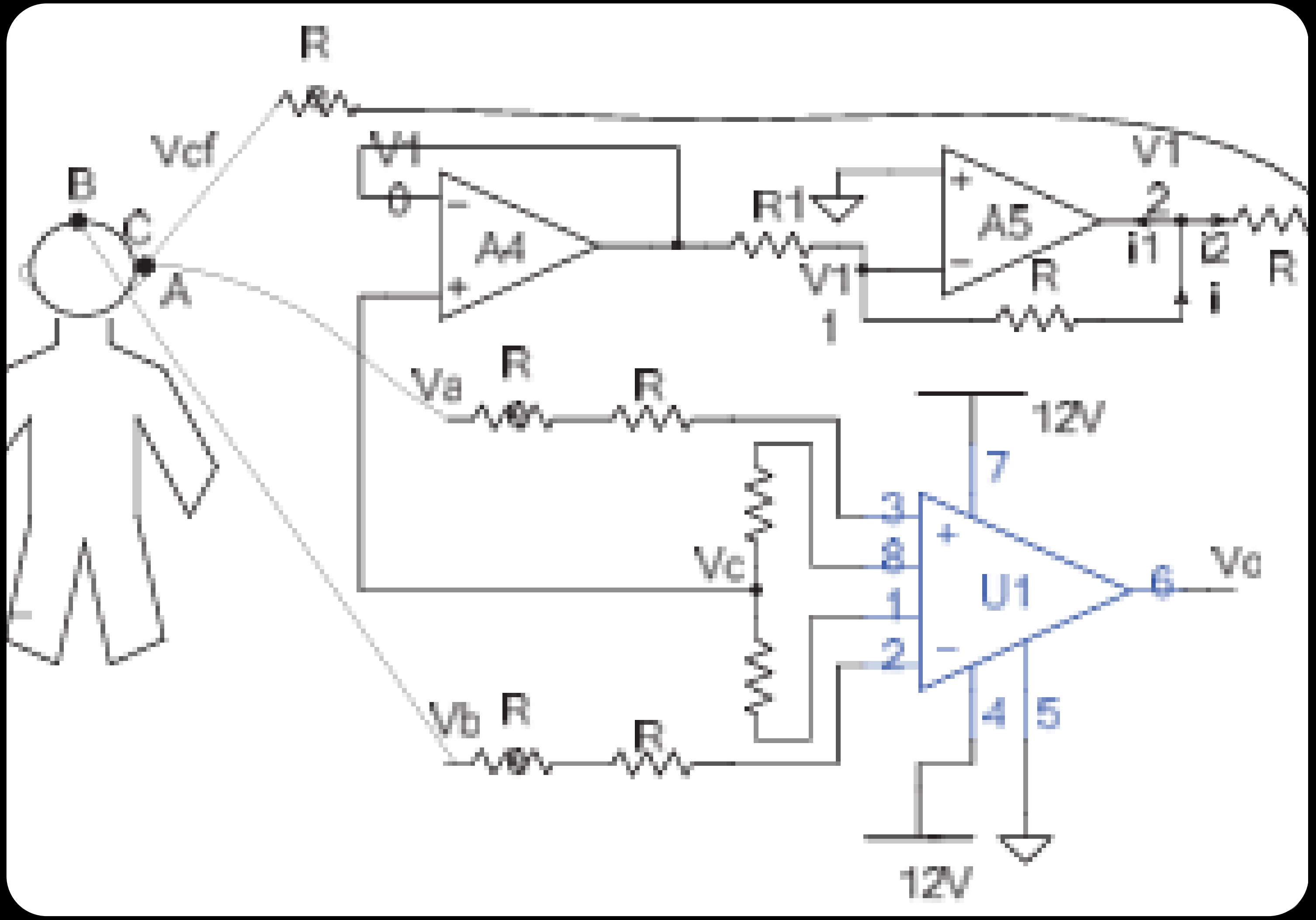
AMPLIFICATION STAGES

BRAIN PULSE

Stage	Input Voltage	Gain	Output Voltage
AD620	50 µV	×10	0.5 mV
Post-Amp 1	0.5 mV	×40	20 mV
Post-Amp 2	20 mV	×40	0.8 V

SIGNAL FILTERING

DRIVEN RIGHT LEG (DRL) CIRCUIT



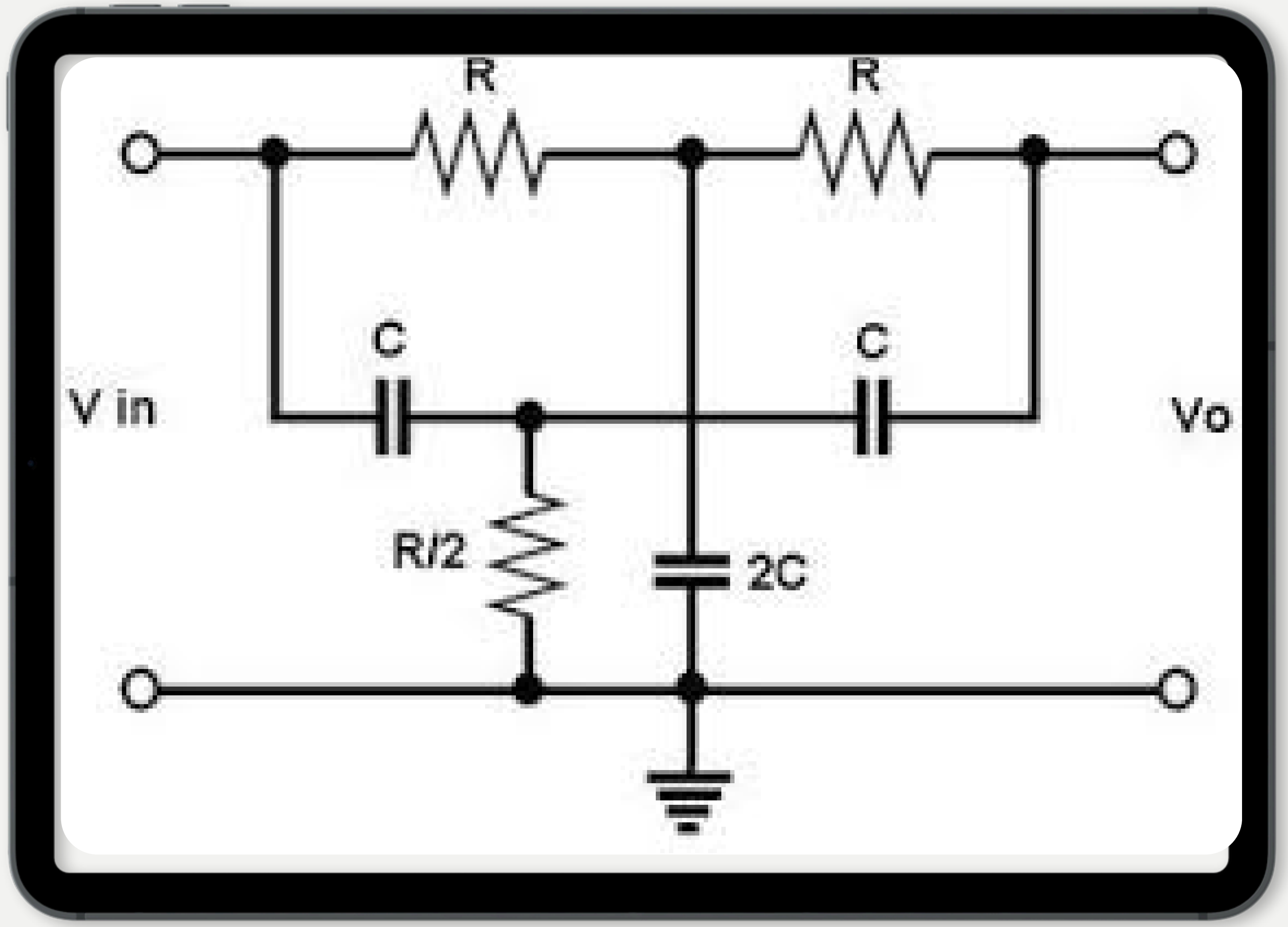
Feedback-based common-mode noise cancellation

Stabilizes baseline and improves CMRR

SIGNAL FILTERING

2.50HZ NOTCH FILTER (DOUBLE-T)

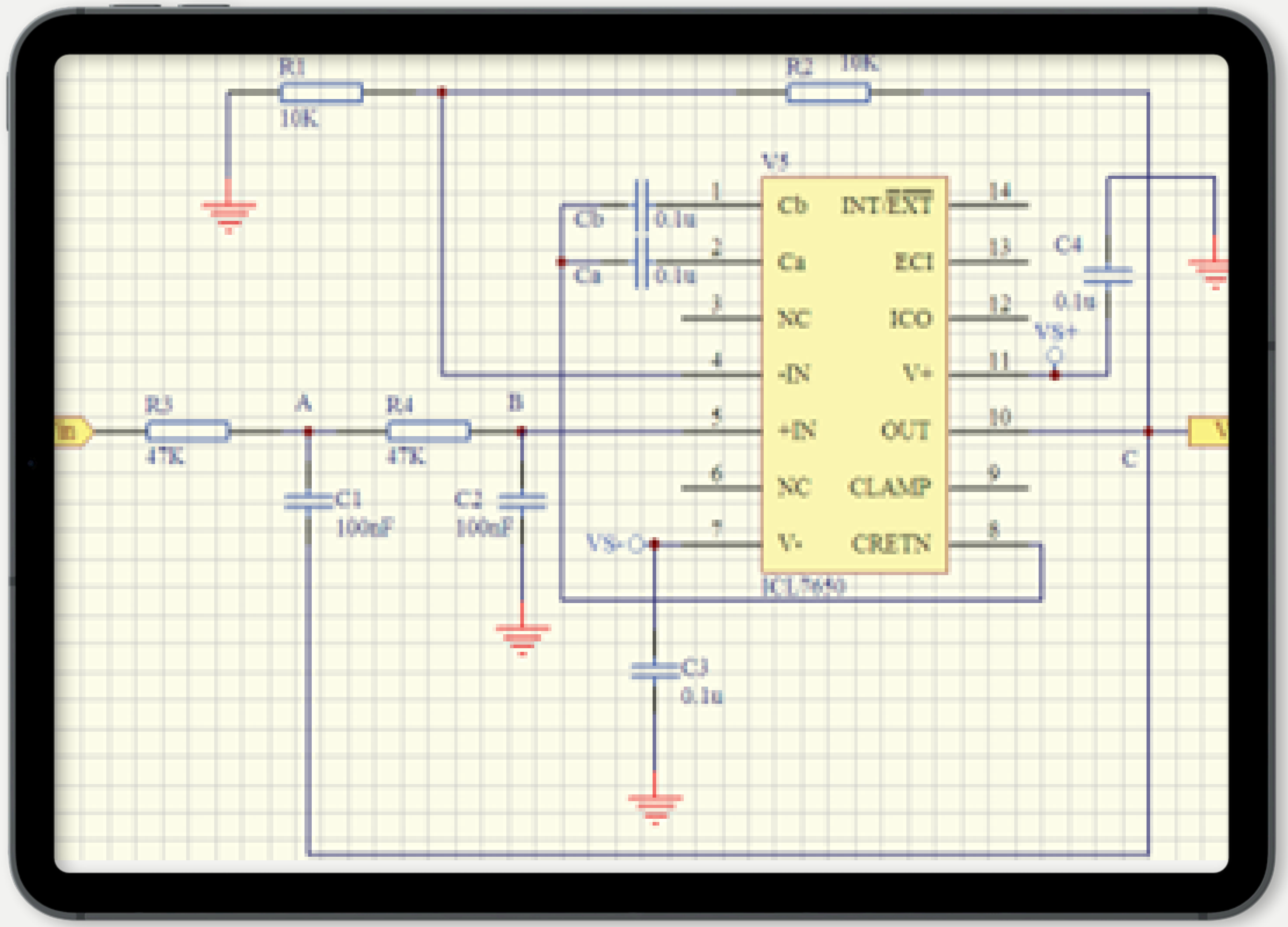
- Removes powerline interference



SIGNAL FILTERING

3.LOW-PASS FILTER (<30HZ)

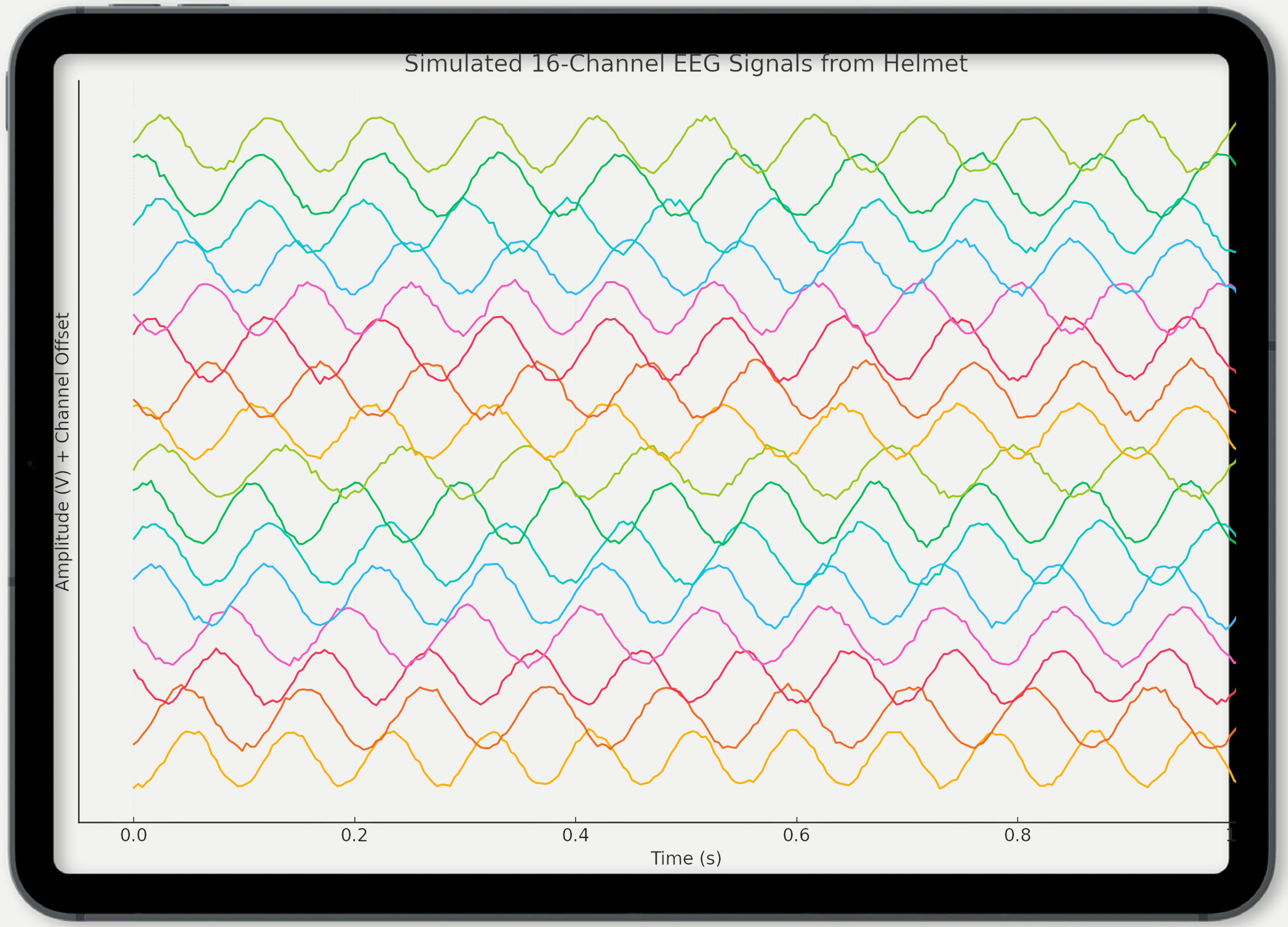
- remove high-frequency noise (e.g. EMG, 50Hz power line).
- Passes EEG signals between 0.5–30 Hz.



ADC & DIGITAL CONVERSION

- ESP32 reads signal via analogRead()
- 12-bit ADC: value from 0 to 4095
- Each channel rises sequentially (with a delay)
- All 16 readings are stored in JSON format

SAMPLE EEG SIGNAL
CAPTURED FROM HELMET



BRAIN PULSE

BLE DATA TRANSMISSION

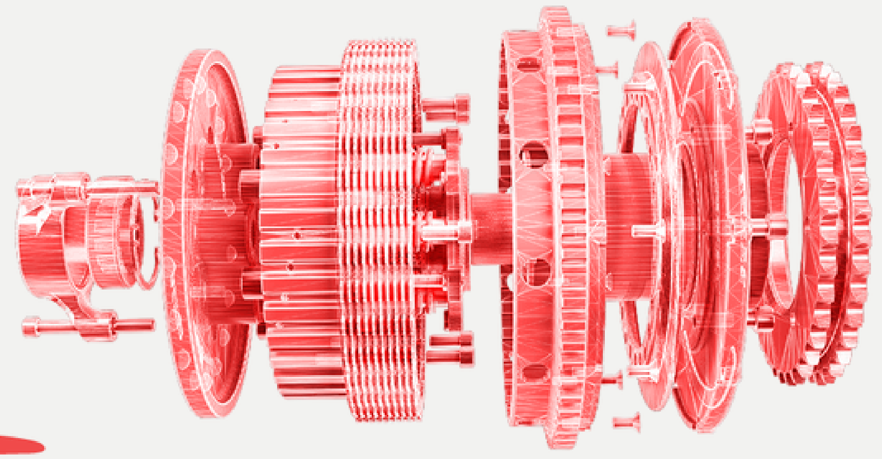
- ESP32 BLE server sends EEG packets
- JSON includes values from ch1 to ch16
- Packets sent every 50ms

FEATURES & ADVANTAGES

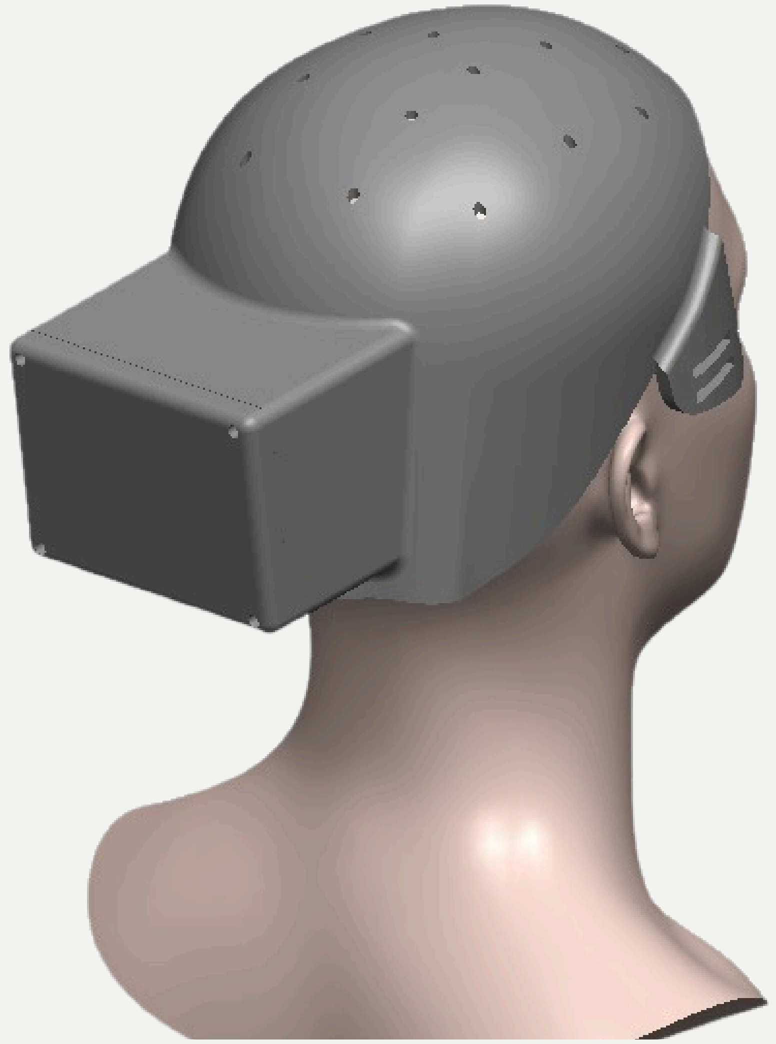
- Low-cost, locally sourced components
- Comfortable 3D-printed design
- Real-time EEG from 16 channels
- Modular analog front-end
- BLE-based mobile integration
- Open-source & upgradable

BRAIN
PULSE

TOOLS & SOFTWARE USED



SOLIDWORKS



3D Design

BRAIN PULSE

TOOLS & SOFTWARE USED

To program the ESP32, we used the Arduino IDE, one of the most widely used and accessible platforms for embedded development.

User-Friendly Interface:
Arduino IDE offers a simple and clean coding environment, which allows us to focus on logic and signal processing without wasting time on a complex setup.

Direct ESP32 Support:
By installing the ESP32 board manager, we were able to write, compile, and upload code easily, just like any regular Arduino board.

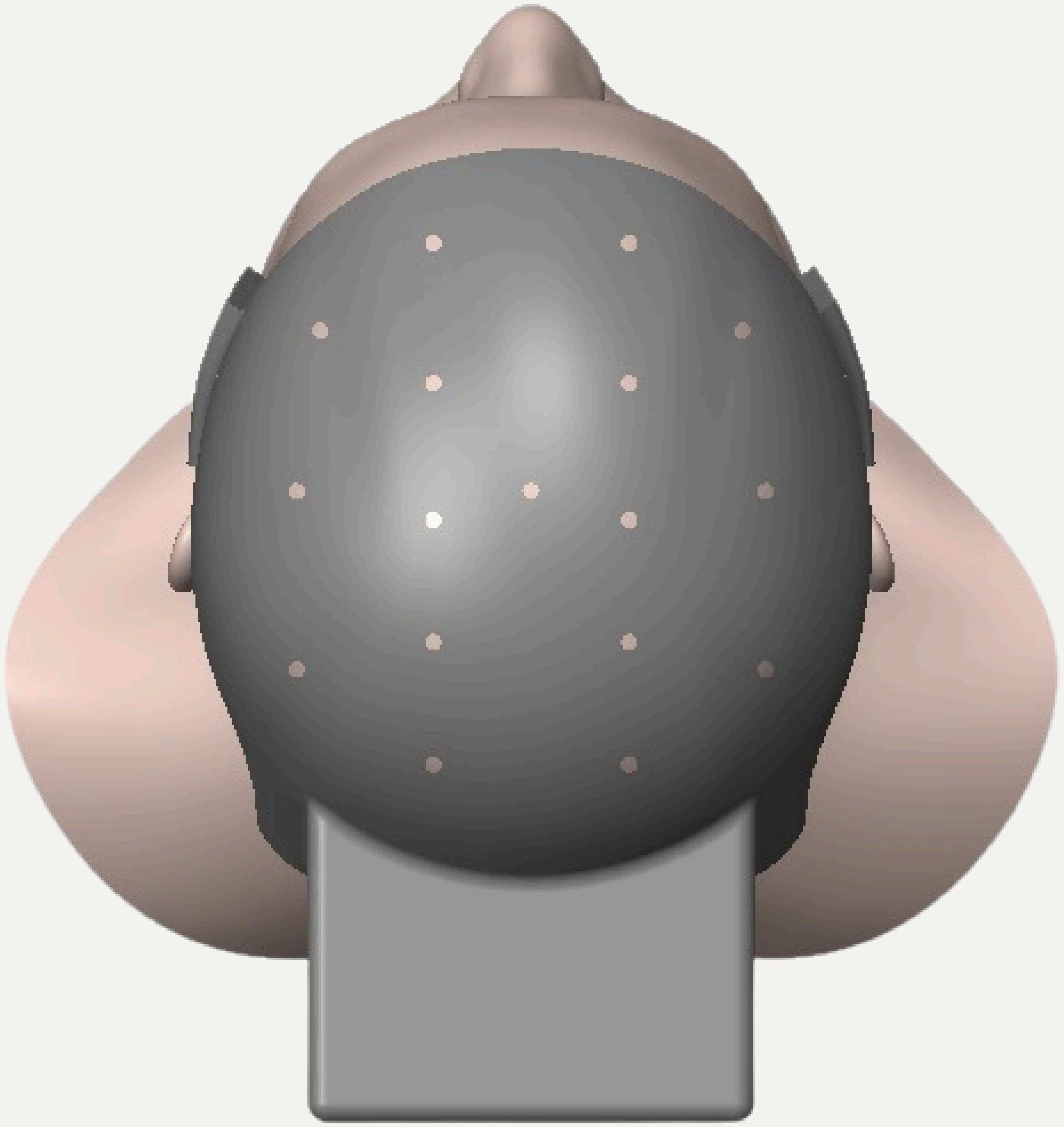
Wide Library Support:
The IDE provides ready-to-use libraries for serial communication, Wi-Fi, Bluetooth, and analog/digital input processing, making EEG signal handling much smoother.

Fast Prototyping:
We were able to test and iterate quickly, which helped us speed up development and debug in real time.

CHALLENGES & LESSONS

Helmet Availability

One of the most difficult challenges was providing a medical helmet with European specifications (CE/FDA), because the local market does not have ready-made products with these specifications, and we had to resort to alternative solutions.



CHALLENGES & LESSONS

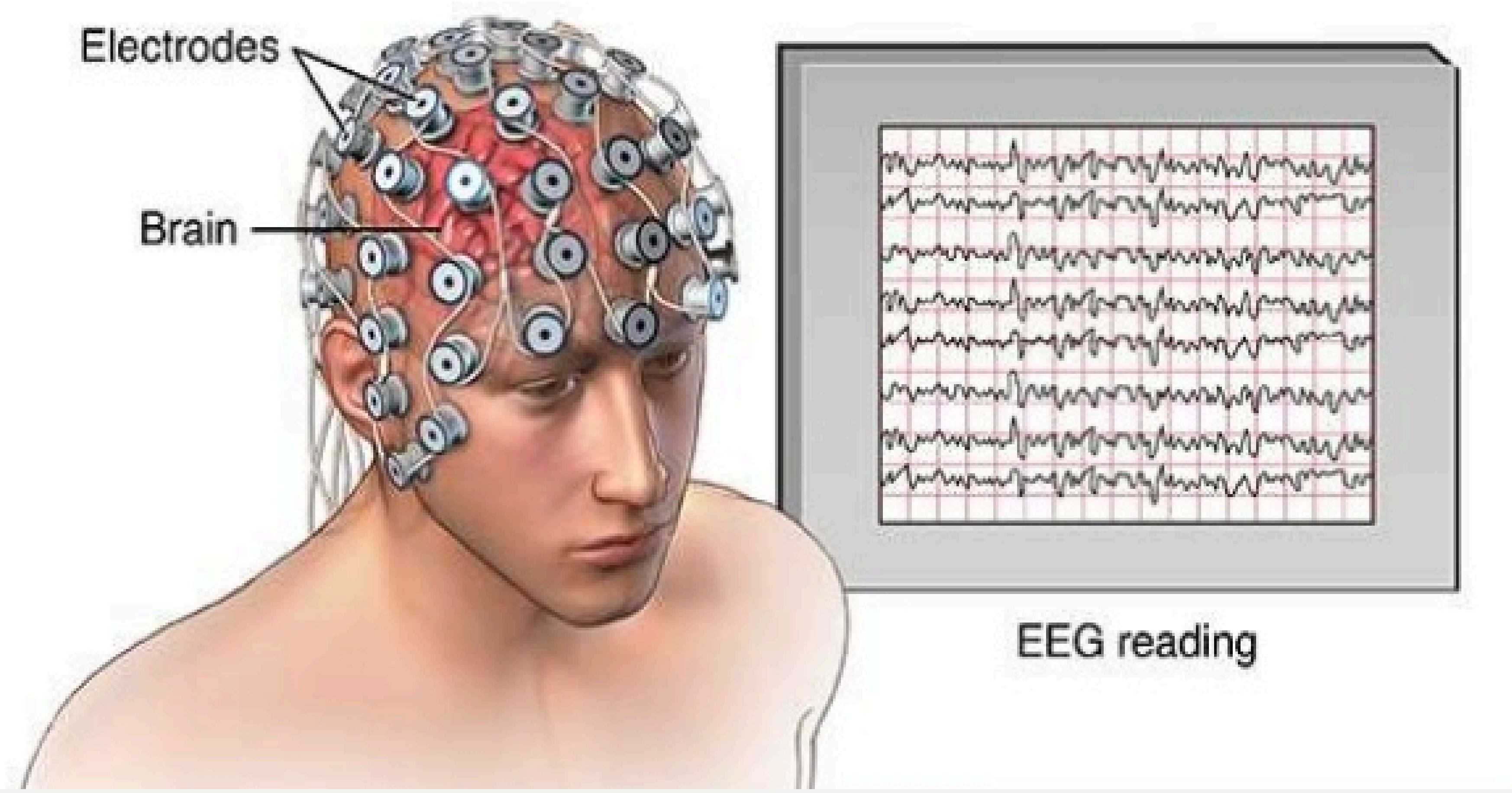
Gold-Plated Electrodes

Gold-plated electrodes are important for cleanliness, but they are very expensive and difficult to find with precise specifications.

CHALLENGES & LESSONS

Cost & Signal Testing

The cost of the prototype increased due to import and testing, in addition to the costs of the equipment we used to accurately control and analyze the signal.



CHALLENGES & LESSONS

Overcoming Challenges

Despite the challenges, we were able to develop a prototype that is ready for use and marketable in hospitals, clinics, and research centers.

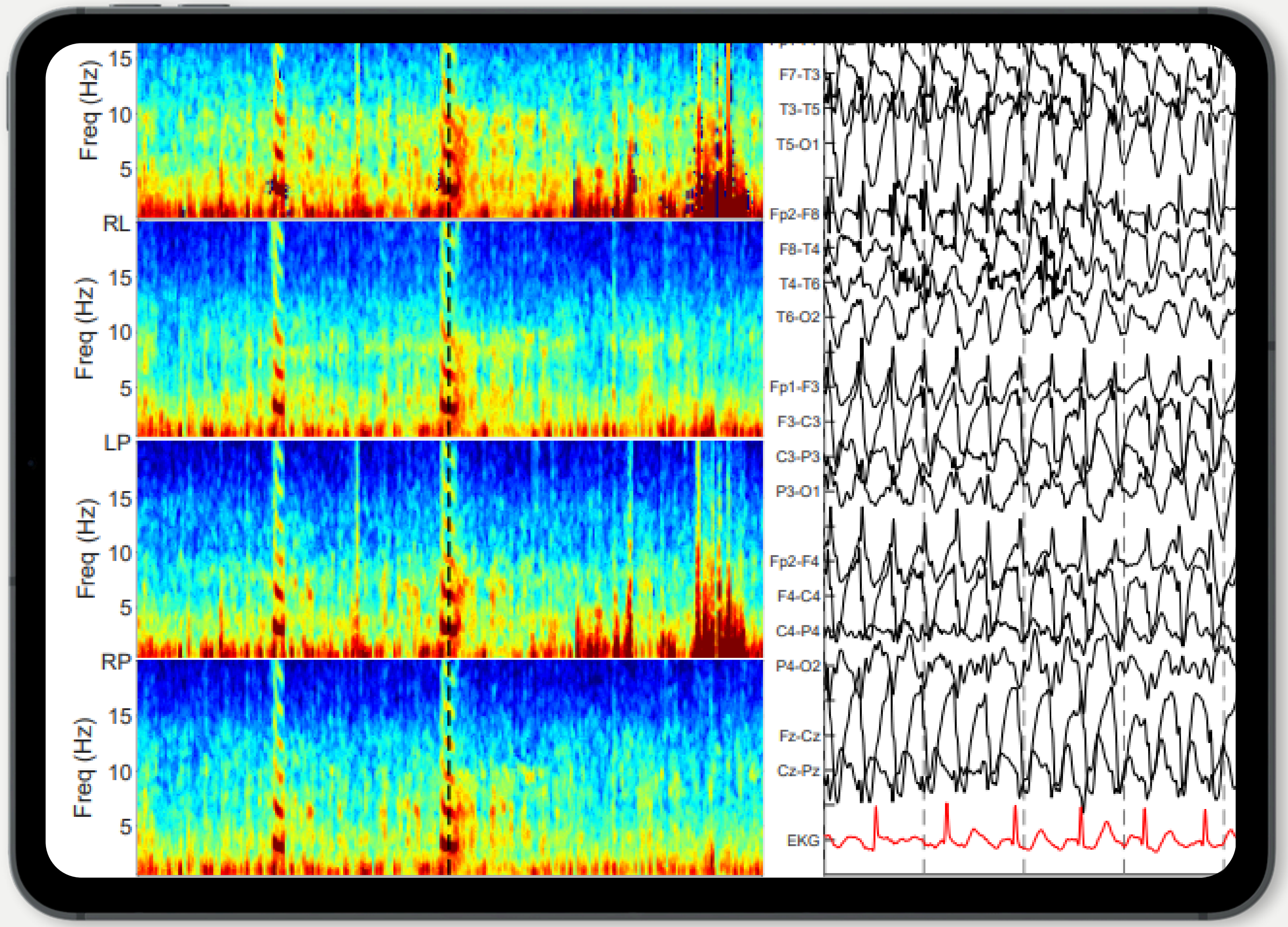
ARTIFICIAL INTELLIGENCE

BRAIN
PULSE

WHAT IS EEG

01 Definition of EEG EEG stands for Electroencephalography. It’s a technique that records the electrical activity of the brain using small sensors placed on the scalp

02 Importance of EEG EEG is important because it helps detect brain problems like epilepsy, monitors brain activity, and supports research in sleep, focus, and emotions



03 How we measure EEG We place electrodes (small metal discs) on a person’s head. These electrodes pick up tiny electrical signals that brain cells produce when they communicate.

04 Spectrograms for Represent EEG EEG signals change over time and can be complex. To make them easier to understand, we turn them into colorful images called spectrograms, which show how the frequency and power of brain activity change over time, like a heatmap for the brain

BRAIN PULSE

DATASET DESCRIPTION

1,950

EEG data was collected from 1,950 patients, primarily in ICU or neurological monitoring units

17,089

The dataset contains 17,089 EEG recordings, offering a wide variety of brain activity samples across different conditions.

50

All recordings were split into 50-second sub-recordings to enable more efficient analysis and training.

MINUTE TO 1 HOUR

Each recording ranges from 1 minute to 1 hour in duration, capturing both short and extended brain activity.

VE RI TAS

HMS
Harmful Brain Activity Classification

Harvard Medical School

Research Code Competition

BRAIN PULSE

WHAT ARE THE PATTERNS OF SIGNALS WE ARE CLASSIFY

Pattern Name	What the Brain Waves Look Like	Possible Health Issues
Seizure	Big, fast, and repeated waves — like a brain storm.	Epilepsy, head injury, or other seizure conditions.
LPD	Sharp bumps on one side, showing up again and again like a ticking clock.	Stroke, brain infection, or a tumor on one side.
GPD	Bumps happening all over the brain in a regular pattern.	Coma, serious brain illness, or brain swelling.
LRDA	Slow, smooth waves mostly on one side — like waves rolling in.	Early sign of seizures, stroke, or brain pressure.
GRDA	Slow waves across the whole brain, happening in a steady rhythm.	Often seen in deep coma or when the brain is very sick.

MODELING PIPELINE OVERVIEW

The Helmet

Everything starts here. A special helmet with sensors reads the brain's raw electrical activity.

The Algorithm

Raw brain signals are complex. This algorithm acts as a translator. It converts the signals into a visual picture called a spectrogram.

The Data Pipeline

Before the AI can analyze the spectrogram pictures, we need to prepare them. This pipeline is like a car wash and tune-up station.

The CNN Model

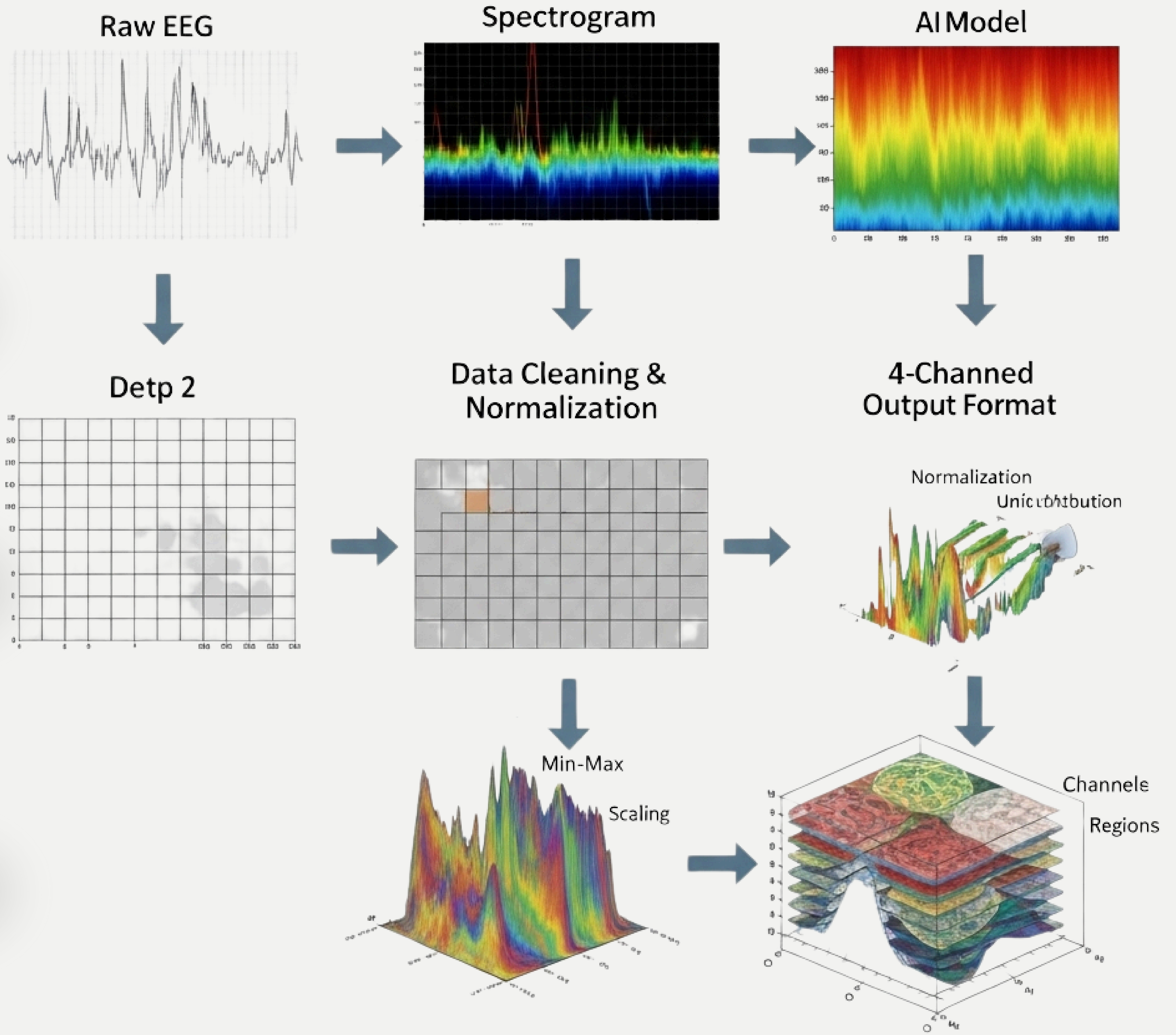
This is our AI model, which is specifically designed to find patterns in images. It looks at the prepared spectrogram pictures and learns to identify the unique visual signatures of different brain activities, such as seizures or other harmful events.

The Prediction & Application

Finally, after analyzing the picture, the model makes a prediction. It classifies the brain activity it has identified. This result is then shown in a simple application, giving doctors a quick and accurate insight to help with their diagnosis.

PREPROCESSING PIPELINE

BRAIN PULSE



Convert Raw EEG to Spectrogram

We take a 10-minute EEG segment and convert it into a spectrogram, turning abstract signals into a visual frequency map.

Fill Nulls & Normalize

Next, we fix any missing data points and normalize all values to a standard scale. This ensures consistency and helps the model learn efficiently.

Save as a 4-Channel Image

Finally, we format the data into a 4x300x100 image, with each channel representing a specific brain region (LL, RL, LP, RP) perfect for a CNN model.

WHY PYTORCH

BRAIN PULSE

PyTorch

To build our powerful AI model, we chose PyTorch the leading platform for AI research and development due to its flexibility and fine-grained control, which are essential for building complex, custom models in cutting-edge projects like ours. By using PyTorch, we are working with the same state of the art technology that powers the world's leading AI companies, aligning our work with industry standards for innovation.

Meta

Meta not only uses PyTorch they created and maintain it.

OpenAI

OpenAI builds and trains models like ChatGPT using PyTorch.

Tesla uses PyTorch to develop its sophisticated AI for Autopilot.

HOW AI LEARN?
LIKE A CHILD

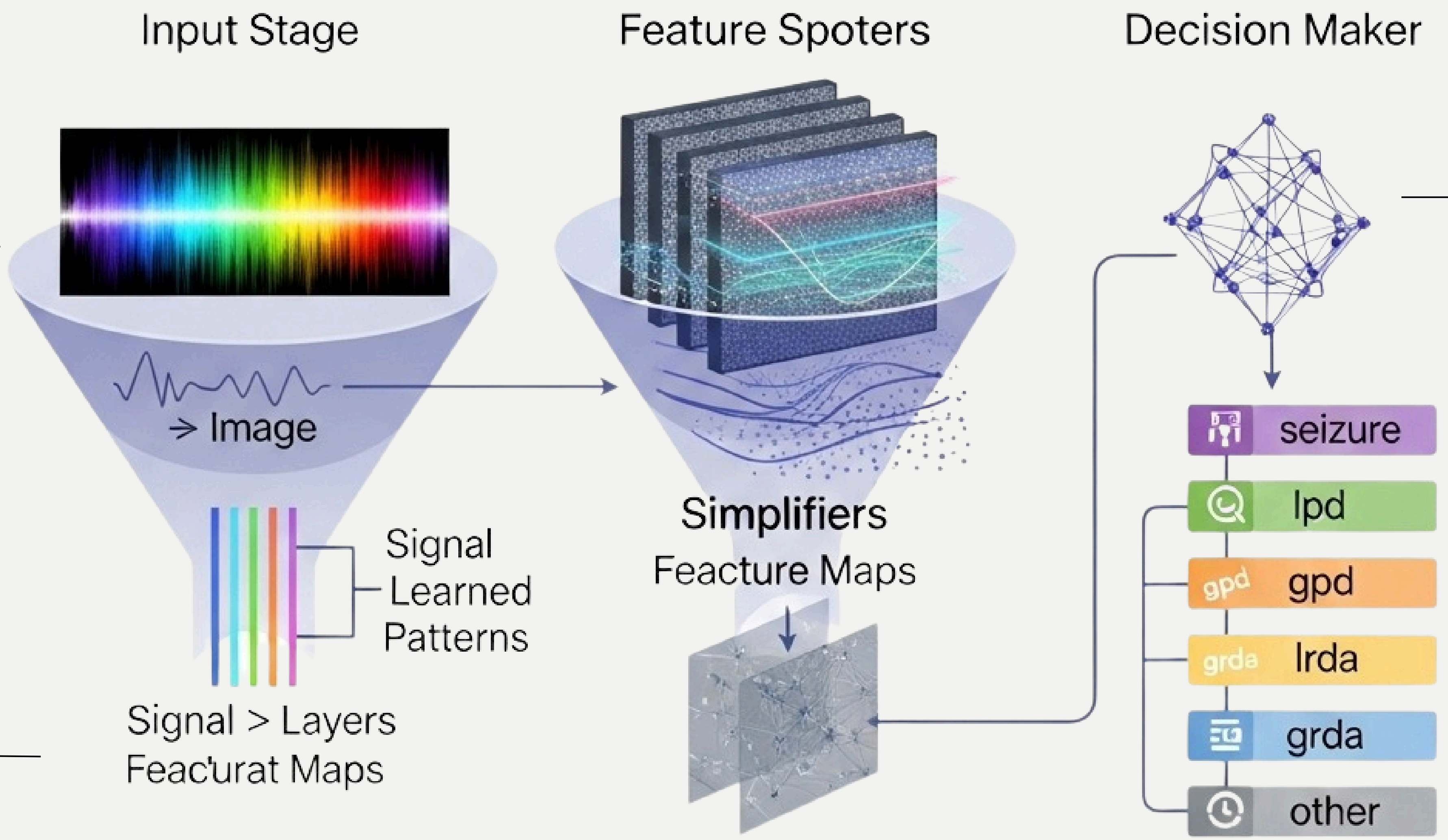
We give the AI model lots of images, labeled as "cat" or "not cat".
A CNN (Convolutional Neural Network) acts like the AI's “eyes”.
It scans the image in small parts (like how we look at details).

It learns important features (shapes, edges, patterns) layer by layer.
Eventually, the CNN can say: “Yes, this is a cat” or “No, it’s not.”

A child sees a cat, notices features (ears, tail, meow), and learns: “This is a cat.”

After seeing more cats, the child learns to recognize them better even if they look different.

BUILDING THE MODEL



CNN Model

From Image to Insight
We built a custom Convolutional Neural Network (CNN) – a type of AI that analyzes spectrogram images in three smart stages, like a funnel:

feature Spotters

The AI scans the image using digital filters to detect simple patterns (lines, textures, spots). These are the building blocks of understanding brain activity.

Simplifiers (Pooling Layers)

Like a highlight reel, this step summarizes what's important and ignores the noise, helping the model focus and speed up.

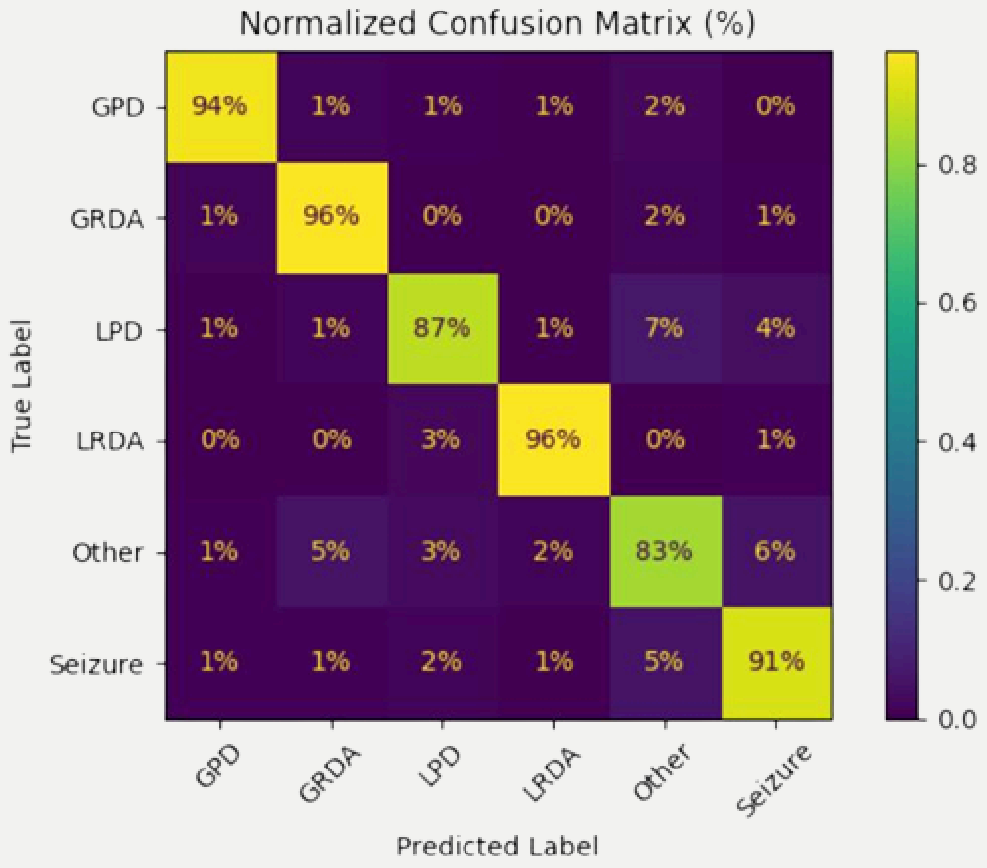
The Decision Maker (Classifier)

Using all the extracted patterns, the AI makes a final decision: it classifies the brain activity into one of six categories.

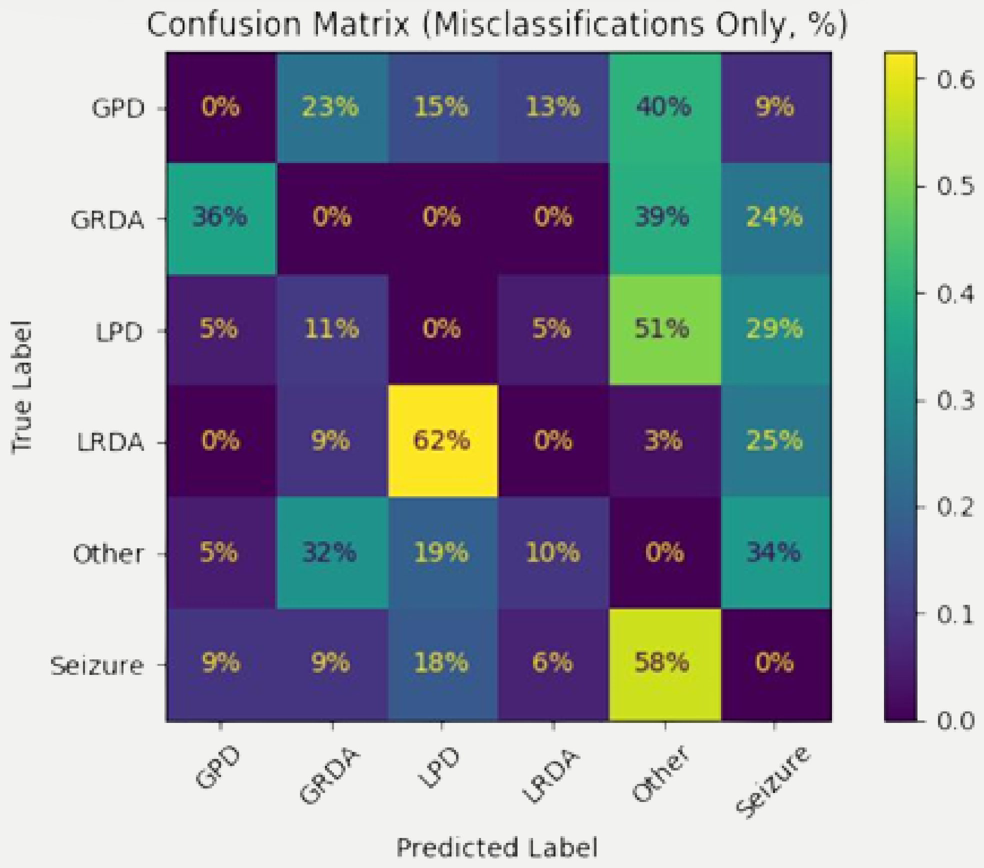
Model Performance

Confusion Matrix It shows how well our model is doing. It compares what the model predicted vs. what was actually correct. Helps us see the correct predictions and the mistakes.

True VS Predicted matrix



Misclassification



BRAIN PULSE

MOBILE APPLICATION USING FLUTTER

01. How an application can help doctors

02. WHY Flutter

03. System Design and Application Architecture

04. What Makes Our App Stand Out

05. App Flow

06. Project Objectives & UI Overview

BRAIN PULSE

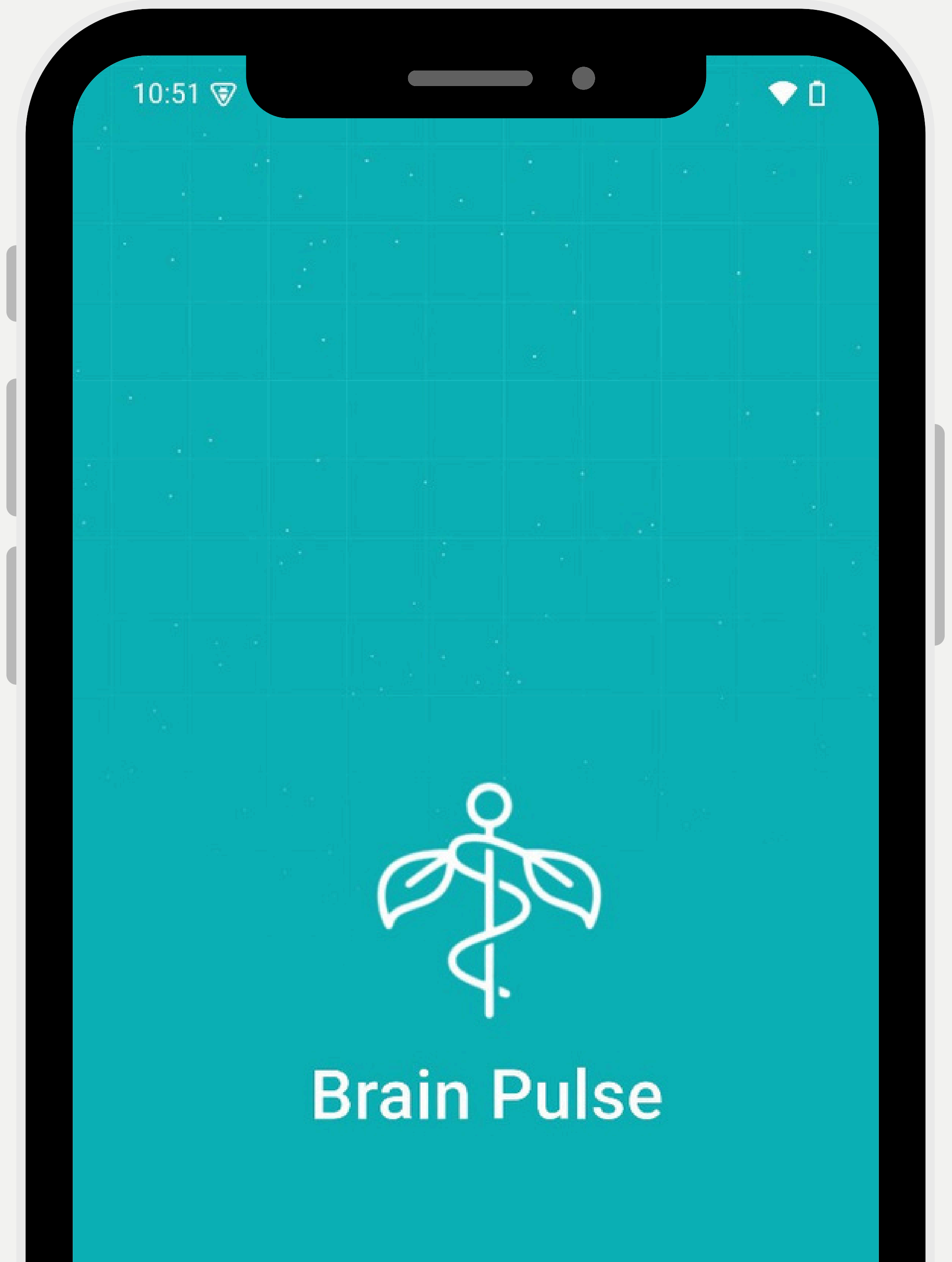
HOW AN APPLICATION CAN HELP DOCTORS

01 Save Time and Effort in the Diagnostic Process

02 Accurate Predictions

03 Patient Management

04 Live EEG Monitoring

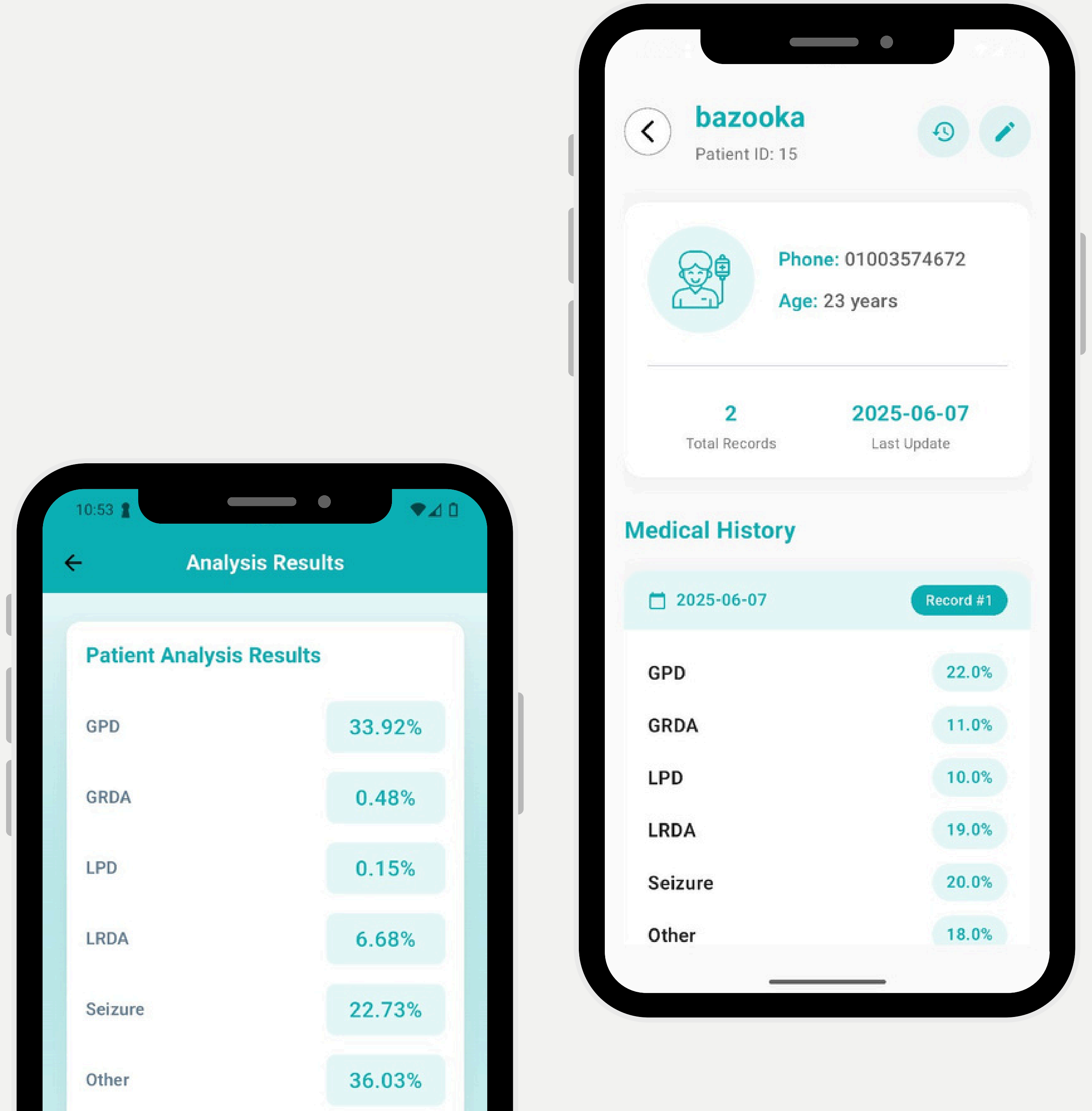


BRAIN PULSE

DEVELOPMENT OPTIONS

1. Android
2. IOS
- React
4. Flutter

WHY FLUTTER



01 **Supports multiple platforms:**
Android, iOS, Web, Desktop, using the same codebase.

02 **High performance**
comparable to native applications.

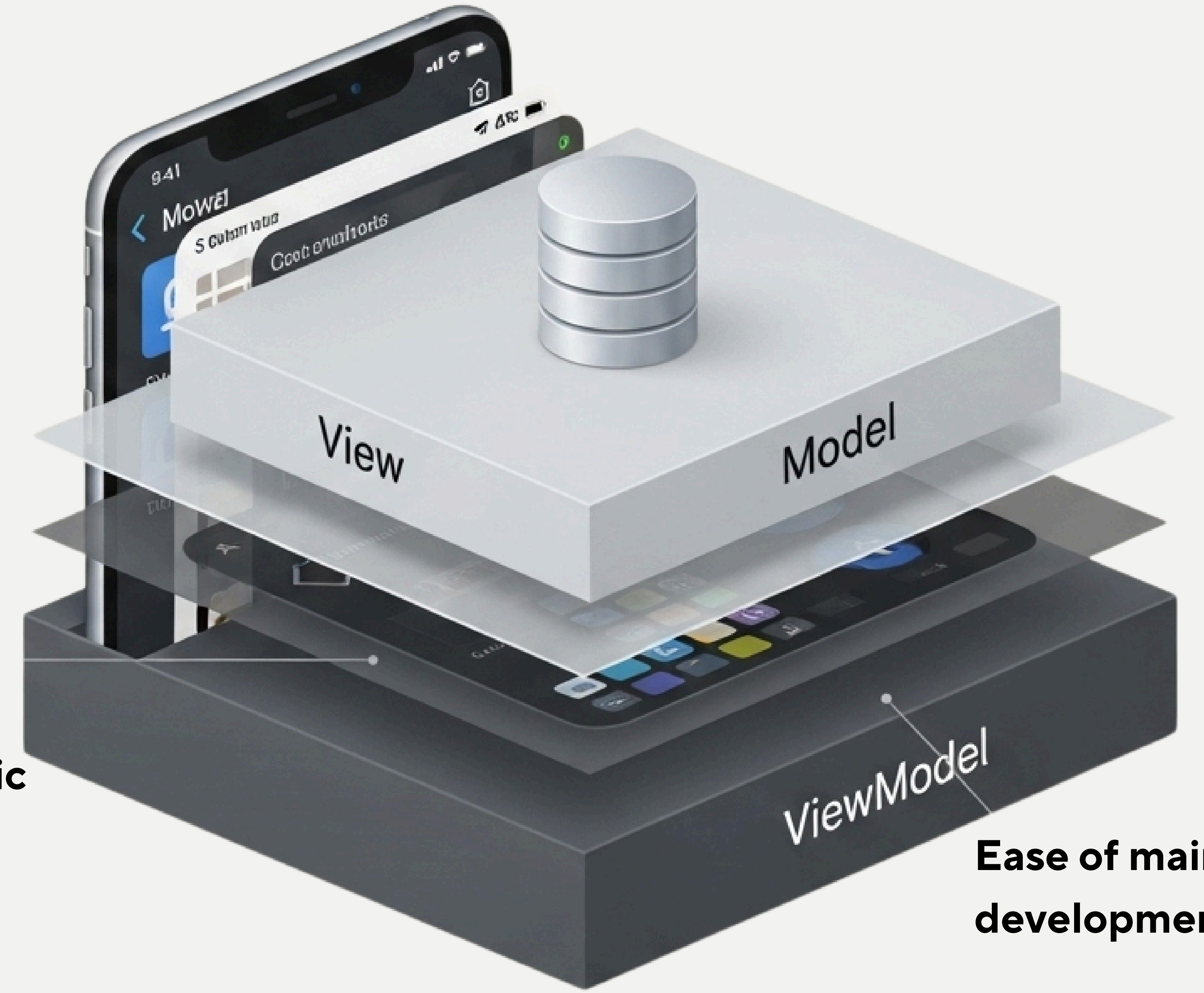
03 **Hot Reload feature**
speeds up development.

04 **Supported by Google**
stabile app and high efficiency and performance and strong ecosystem

SYSTEM DESIGN AND APPLICATION ARCHITECTURE

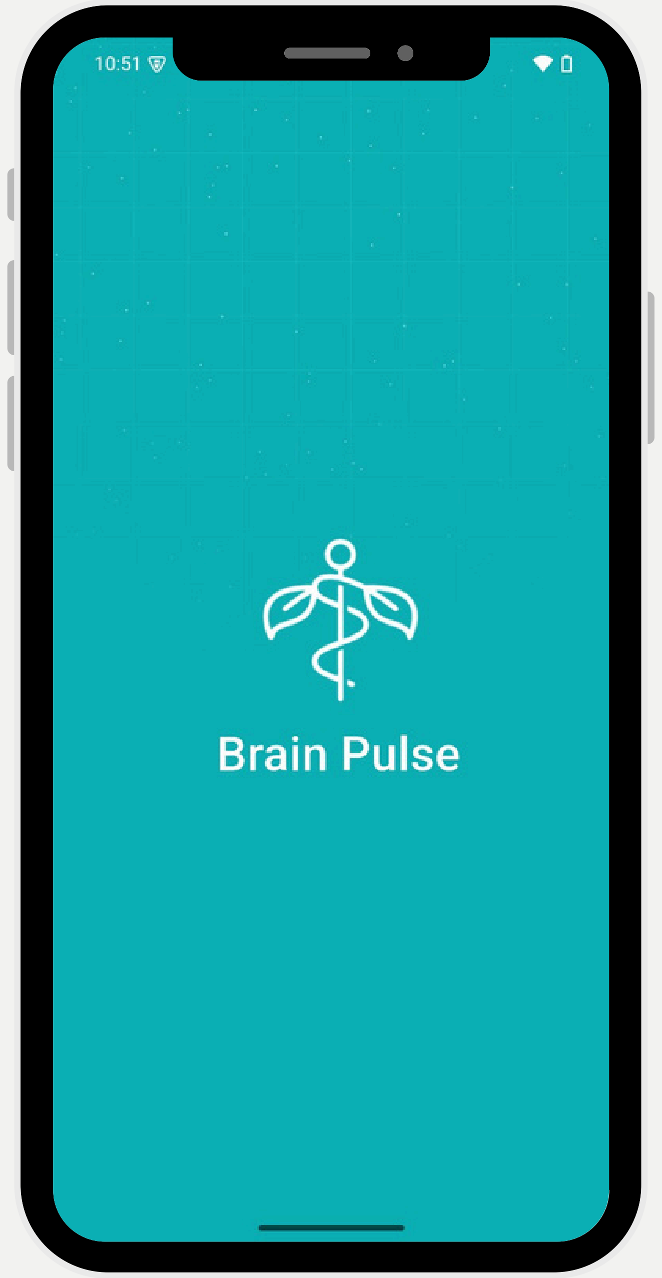
BRAIN PULSE

MVVM - Model View View Model



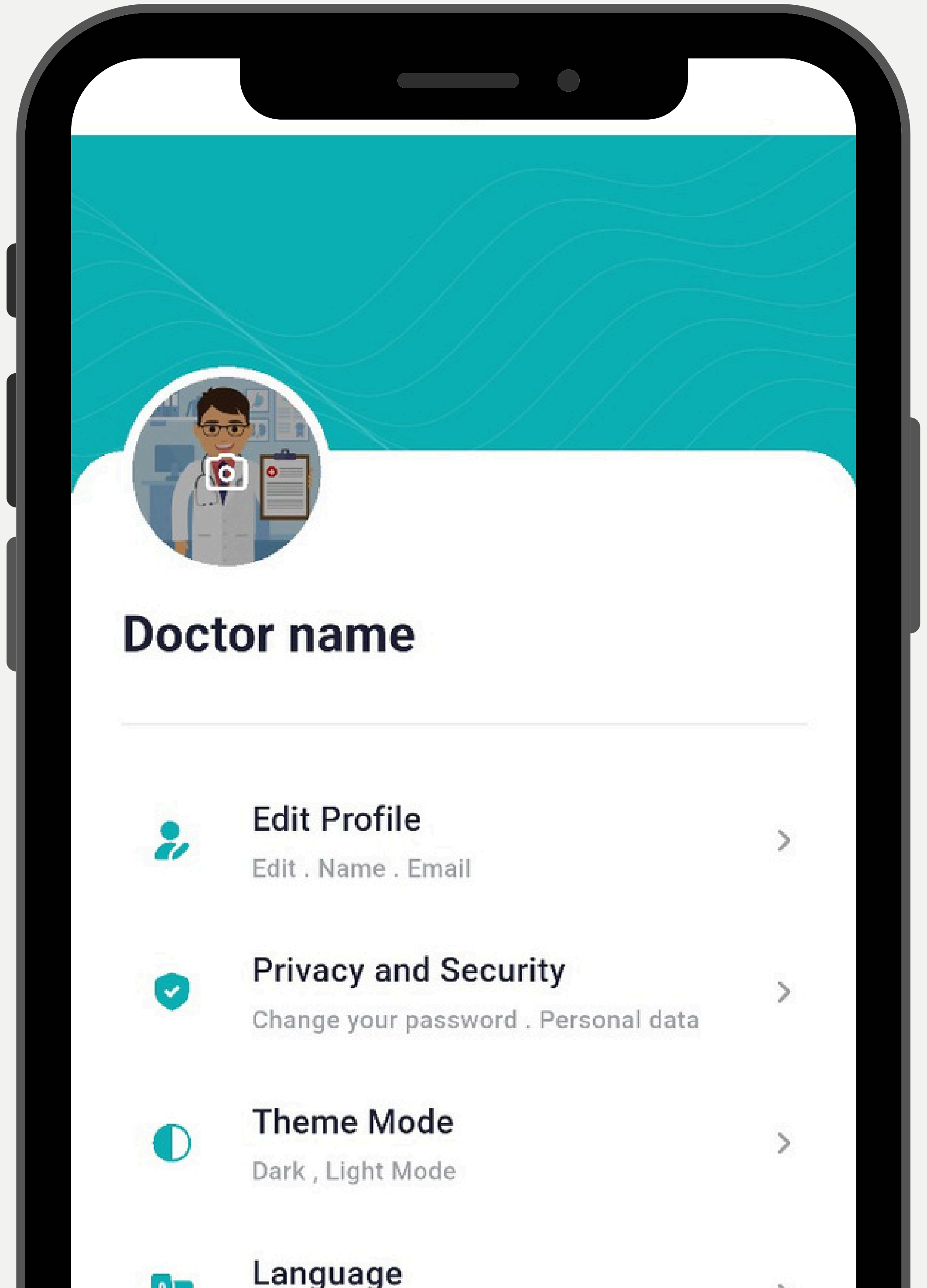
Clear separation between user interface and logic

Ease of maintenance and development



WHAT MAKES OUR APP STAND OUT

BRAIN PULSE



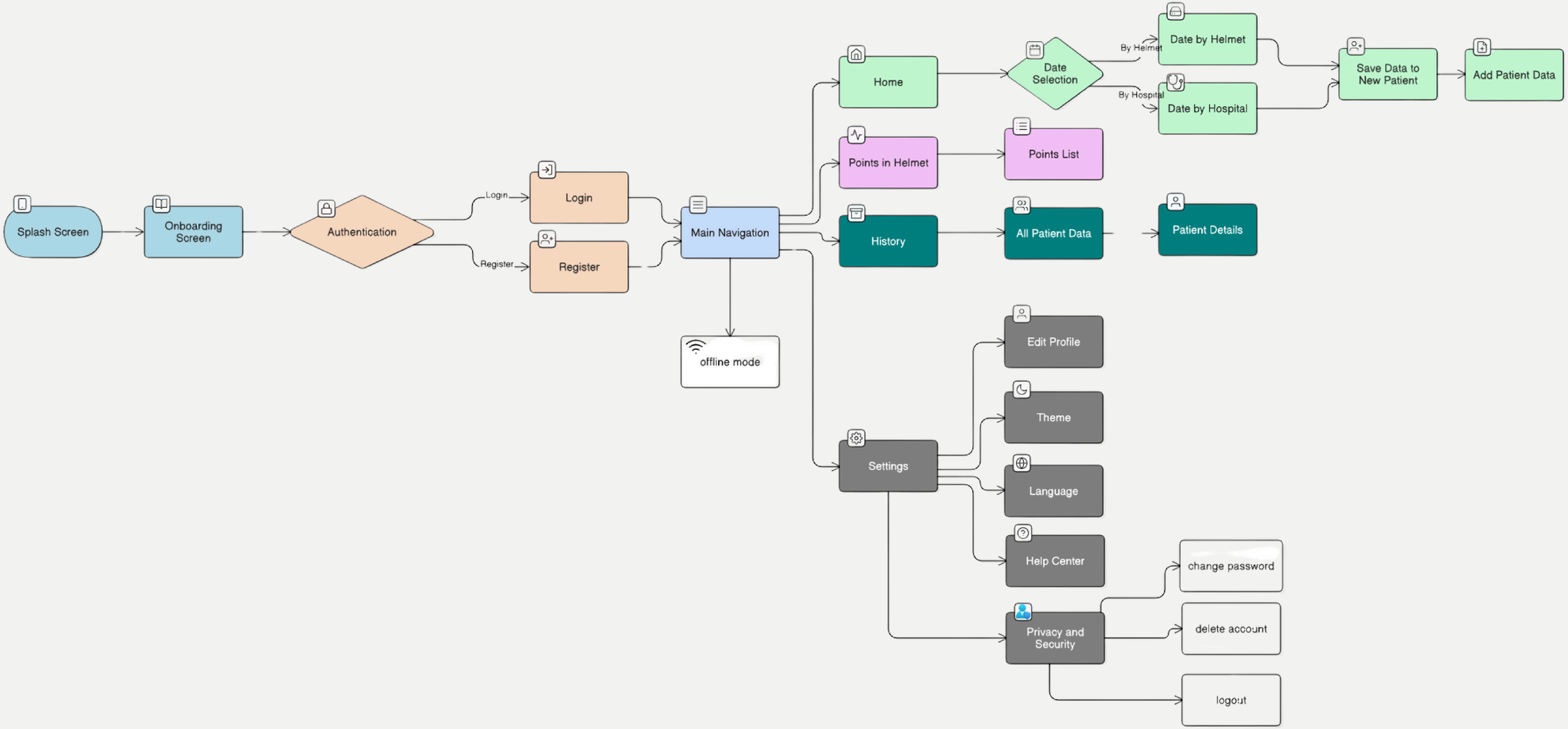
01 **Sentry Integration**
Real-time error detection system to improve application quality.

02 **High Performance**
Utilizes BLOC & Cubit for state management and Dependency Injection for performance enhancement.

03 **Ease of Maintenance and Updates**
Clear code structure and easy addition of new features.

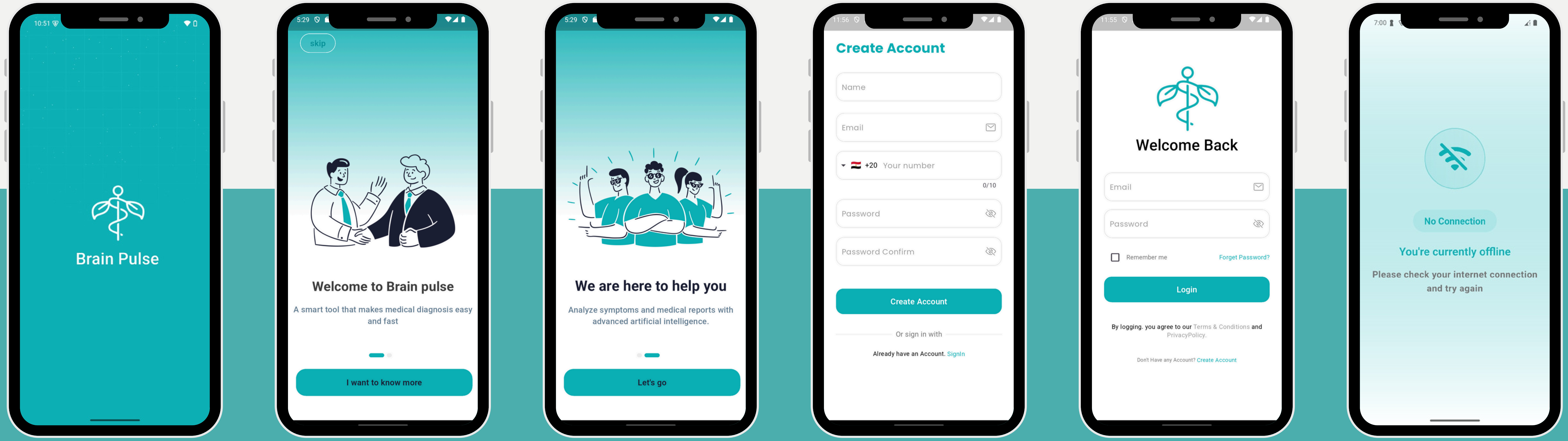
04 **Application Responsiveness**
Ensures a smooth and responsive user experience.

THE FLOW



Splash Screen
Onboarding Screen
Authentication
Login
Register
Login
Register
Main Navigation
offline mode
Home
Date Selection
By Helmet
By Hospital
Date by Helmet
Date by Hospital
Save Data to New Patient
Add Patient Data
Points in Helmet
Points List
History
All Patient Data
Patient Details
Settings
Edit Profile
Theme
Language
Help Center
Privacy and Security
change password
delete account
logout

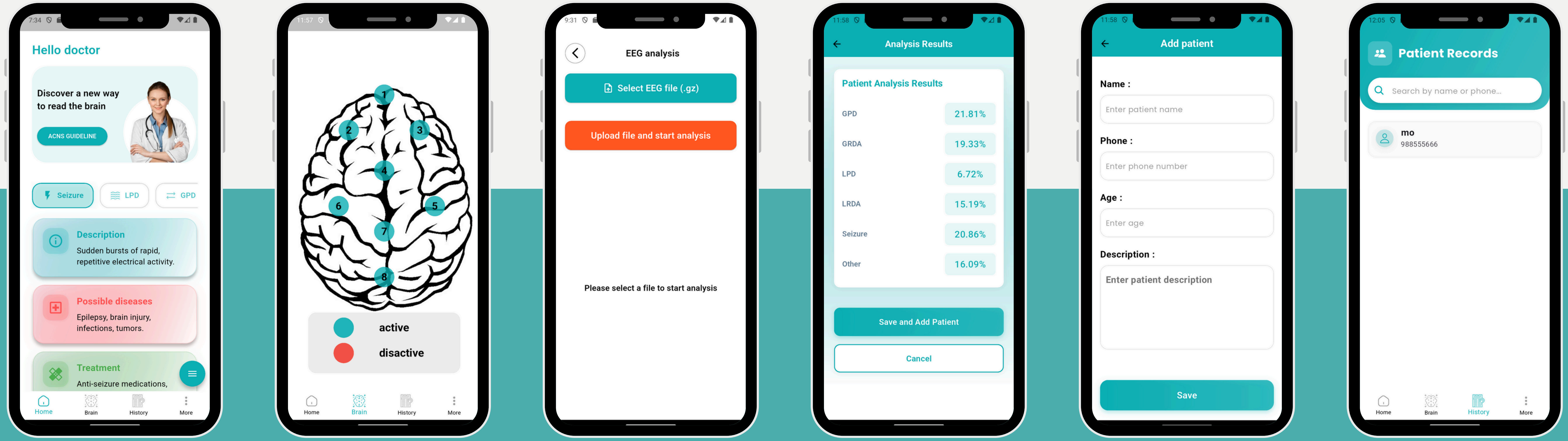
PROJECT OBJECTIVES & UI OVERVIEW



Enhance data quality by applying precise filtering techniques that remove noise and irrelevant information, through a user-friendly interface designed for easy configuration and clear visualization of filtering parameters.

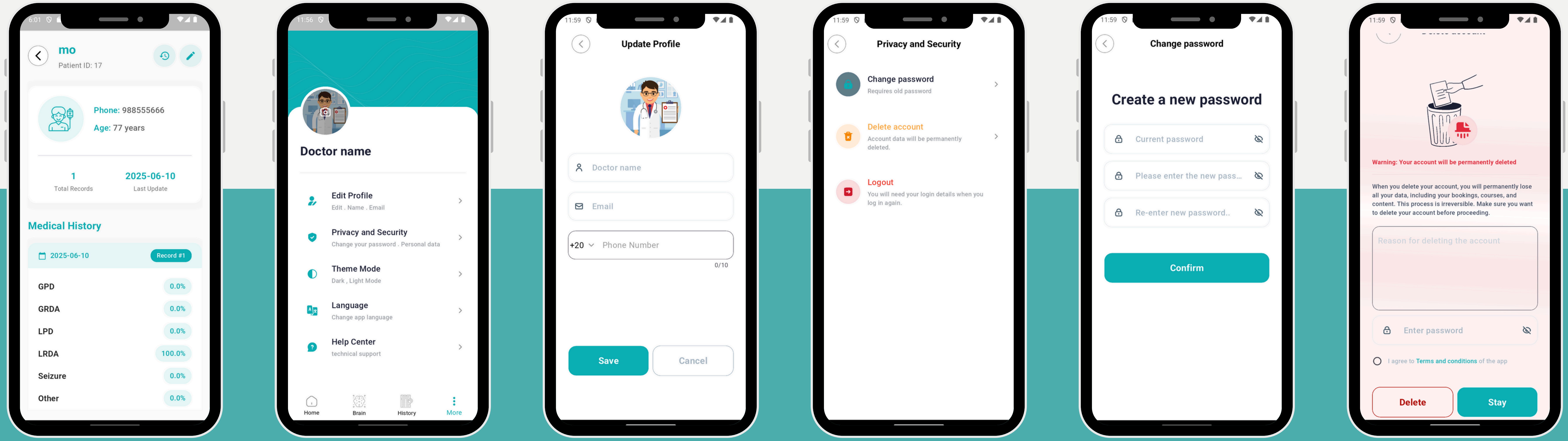
BRAIN PULSE

PROJECT OBJECTIVES & UI OVERVIEW



Enhance data quality by applying precise filtering techniques that remove noise and irrelevant information, through a user-friendly interface designed for easy configuration and clear visualization of filtering parameters.

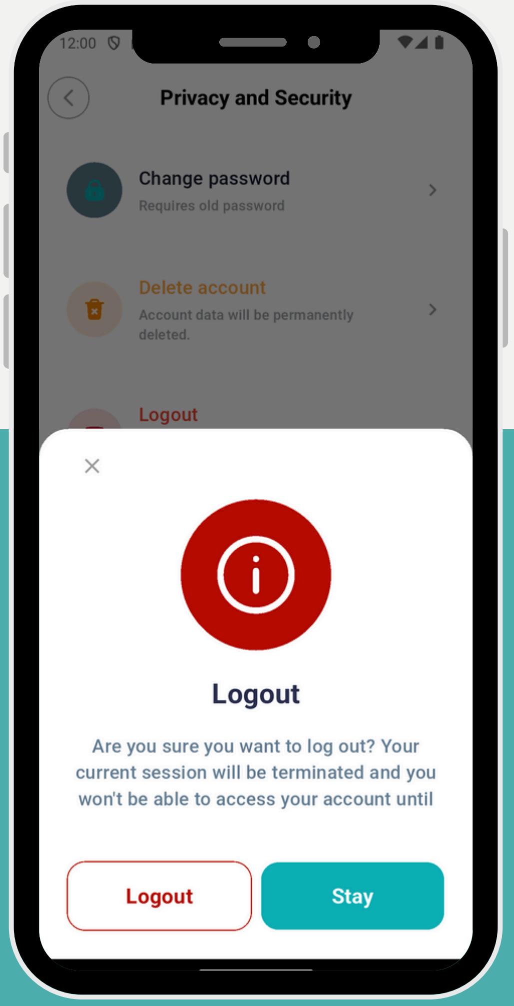
PROJECT OBJECTIVES & UI OVERVIEW

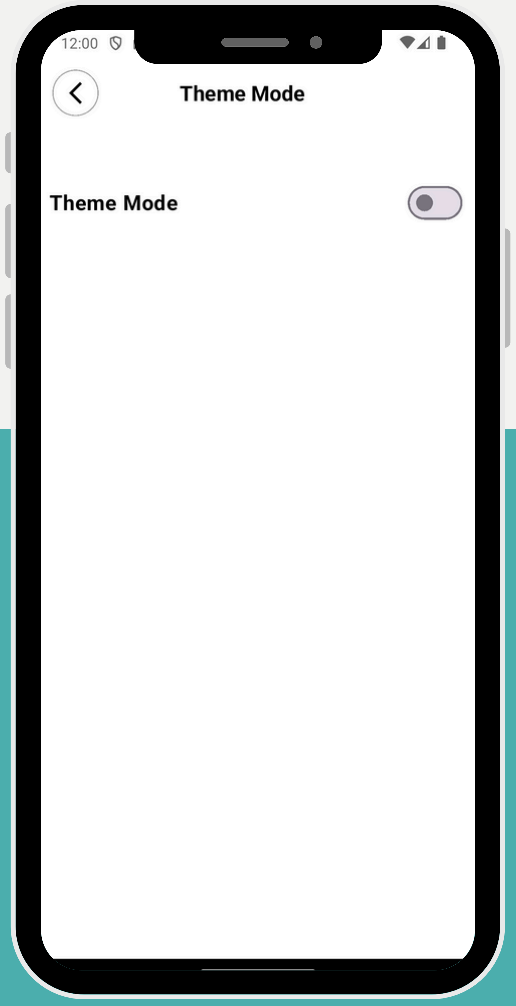


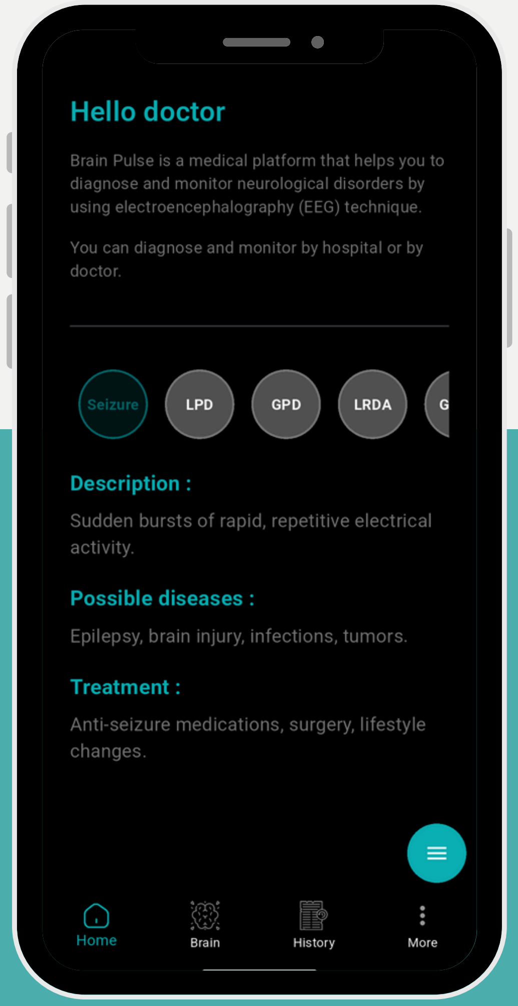
The filtering process ensures that only relevant and clean data moves forward in the pipeline, improving overall model performance. The intuitive UI allows users to monitor filter effects in real-time and make adjustments effortlessly.

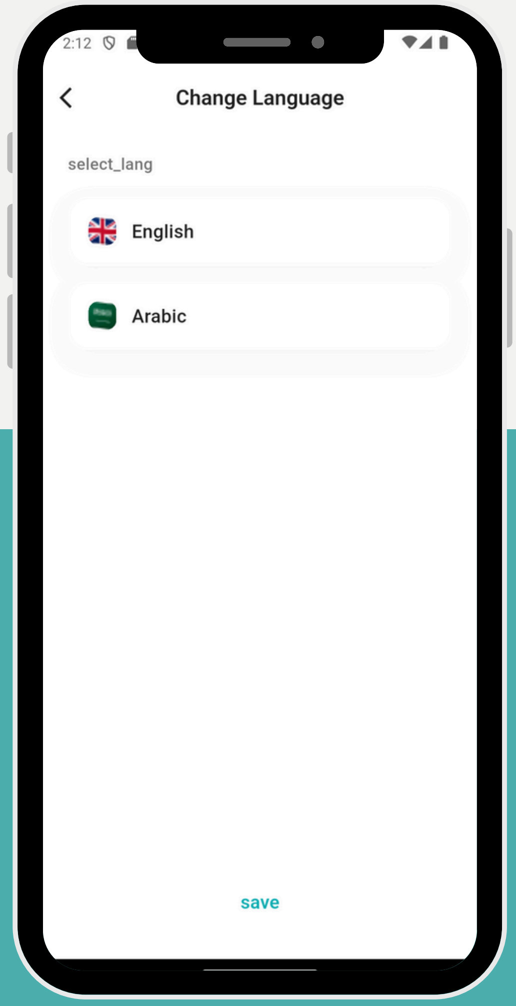
BRAIN PULSE

PROJECT OBJECTIVES & UI OVERVIEW









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BACKEND

01. Project Objectives & Overview
02. System Architecture
03. Technologies & Libraries
04. Core Features
05. API Endpoint Documentation
06. Database Schema
07. Challenges

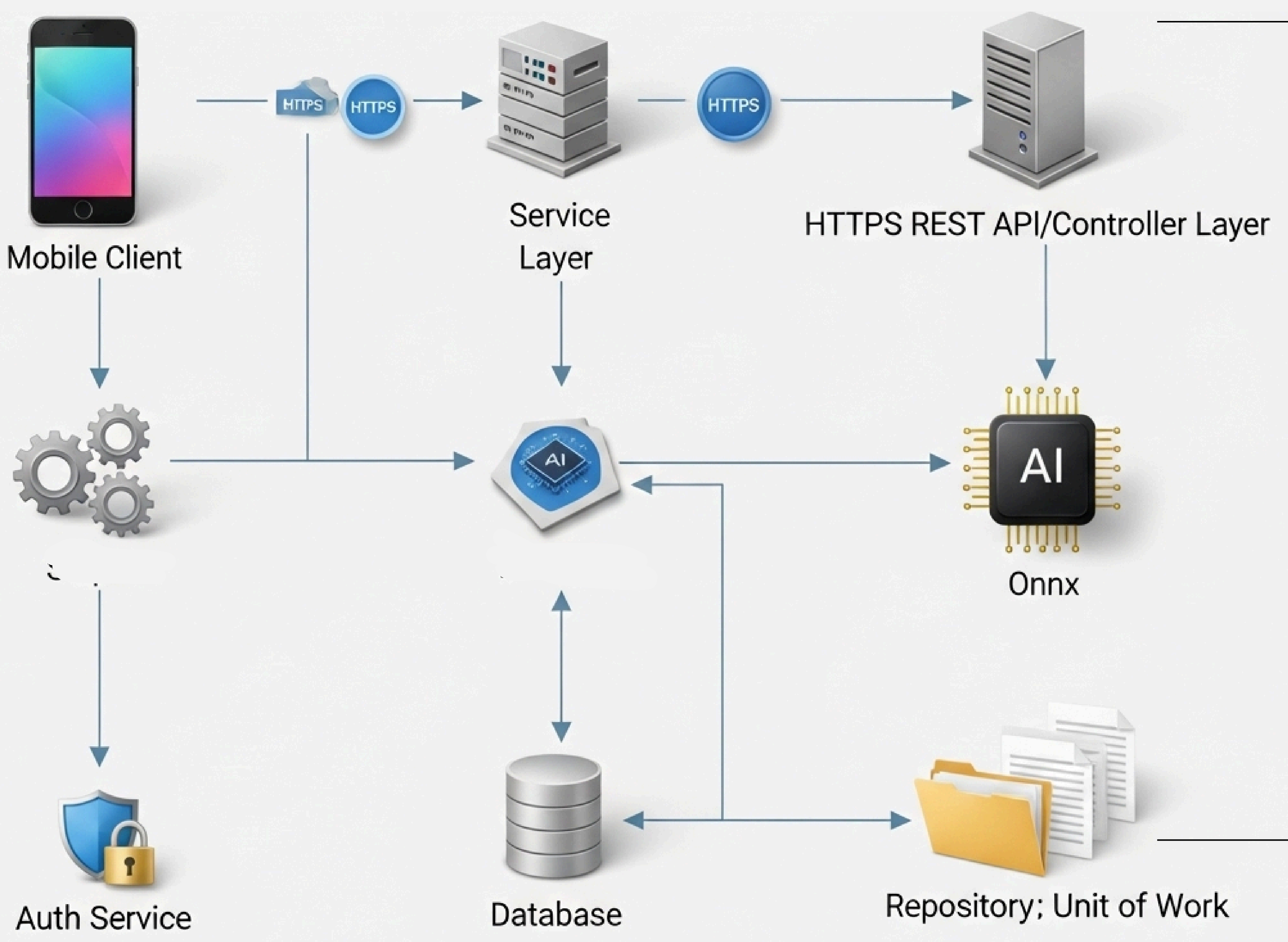
PROJECT OBJECTIVES & OVERVIEW

BRAIN PULSE

This project is the **backend system** for a medical mobile application designed for use by registered doctors. The primary goal is to provide a secure and efficient tool that leverages an AI model to aid in patient diagnosis.

The core functionality allows doctors to manage their patient records and utilize a pre trained AI model. By inputting 20 specific numerical parameters for a patient—either directly obtained from the patient or via an CSV File —the API processes this data through the AI model to predict 6 key medical outcomes (GPD, GRDA, IPD, IRDA, SEIZURE, OTHER).

SYSTEM ARCHITECTURE



Client Interaction & API Routing

The system starts with requests from the mobile client via HTTPS REST API. These are received by the Controller Layer, which routes them to the Service Layer responsible for executing business logic.

Business Logic & AI Model Integration

The Service Layer processes the request with the help of the Unit of Work Layer and then sends the input to the AI Model (ONNX – Black-box) to generate medical predictions.

Data Management & Transactions

The Unit of Work Layer ensures safe and consistent CRUD operations, while the Repository Layer accesses the database to retrieve or store information related to doctors and patients.

Security & Authentication

Authentication is handled by the Auth Service using token-based mechanisms (e.g., JWT) to ensure secure access to the system and its sensitive medical data.

TECHNOLOGIES & LIBRARIES

- **Framework:** .NET 8 (ASP.NET Core Web API)
- **Language:** C#
- **Database ORM:** Entity Framework Core 6
- **Database:** Microsoft SQL Server
- **AI Model Integration:** Microsoft.ML.OnnxRuntime for loading and running the .onnx model.
- **Authentication:** JWT (JSON Web Tokens) using Microsoft.AspNetCore.Authentication.JwtBearer.
- **Password Hashing:** BCrypt.Net-Next for secure hashing and verification of passwords.
- **API Documentation:** Swagger (Swashbuckle) for interactive API documentation and testing.
- **Development Tooling:** Visual Studio 2022, Postman

REGISTER A NEW DOCTOR

BRAIN PULSE

Route: POST /api/auth/register
This is the specific URL path that the client (usually the mobile app) uses to send a request when a new doctor wants to create an account. The POST method means that the request is used to send new data to the server

Description: Creates a new doctor account
When this endpoint is called, the system processes the provided information (like name, email, and password) and registers a new doctor in the database.

Authorization & Request Body: Public (Allow Anonymous)
This endpoint is open to anyone. A user does not need to be logged in to access it. It's designed this way because new users (doctors) won't have an account or token yet, so they need to register first.

```
json
    {
     "email": "doctor.new@example.com",
     "password": "StrongPassword123!",
     "phoneNumber": "555-010-2030",
     "name": "Dr. Emily Carter"
    }
```

LOGIN
A DOCTOR

BRAIN PULSE

```json
{
  "id": "8f0a0234-b95e-4442-a61f-64f9feec60b4",
  "email": "engahmedelsherbiny1@gmail.com",
  "firstName": "ahmed",
  "lastName": "sherbo",
  "token":
"eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJzdWIiOiI4ZjBhMD
IzNC01VLLTQ0NDITyYXzZi02NGY5ZmVlYzYwYjQ1LCJvYW1LJoiYWhtZ
WQiLCJmYWlpbHlfbmFtZSI6ImNoZXJiobyIsImVtYWlsIjoiZW5nYWht
ZWRIbNoZXJiaw5M5MUbnbWFpbC5jb20iLCJleHAiOjE3NTUyNTUyMDUs
ImZyc2l6I6Imh0dHBzOi8vbg9jYWxob3N0OjQ0M2Ml1twiYXVkIjoiaH
R0cHM6Ly9sb2NhbGhvc3Q6NDQ2MzU1fQ.-2ZZbBc3gEhPMOt4zkWwZNn
OjL3RiBmkJ2LkV_xE",
  "expire": 4800000,
  "refreshToken":
"42+p9ZABSCH41u07m8M5Zi0WHorfxE/WkUng8nPImw=",
  "refreshTokenExpireOn": "2025-07-05T21:33:25.938927Z"
}
```

Route: POST /api/auth/login

Description: Authenticates a doctor and returns a JWT Token.

Authorization: Public (Allow Anonymous)

Request Body

CHANGE PASSWORD

BRAIN PULSE

```
json
 {
  "oldPassword": "StrongPassword123!",
  "newPassword": "AnotherStrongPassword456!",
  "confirmNewPassword": "AnotherStrongPassword456!"
 }
```

Success Response & Responses:

Success Response: 200 OK Error **Responses:** 400 Bad Request (incorrect old password, or passwords don't match), 401 Unauthorized

Route: PUT /api/auth/changepassword
Description: Allows a logged-in doctor to change their password.
Authorization: Bearer Token required.
Request Body

GET A SPECIFIC PATIENT BY ID


```json
{
  "firstName": "kareem",
  "lastName": "mostafaa",
  "phone": "0102875456",
  "age": 15,
  "history": [
    {
      "points": {
        "gpd": 20.50,
        "grda": 30.30,
        "ipd": 10.40,
        "irda": 10.1,
        "seizure": 0.0,
        "other": 30.0
      },
      "createdat": "2025-06-22T15:44:06.3417689Z",
      "description": "the Doctor Description"
    }
  ]
}
```


Route: GET /api/patients/{id}

Description: Retrieves a single patient by their ID

Authorization: Bearer Token required.

Success Response: 200 OK with a single patient object.

Error Responses: 401 Unauthorized, 404 Not Found.

AI MODEL CONTROLLER (API/AI MODEL)

BRAIN PULSE

```json
{
  "Prediction Class": "grda",
  "points": {
    "gpd": 20.50,
    "grda": 40.30,
    "ipd": 10.40,
    "irda": 10.1,
    "seizure": 0.0,
    "other": 20.0
  }
}
```

Route:

- **Post** /api/EEGPrediction/predict-gzip?isRaw=true (EEG File)
- **Post** /api/EEGPrediction/predict-gzip?isRaw=False (Spectrogram File)

Description:

- An endpoint to receive CSV File with extension .gz that Contains 20 numerical Points.
- Loads and runs a pre-trained Onnx model.
- Returns precentage of 6 objects and one of six types representing the model's prediction.

DATABASE SCHEMA

Doctors Table:

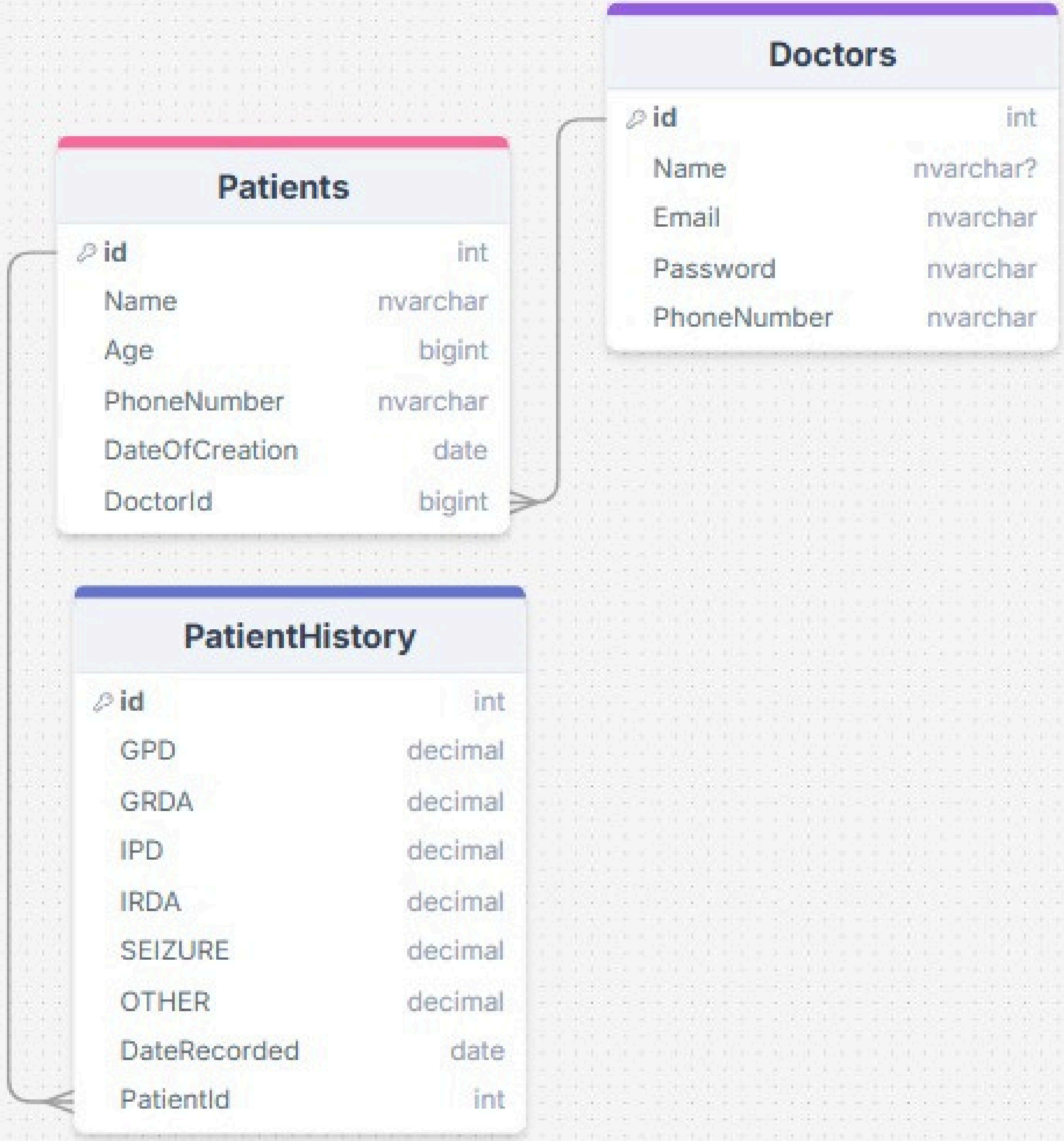
- Id (int, Primary Key, Identity)
- Name (nvarchar(max))
- Email (nvarchar(max), Unique)
- Password (nvarchar(max))
- PhoneNumber (nvarchar(max))

Patients Table:

- Id (int, Primary Key, Identity)
- Name (nvarchar(max)) Age (int)
- PhoneNumber (nvarchar(max))
- DateOfCreation (datetime2)
- GPD, GRDA, IPD, IRDA, SEIZURE, OTHER (decimal(18,6))
- DoctorId (int, Foreign Key

Patient History Table:

- PatientHistories Table
- Id (int, Primary Key, Identity)
- GPD (nvarchar(max))
- GRDA (nvarchar(max))
- IPD (nvarchar(max))
- IRDA (nvarchar(max))
- Seizure (nvarchar(max))
- Other (nvarchar(max))
- DateRecorded (datetime2)
- PatientId (int, Foreign Key)

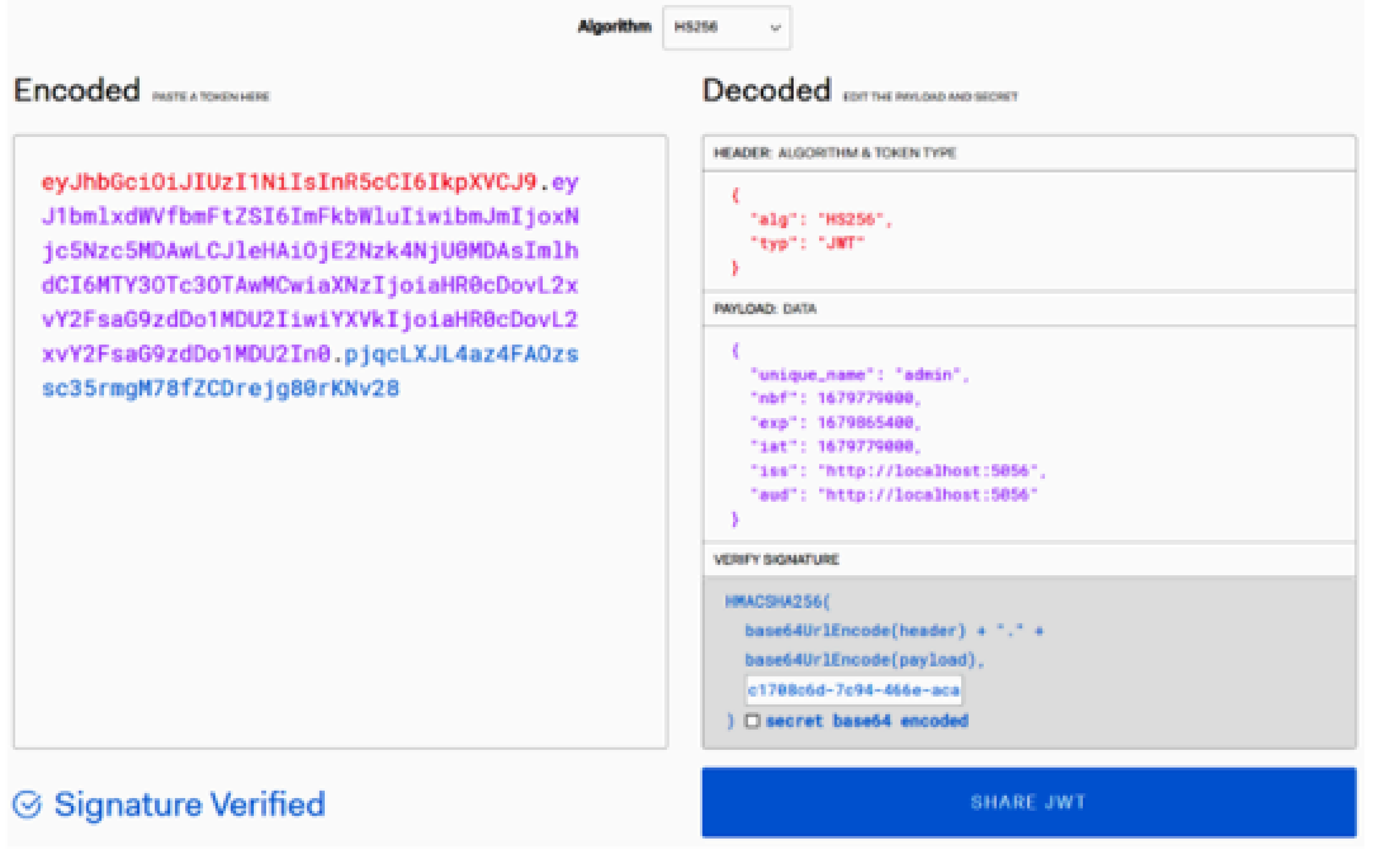


SECURITY IMPLEMENTATION

Authentication: For some resources, we want to restrict access to only authenticated users.

Authorization: API endpoints are protected using the [Authorize] attribute. The middleware validates the JWT on each request, ensuring that only authenticated users can access these resources

Password Storage: Passwords are *never* stored in plaintext. The BCrypt.Net library is used to generate a strong, salted hash of the user's password during registration. During login, the provided password is compared against the stored hash using BCrypt.Verify



CHALLENGES

Integrating an AI Model with a C# Application

Approach 1

Using Flask with API Endpoints on a Python Server Flask is a Python web framework that allows you to create a server with API endpoints to serve predictions from an AI model. This approach is ideal when you want to decouple the AI model (running on a Python server) from the C# application, enabling seamless communication over HTTP.

Approach 2

Using the ONNX Package The ONNX (Open Neural Network Exchange) format allows you to run pre-trained AI models directly within a C# application using the ONNX Runtime, eliminating the need for a separate server. This approach is suitable for scenarios requiring low latency or oline capabilities.

COST STRUCTURE

BRAIN PULSE

Componant	Cost	Componant	Cost
OP07X2	200	CapacitorX15	70
AD620	120	CD4051	150
electrodes(17)	3600	Upgrade Server	660
3D	5000		
ESP32	360		
ResistanceX35	50		

REVENUE STREAMS

BRAIN PULSE

BUSINESS MODEL: B2B-FOCUSED EEG HELMET & APPLICATION

DEVICE RENTAL (LEASING MODEL)

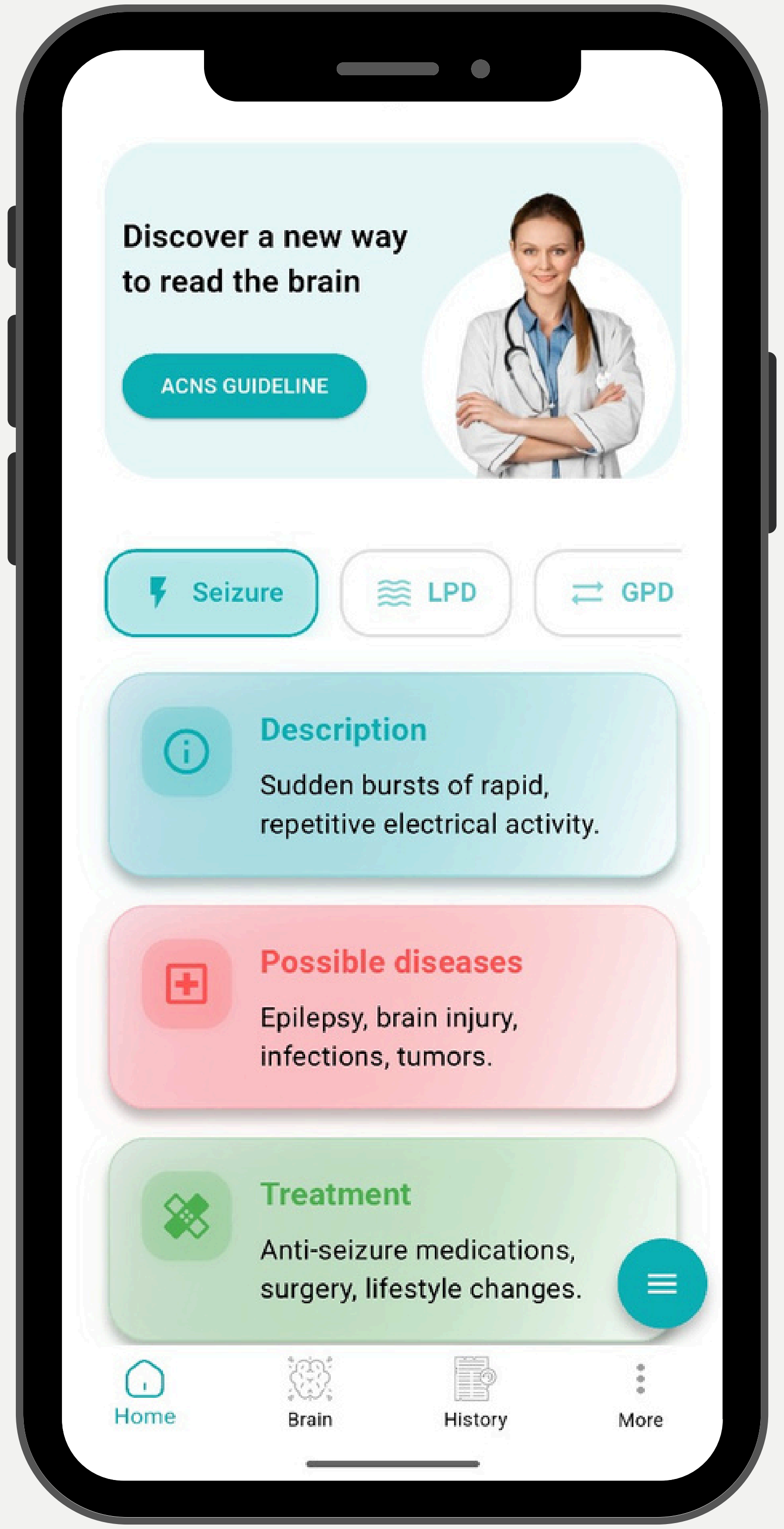
- Instead of full purchase, clinics can rent the EEG helmet on a monthly or quarterly basis. This reduces upfront cost and makes it easier to adopt in the pilot phase.

HARDWARE UPGRADE PROGRAM

- After 3–6 months, clinics can pay for upgraded or additional devices (e.g., newer sensors, more channels).

PAY-PER-UPLOAD

- Charge a fee for each EEG session analyzed through the app (e.g., $5–$10 per session).



INCUBATION
PARTNERSHIP

BRAIN PULSE

CREATIVA
مراكز إبداع مصر الرقمية

LABTRONIC

CREATIVA

- Guided us through the early stages of development
- Helped us refine our idea and structure our plan
- CONNECTED US WITH **LABTRONIC** FOR HARDWARE DESIGN AND PROTOTYPING

LABTRONIC

- Helped us validate the concept & build our Gen 1 prototype
- Provided guidance, technical support
- Provided guidance, technical support

BRAINPULSE
GENERATION 2 OVERVIEW

BRAIN PULSE

01

AI & Signal Processing Enhancements

. Confidence Score + Similar Case

- Shows confidence for each class
- Displays similar labeled EEG sample for transparency

Data-Driven Diagnosis Support

- Uses historical case patterns + clinician labels
- Recommends likely diagnosis based on matched cases

02

Hardware Upgrades – BrainPulse Gen 2

Multi-Channel Helmet 4–8 channels for richer, more accurate brain signal capture

Active Electrodes

Built-in preamps for cleaner, low-noise signals

Wireless & Battery Boost

Bluetooth/Wi-Fi, long battery life, and safe isolation

Compact & Shielded Design

Smaller PCB with reduced interference and better portability

03

Software & Clinical Integration

Mobile App

Live EEG view, session history, instant PDF reports

Doctor Dashboard

Compare sessions, annotate patterns, view AI insights

Real-Time Alerts

Instant warnings for abnormal activity with risk levels

Session Summary

Band trends, frequency analysis, suggested diagnosis + similar cases

LABTRONIC

M.E.T
MISR ENGINEERING & TECHNOLOGY

BRAIN
PULSE

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Thank You