Using EEG headset Based on AI and IoT techniques to help the handicapped

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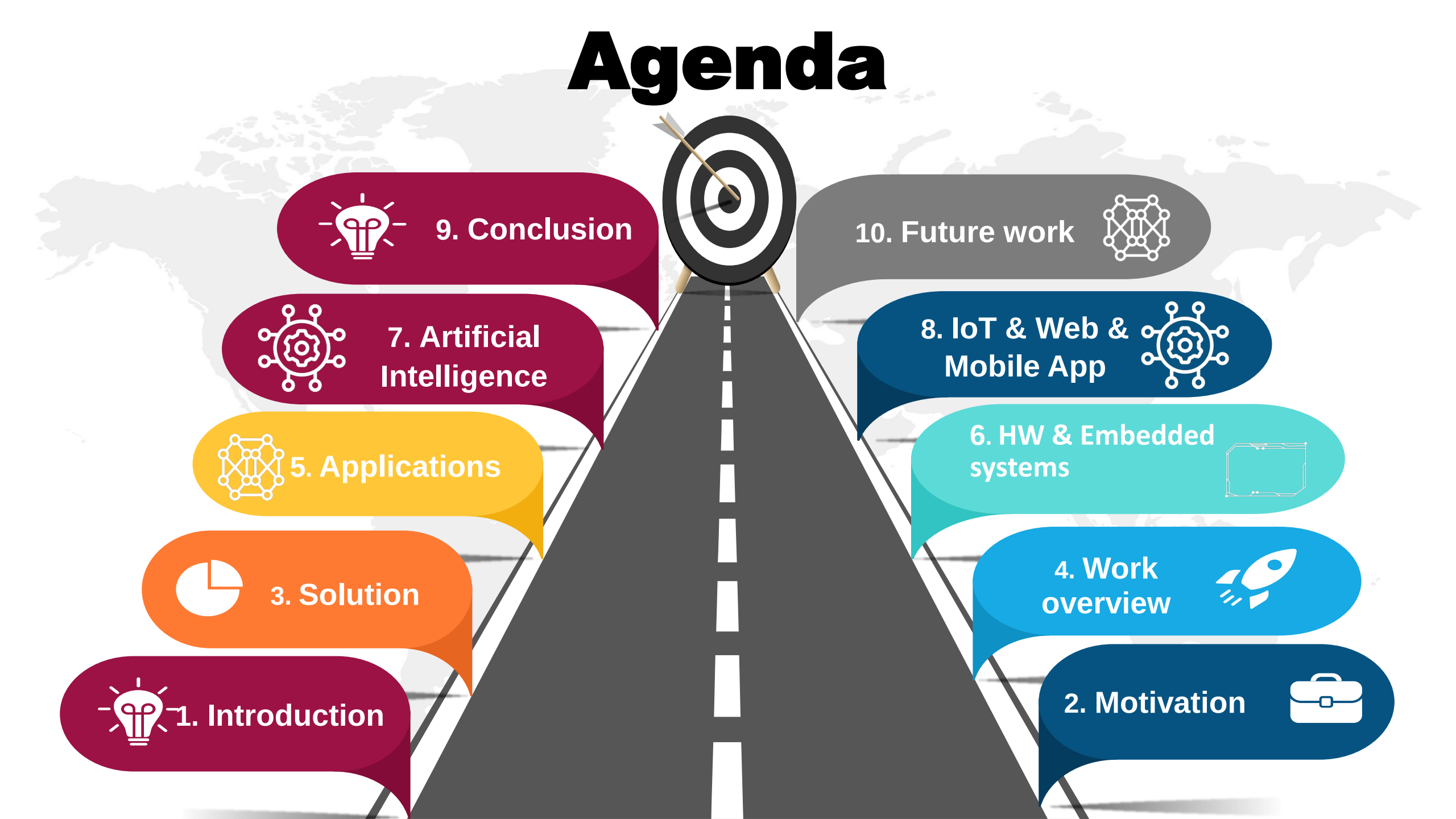
Dedicated to our colleague Ahmed Magdy

Agenda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10. Future work
7. Artificial Intelligence
8. IoT & Web & Mobile App
5. Applications
6. HW & Embedded systems
3. Solution
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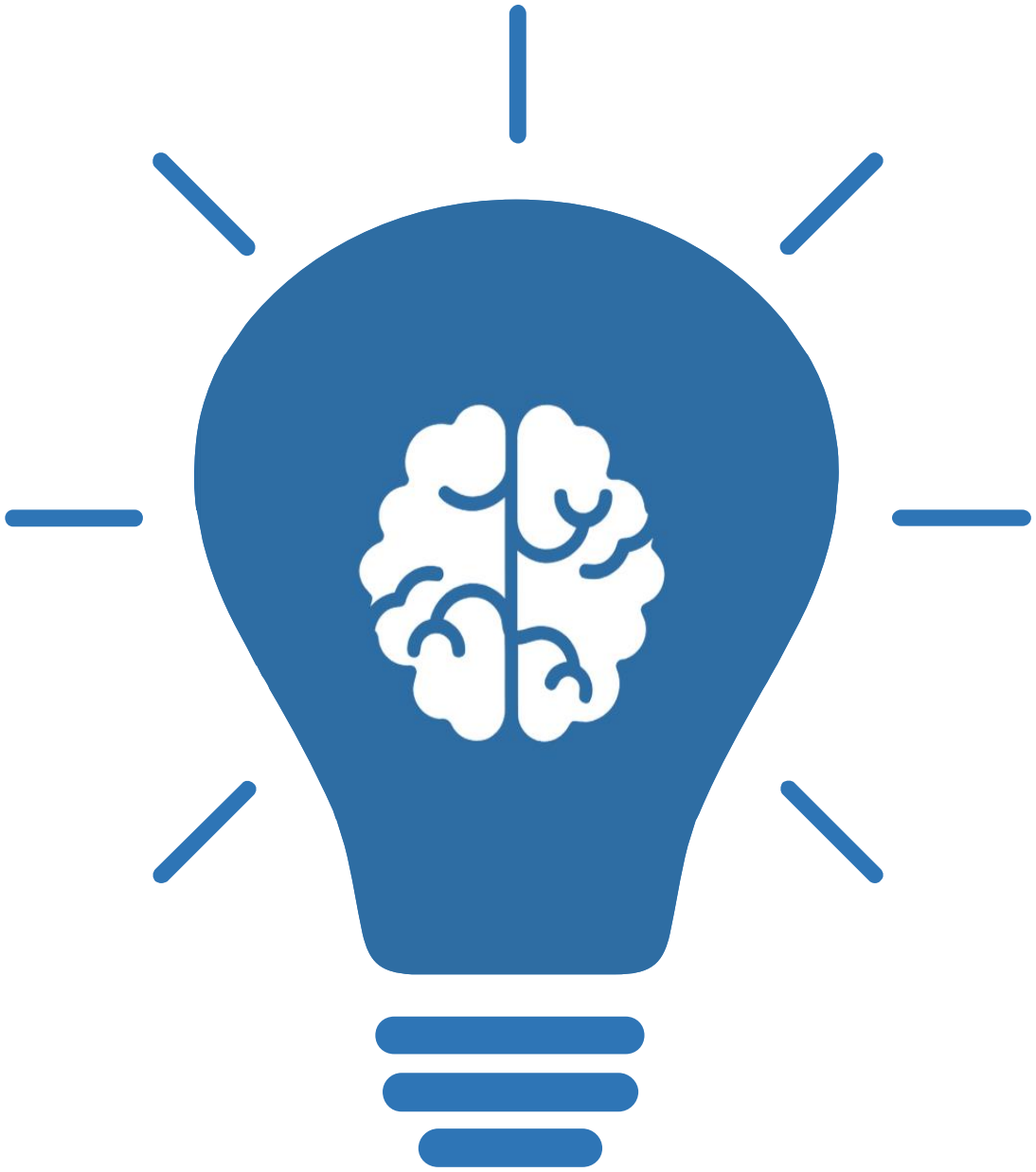
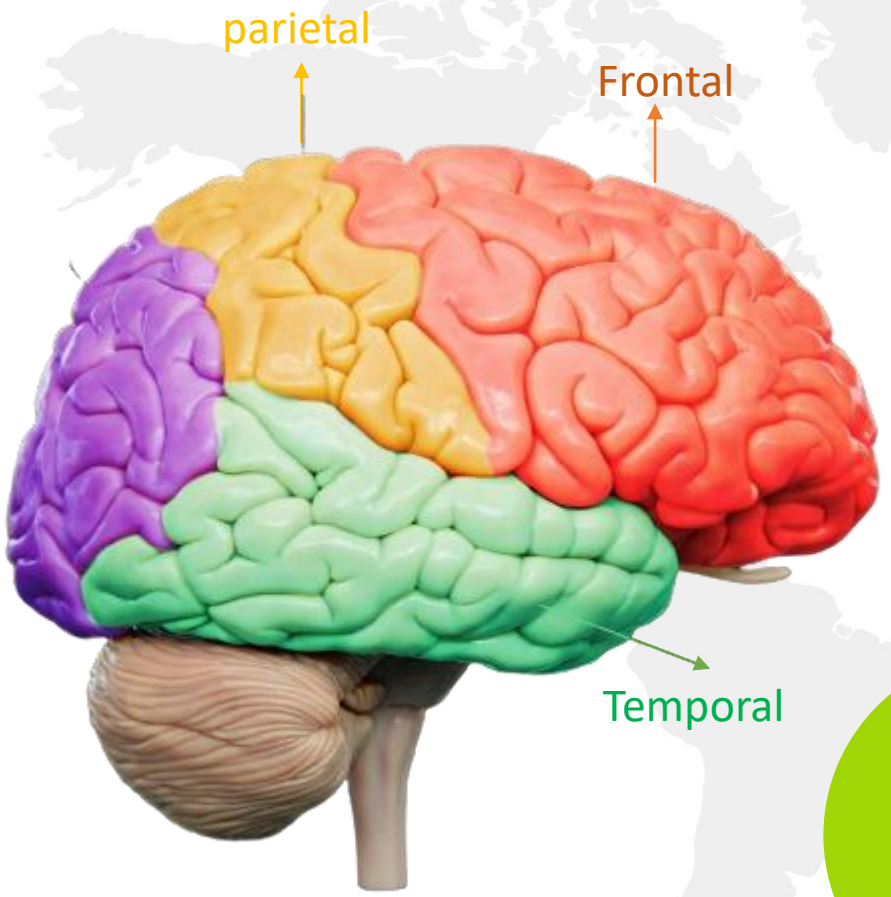
1. Introduction
2. Motivation



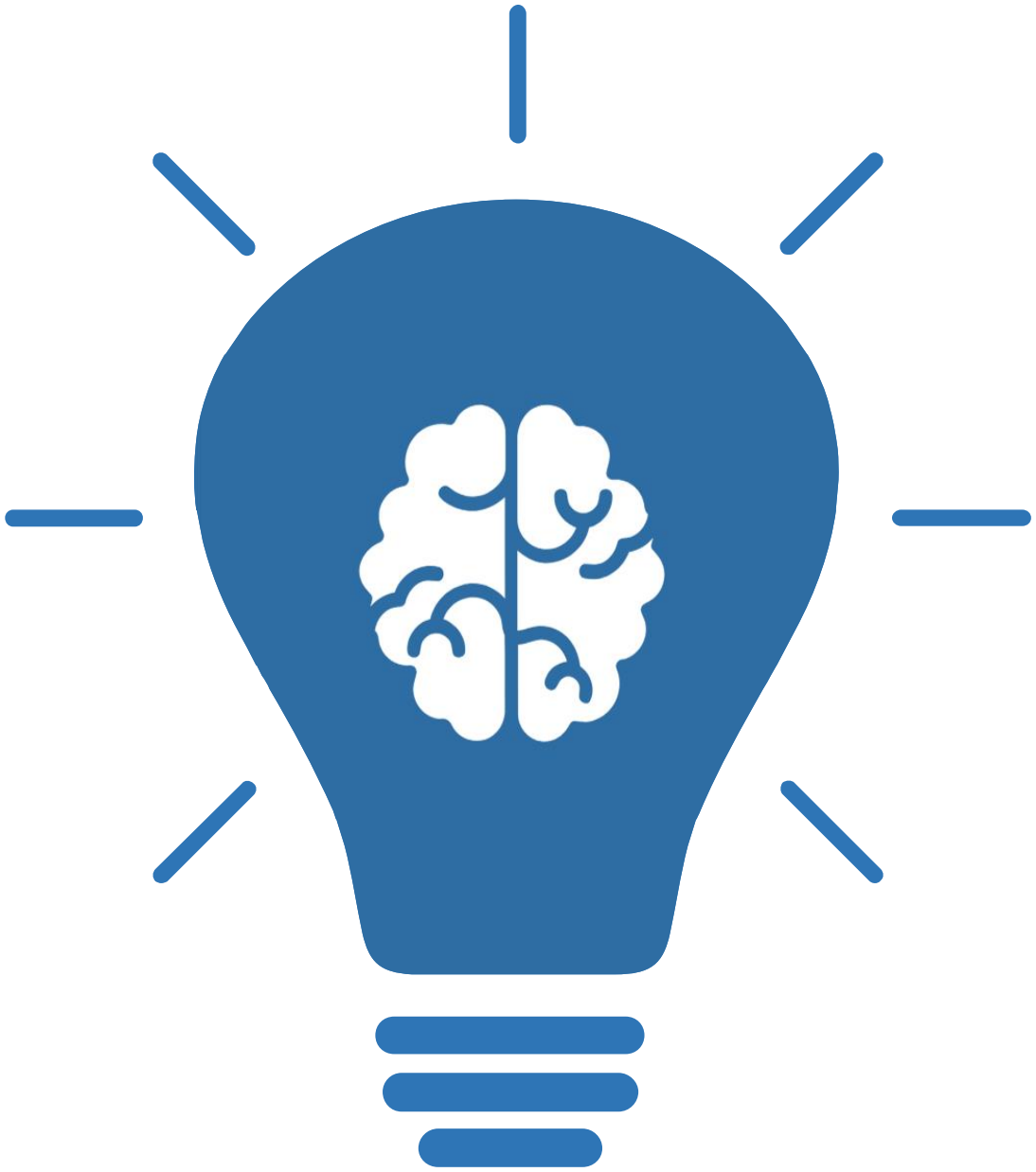
Introduction

Introduction



01 BCI Concept

02 Temporal, Frontal, Parietal lobes

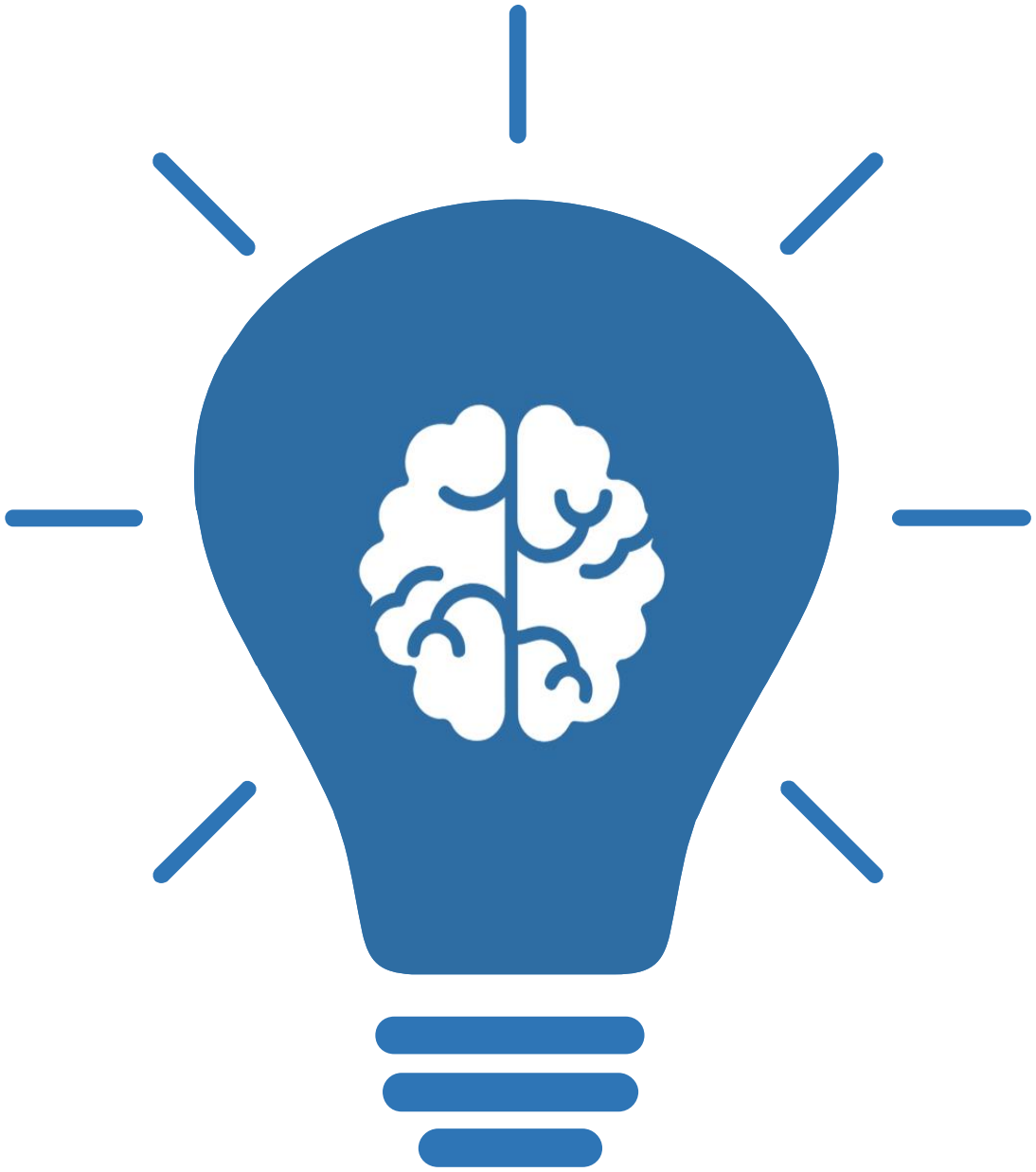


Motivation

Motivation

Handicapped with different types.

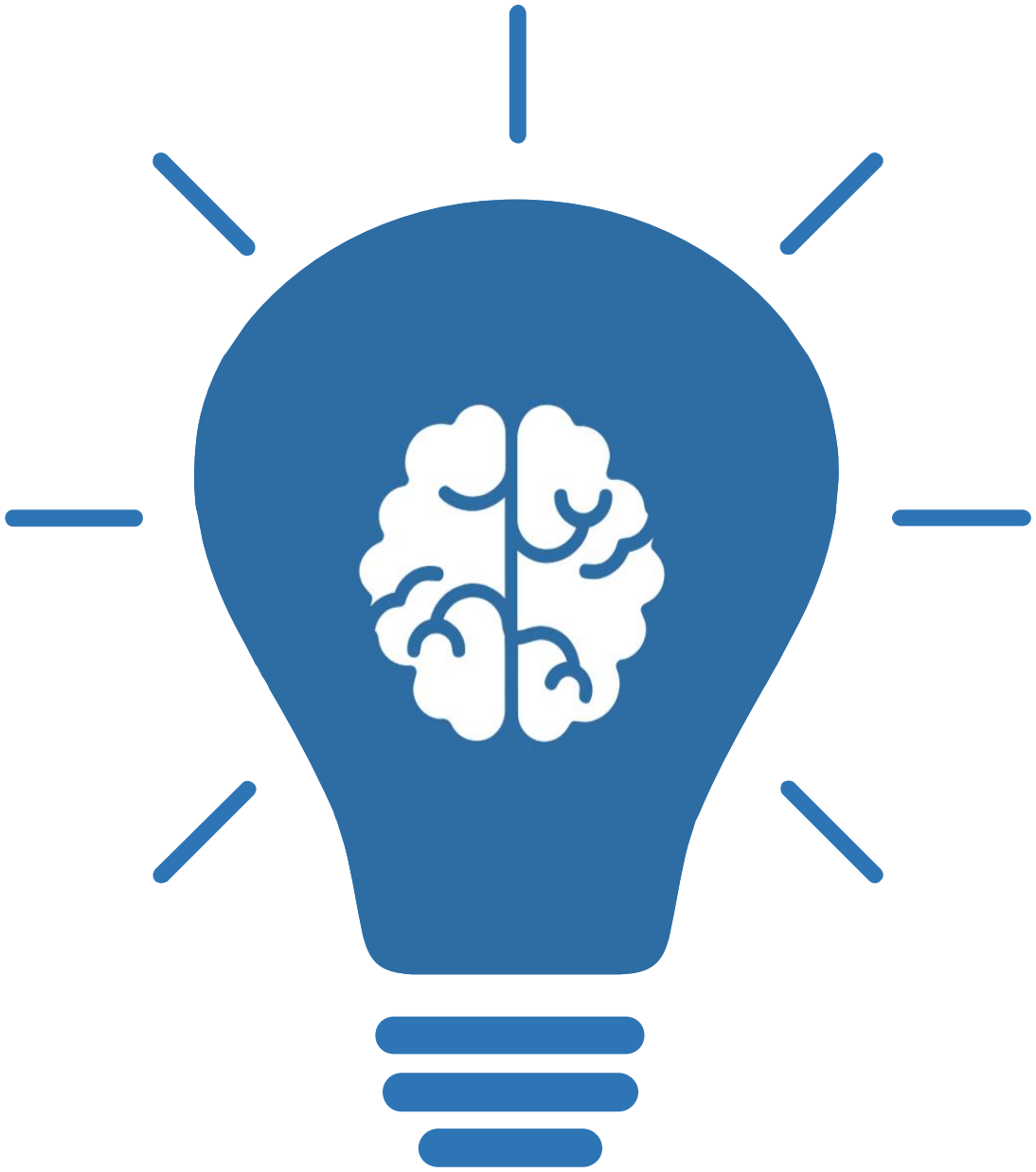
Multiple paralysis types.



Solution

Solution

With the growth of technology and artificial intelligence, we applied BCI concept and combined IOT and AI approaches to create a project that receives signals from the human mind through a headset, converting it to numerical data by cortex, sending it to the Firebase, and then microcontroller to read and translate the event of each application.



Work overview

Work overview

Artificial Intelligence

Classify brain signals

HW & Embedded Systems

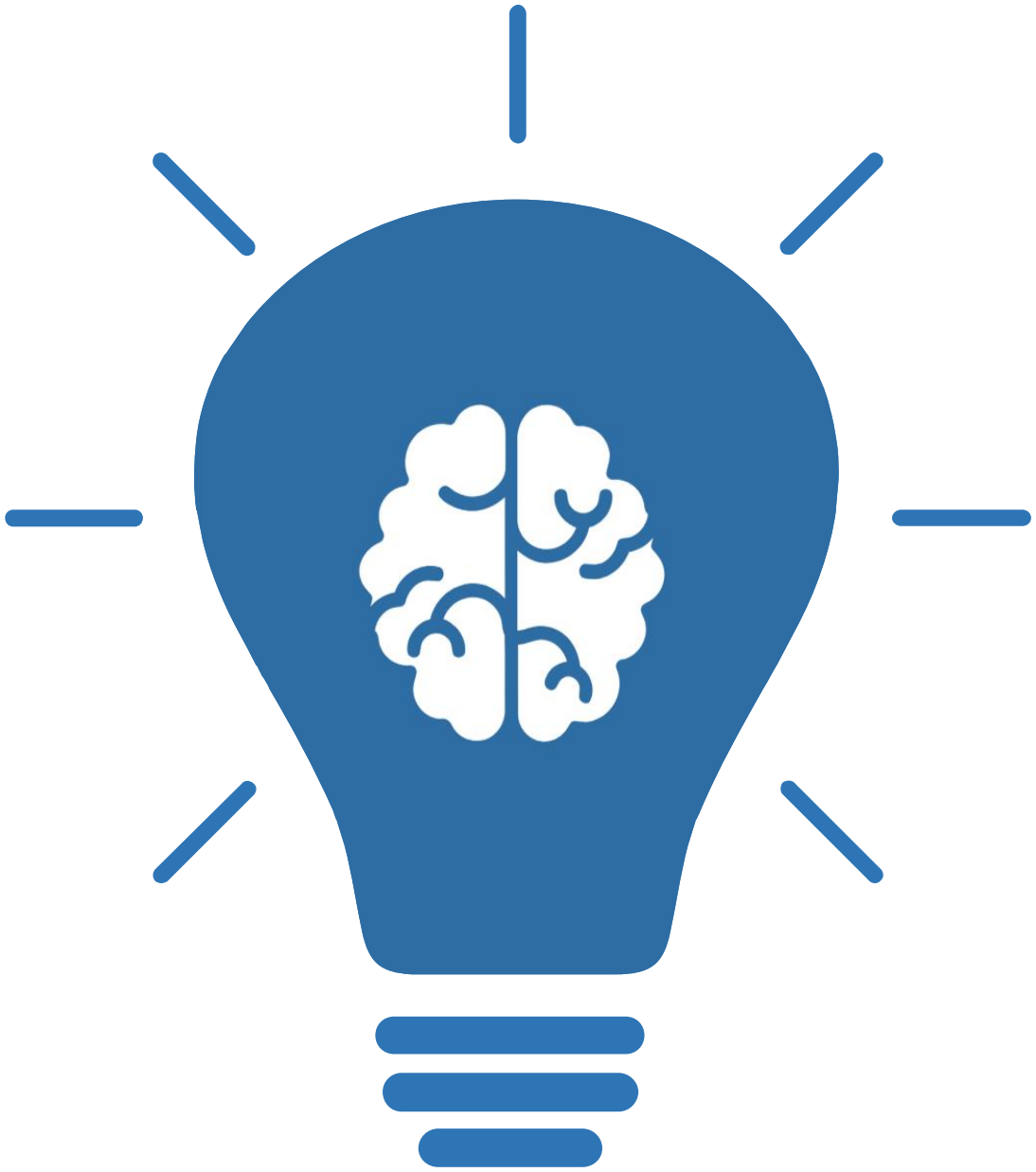
Sensors & Actuators programming and installation

Web Application & IoT

Simulate real actions

Mobile Application

Simulate real actions



Applications

1

Smart home

By receiving signals and employing automation, you can operate appliances at your home by simply thinking about them.

2

Smart car

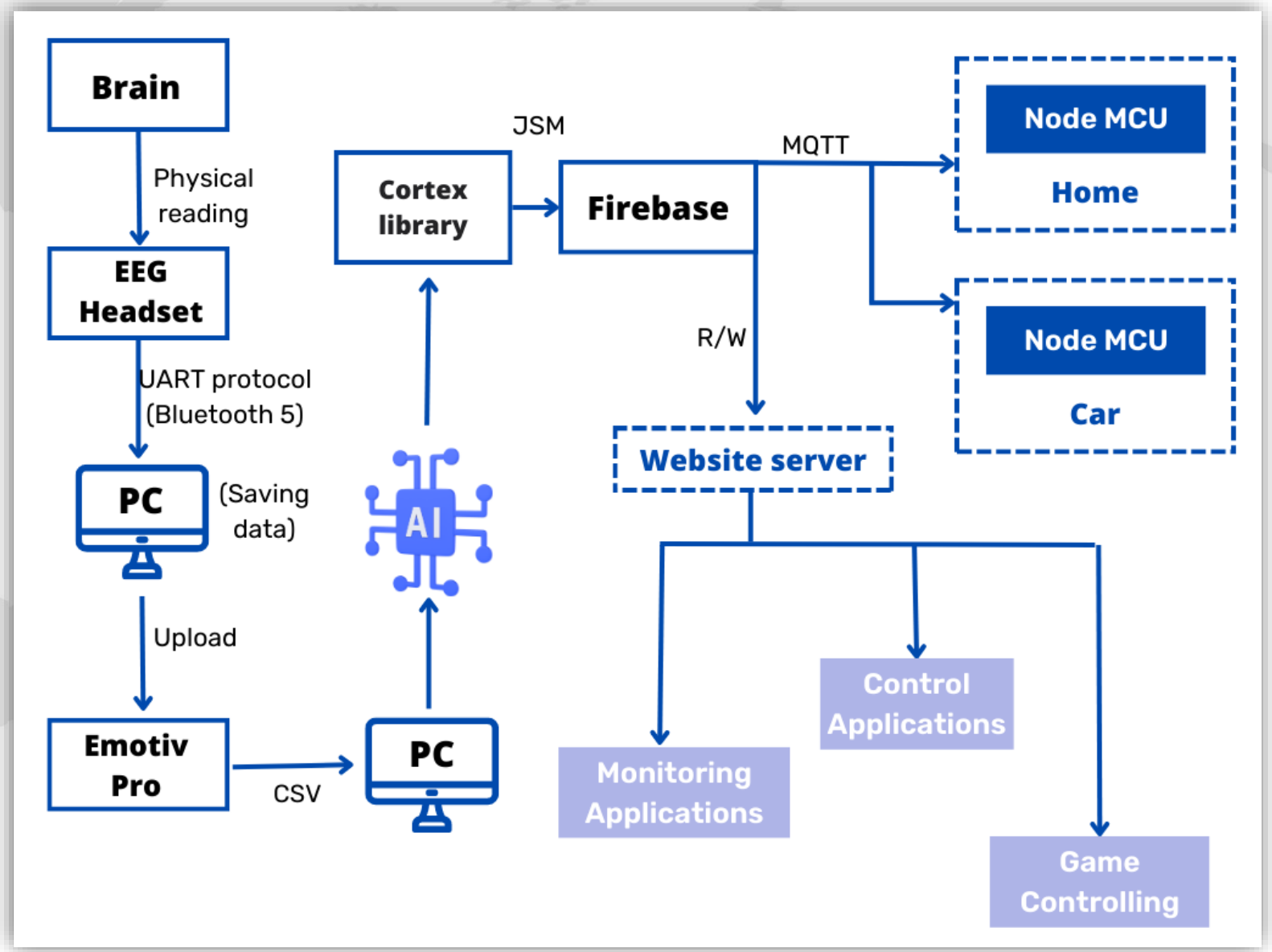
You can drive your car the way you think.

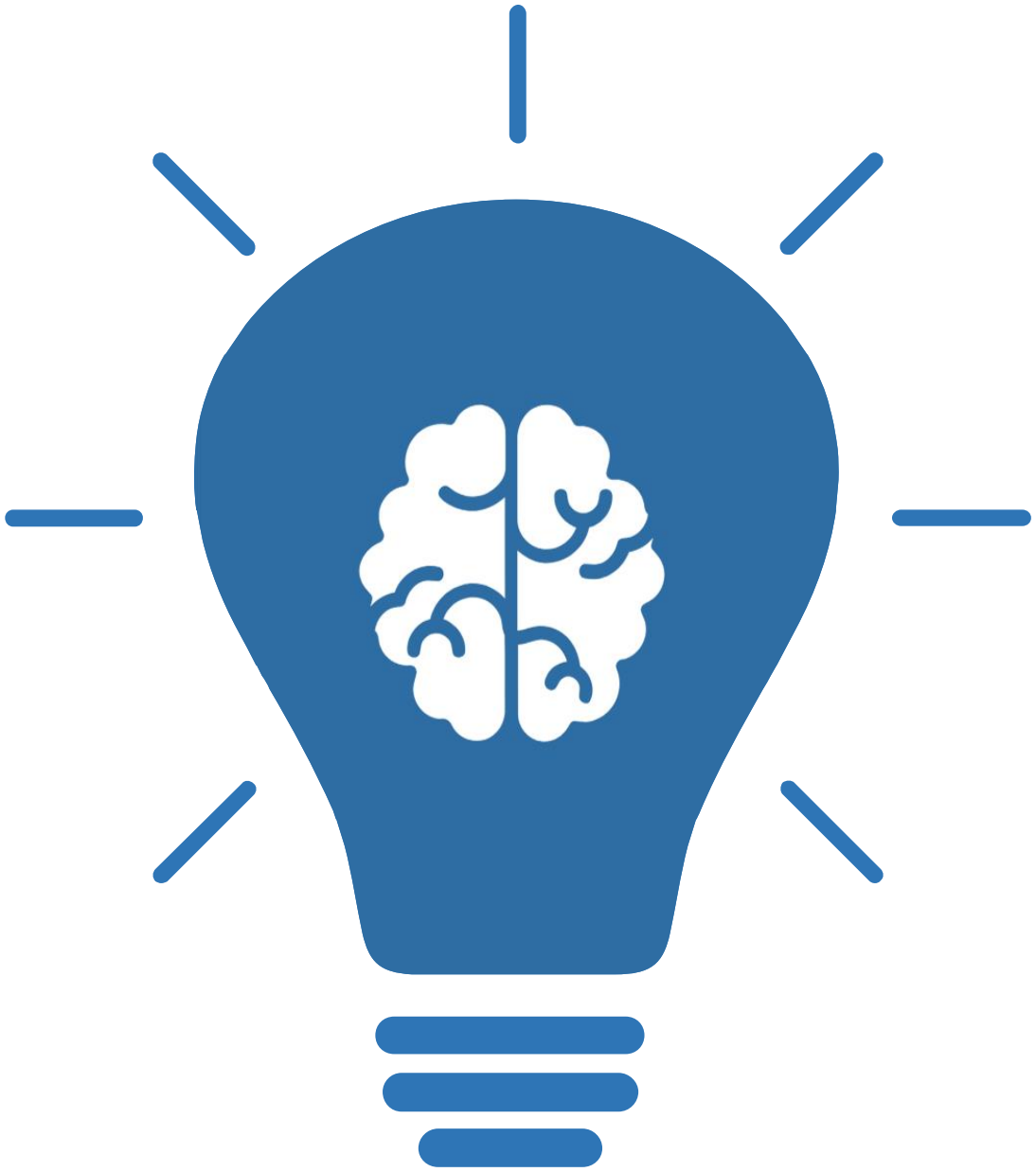
3

Game

we worked on creating a game that can be played by your EEG signals.

Project infograph



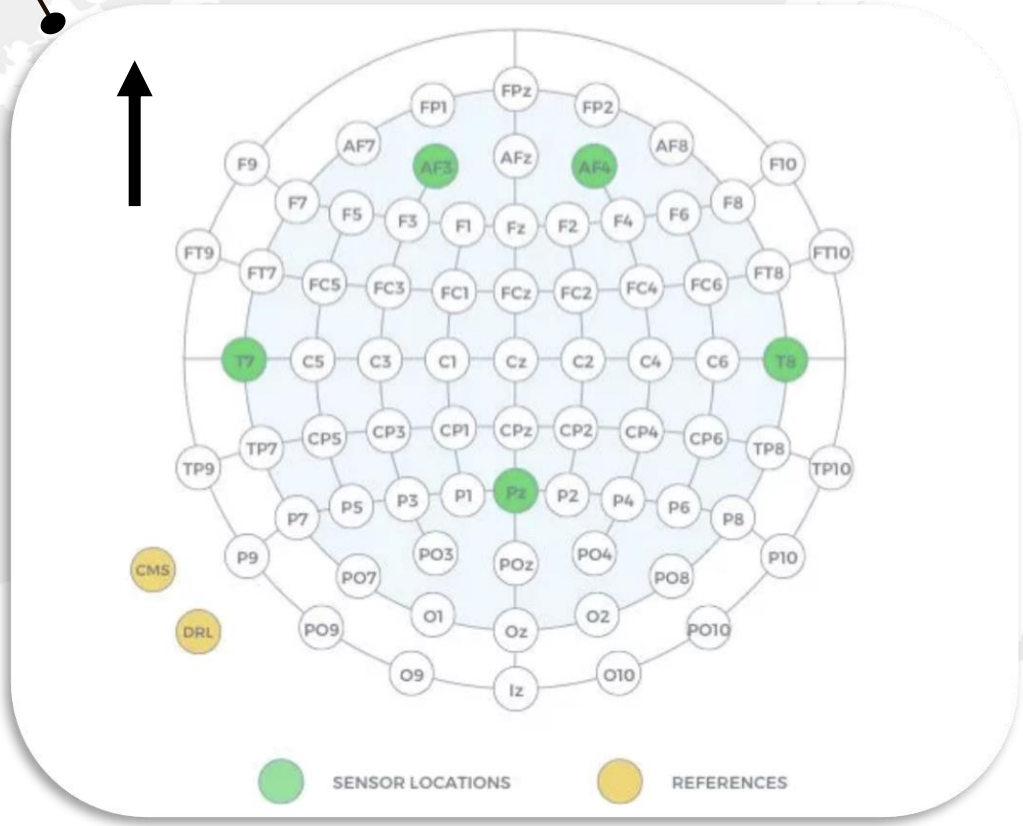


HW & Embedded systems

EMOTIV Headset

Insight is EMOTIV's 5-channel consumer EEG (Electroencephalogram) headset

Insight provides coverage of the frontal, temporal and parietal lobes. It has five sensors (AF3, AF4, T8, Pz and T7) and two reference sensors (CMS and DRL). The sensor locations can be seen in the sensor map above. Insight uses the international 10/20 system.

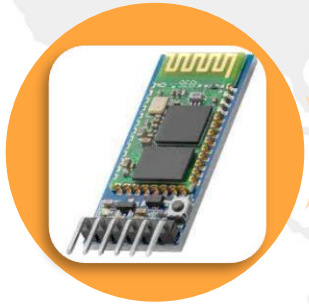


Hardware Categories

Sensors and Inputs

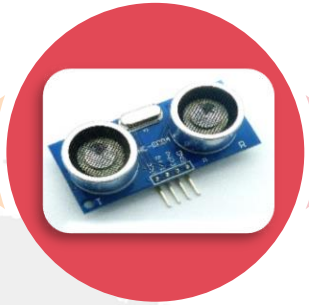
HC-05 Bluetooth module

The HC-05 is a class 2 Bluetooth module designed for transparent wireless serial communication



Ultrasonic sensor

It is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal.

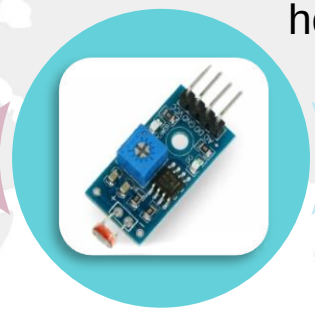


LM35

It is a temperature measuring device having an analog output voltage proportional to the temperature.

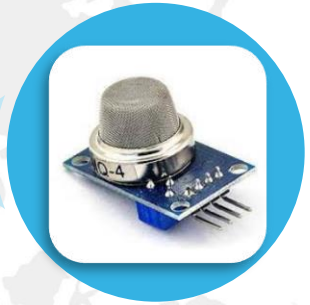
LDR sensor module

It is a low-cost digital sensor as well as analog sensor module, which is capable to measure and detect light intensity.



MQ-4 Gas sensor module

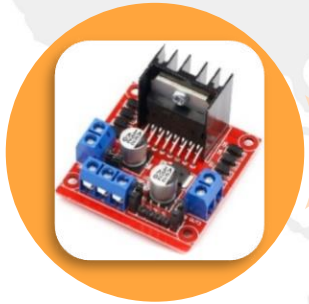
It is a Metal Oxide Semiconductor (MOS) type Gas Sensor mainly used to detect the Methane (CNG) gas concentration in the air at home.



Actuators

Motor_Driver

It is used to control motion of a motor and its direction by feeding current accordingly.



Servo_motor

It is a self-contained electrical device, that rotate parts of a machine with high efficiency and with great precision.

Relay

A Relay is a simple electromechanical switch. While we use normal switches to close or open a circuit manually, a Relay is also a switch.

LCD Graphical screen

A liquid-crystal display (LCD) is a flat-panel display.

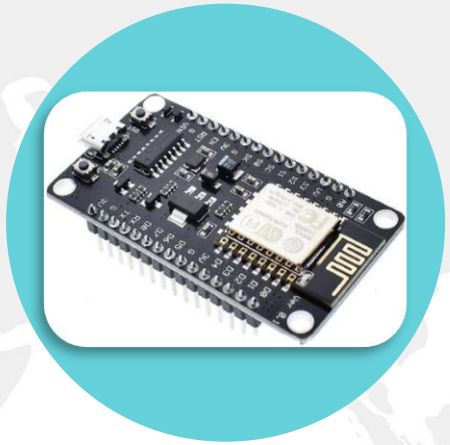
Buzzers

An audio signaling device like a beeper or buzzer may be electromechanical or piezoelectric or mechanical type.

Controllers

PIC18f452

PIC18f452 a high-performance Enhanced Flash Microcontroller with 8 channels of 10-bit Analogue-to-digital (A/D) converter.



ATmega32-8bit AVR

ATmega32 microcontroller is a type of low-power 8-bit CMOS microcontroller. The architecture of this microcontroller is based on enhanced RISC architecture.

ESP8266

The ESP8266 is a low-cost Wi-Fi microchip, with built-in TCP/IP networking software, and microcontroller cap ability.

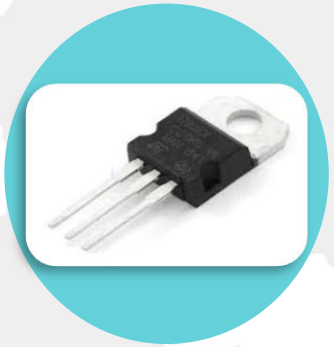
Other Components

Wires

LED

Resistors

Regulators

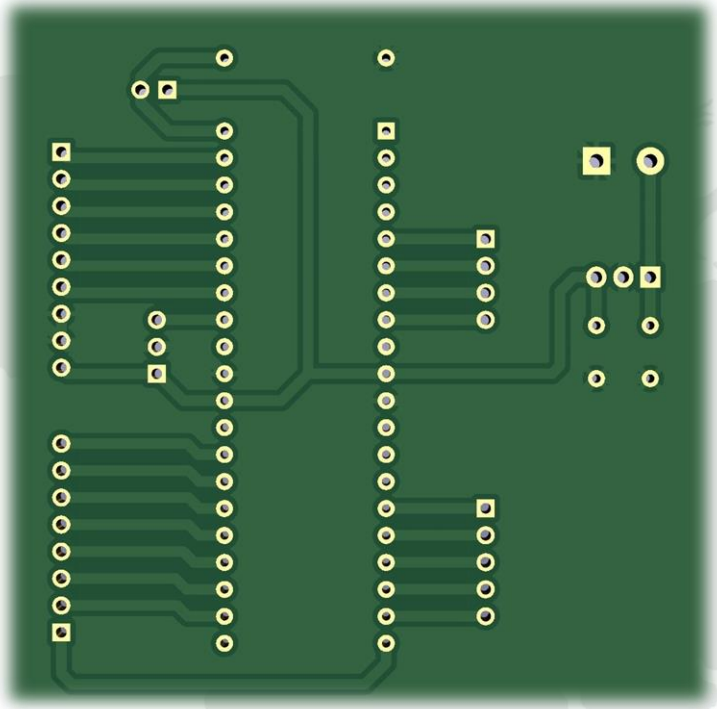


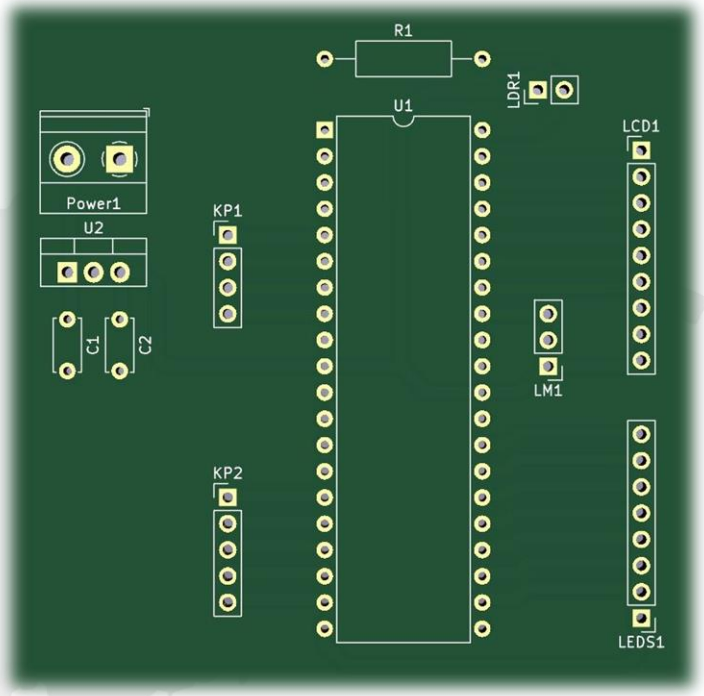
Capacitors

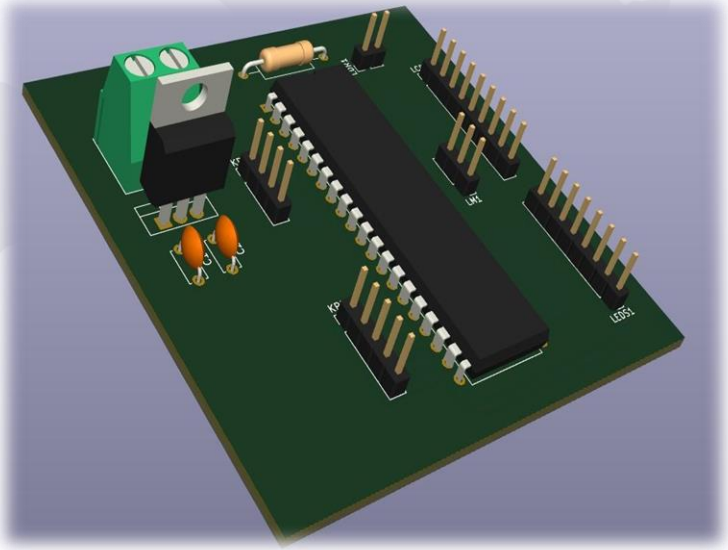
Solar cell

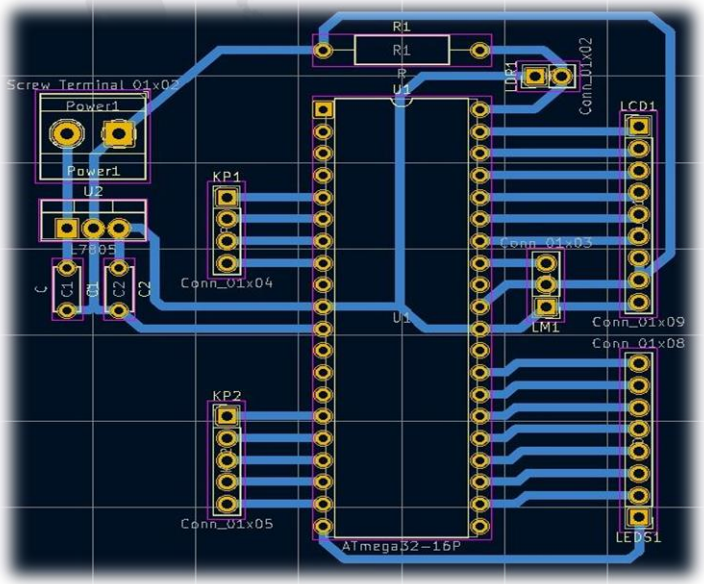
PCB

PCB stands for "Printed Circuit Board". PCBs are the main means of manufacturing electronic circuits in the industry, and are used in many applications, including household electronics, cars, computers, medical devices, industrial control, communications, and many other applications.

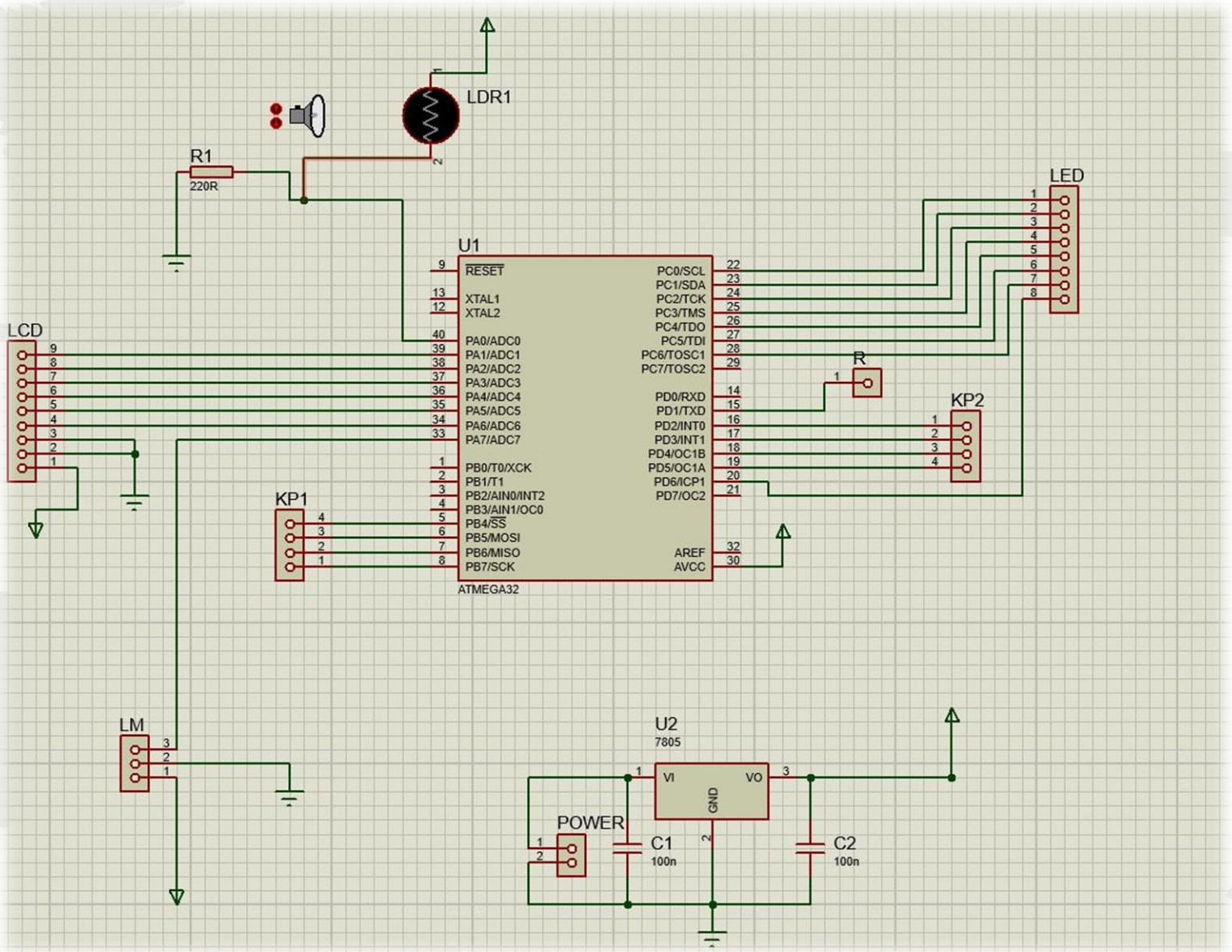




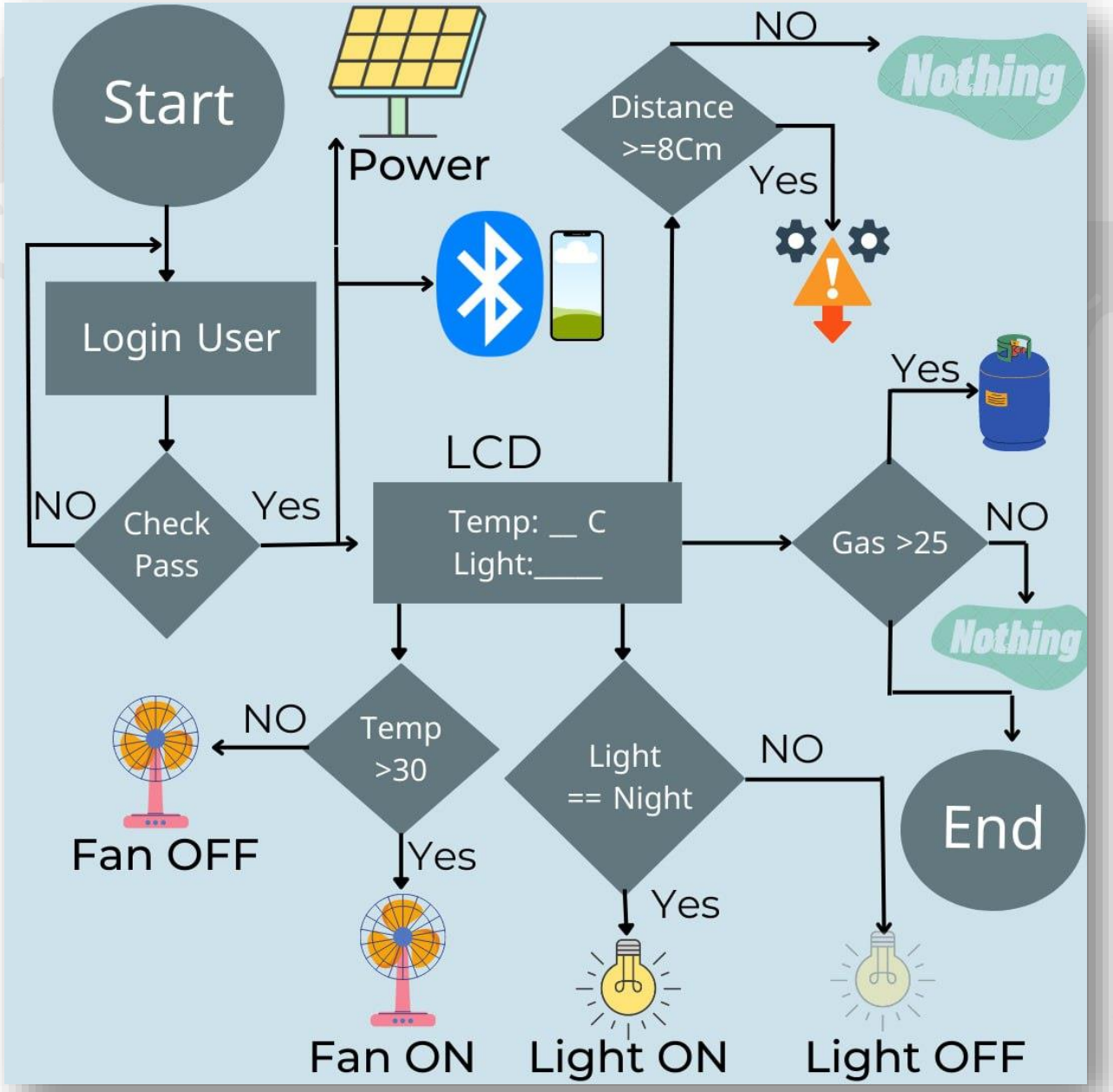




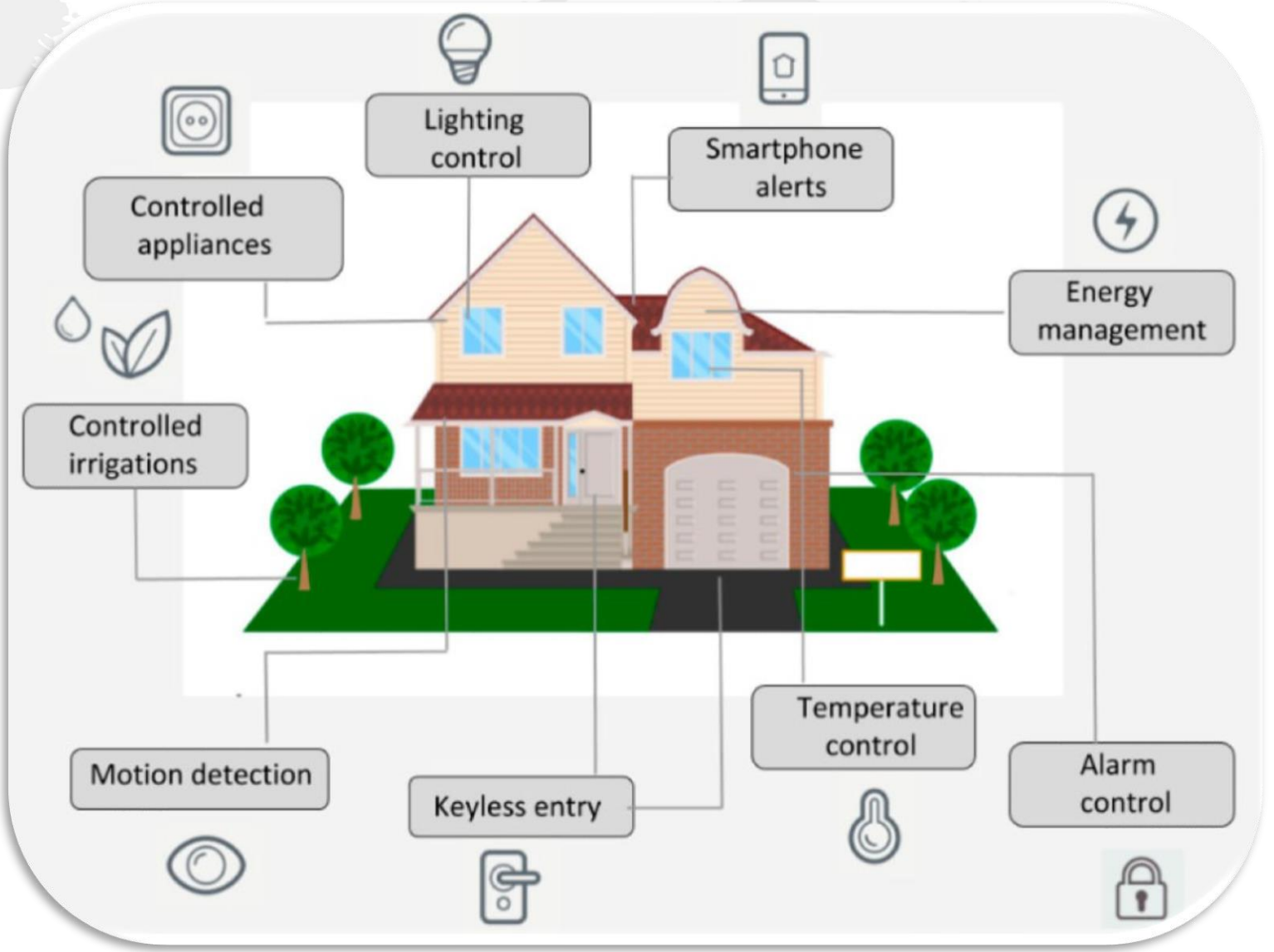
PCB


LDR1
R1
220R
U1
RESET
XTAL1
XTAL2
PA0/ADC0
PA1/ADC1
PA2/ADC2
PA3/ADC3
PA4/ADC4
PA5/ADC5
PA6/ADC6
PA7/ADC7
PB0/T0/XCK
PB1/T1
PB2/AIN0/INT2
PB3/AIN1/OC0
PB4/SS
PB5/MOSI
PB6/MISO
PB7/SCK
PC0/SCL
PC1/SDA
PC2/TCK
PC3/TMS
PC4/TDO
PC5/TDI
PC6/TOSC1
PC7/TOSC2
PD0/RXD
PD1/TXD
PD2/INT0
PD3/INT1
PD4/OC1B
PD5/OC1A
PD6/ICP1
PD7/OC2
AREF
AVCC
ATMEGA32
LED
LCD
KP1
KP2
R
LM
U2
7805
VI
VO
GND
POWER
C1
100n
C2
100n

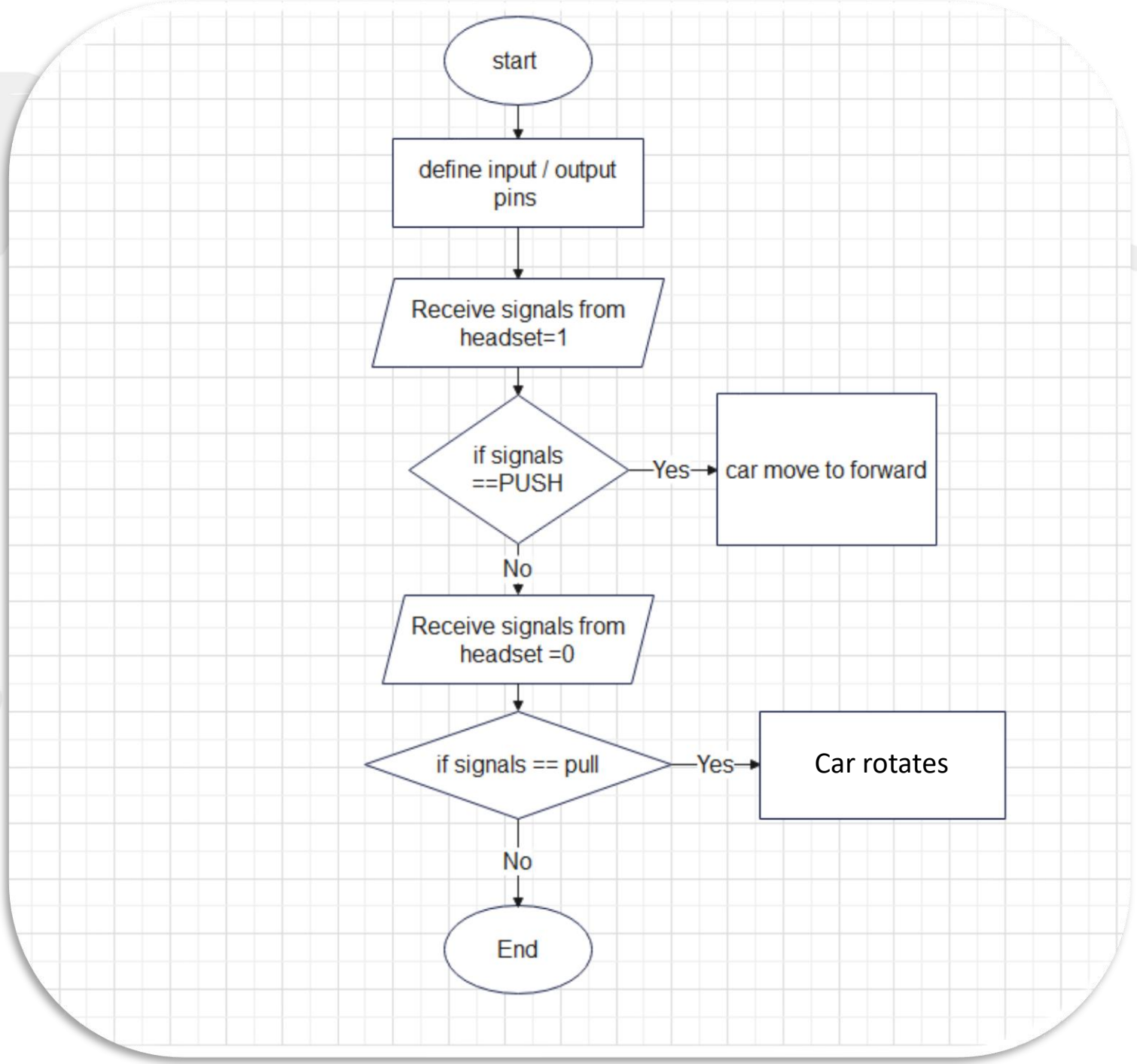
Smart home flowchart



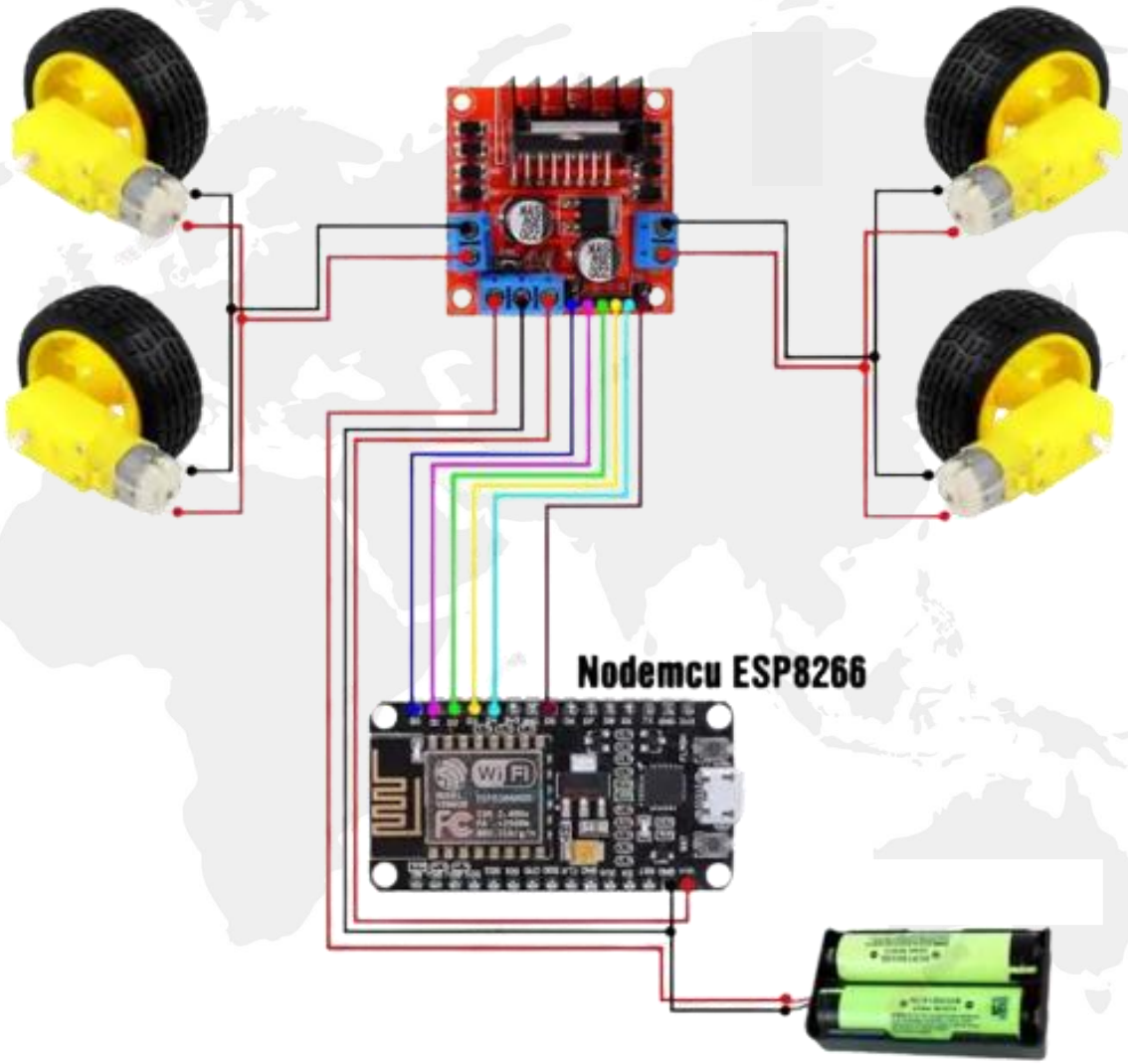
Smart home visual diagram

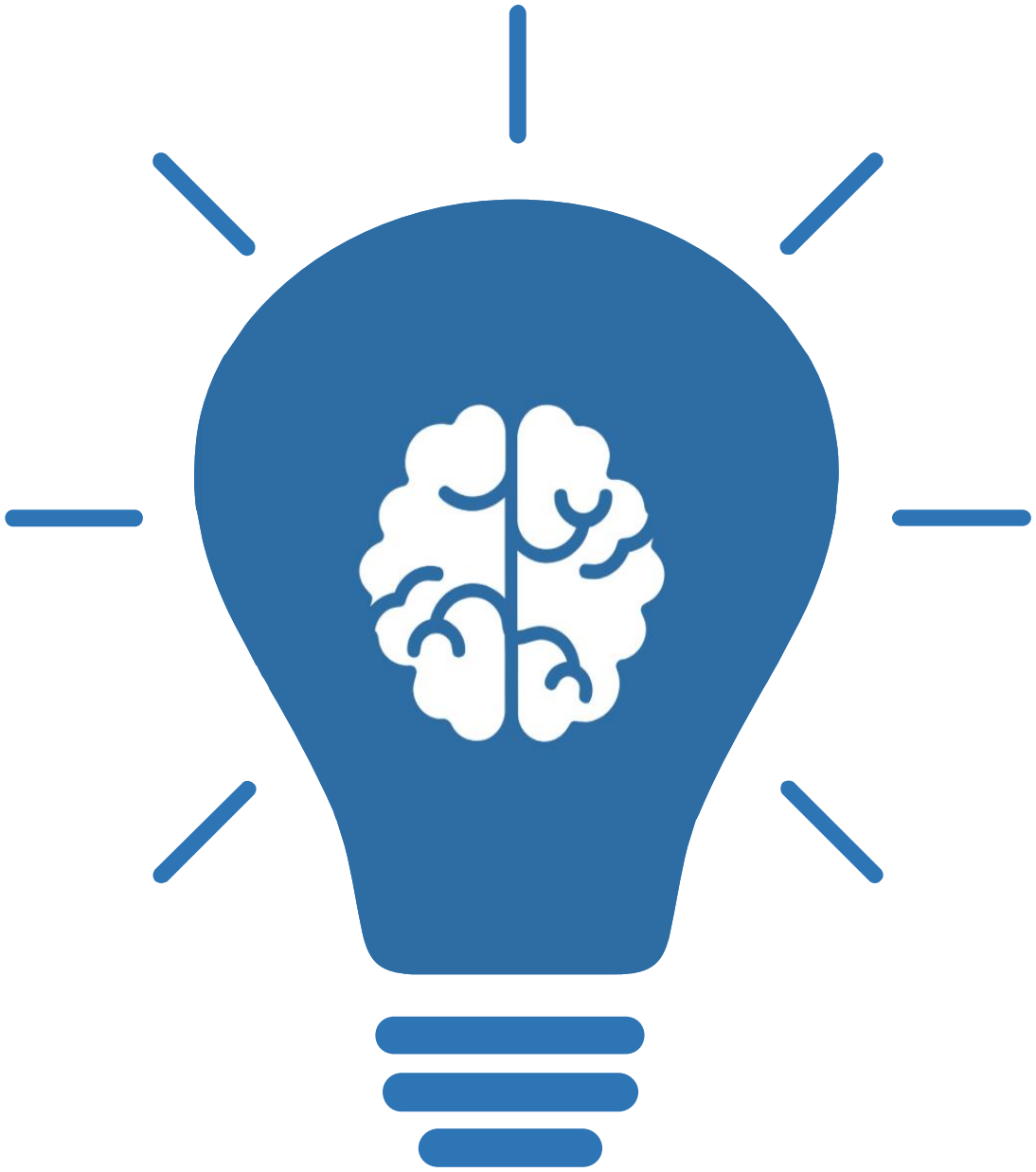


Smart car driver code flowchart



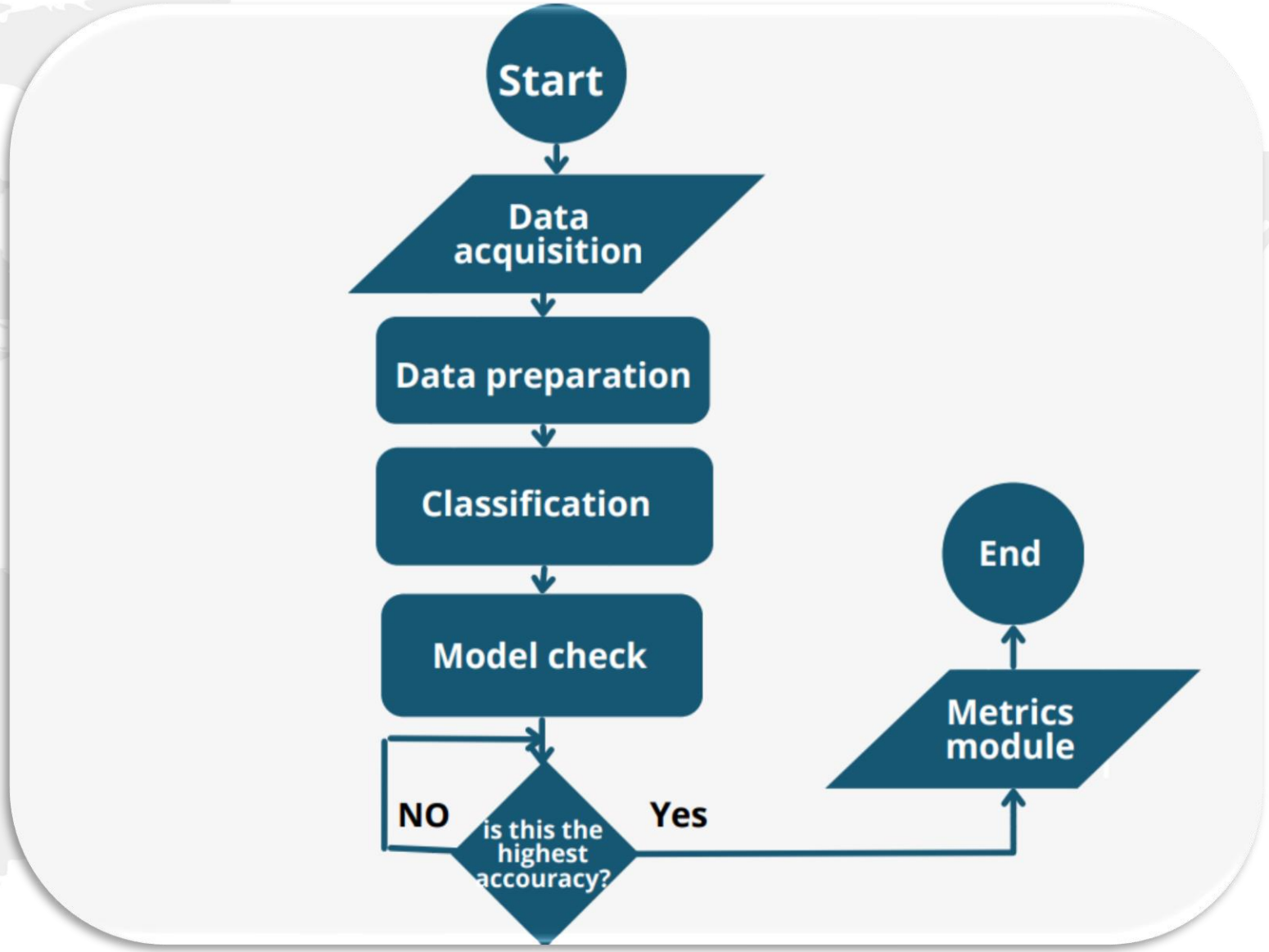
Smart car visual diagram



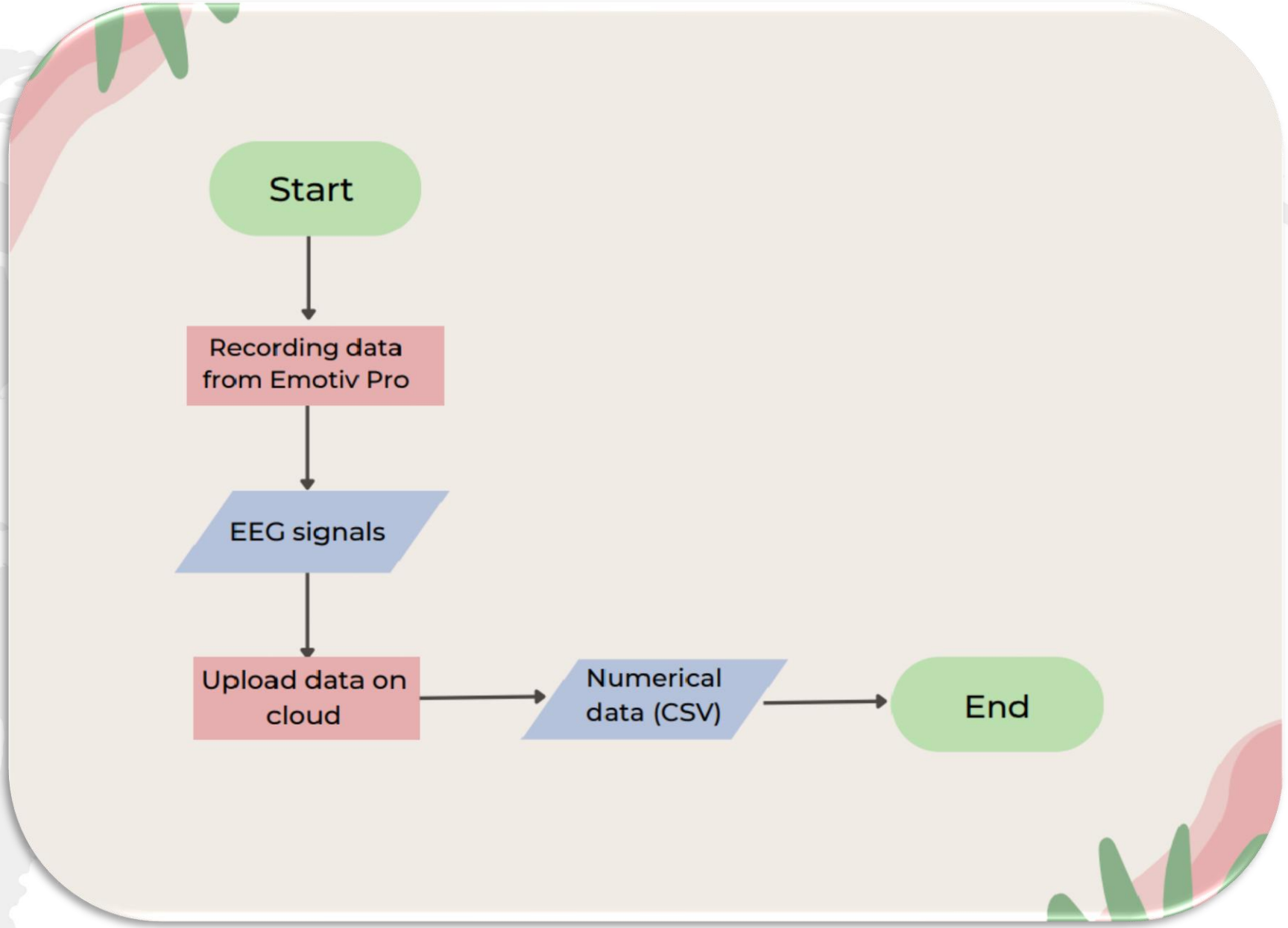


Artificial Intelligence

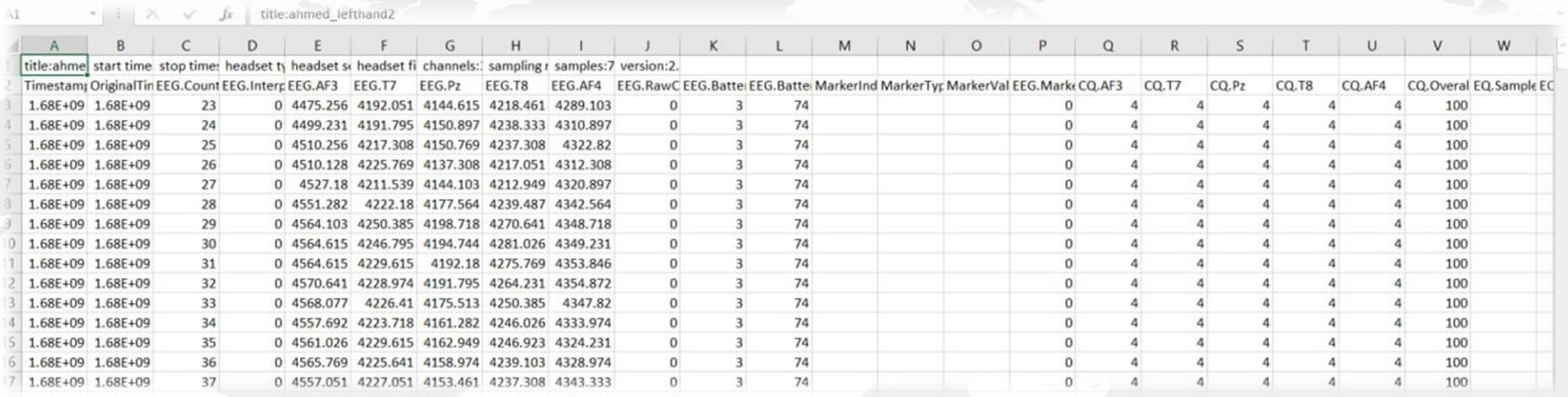
AI Flowchart



Data Acquisition flowchart

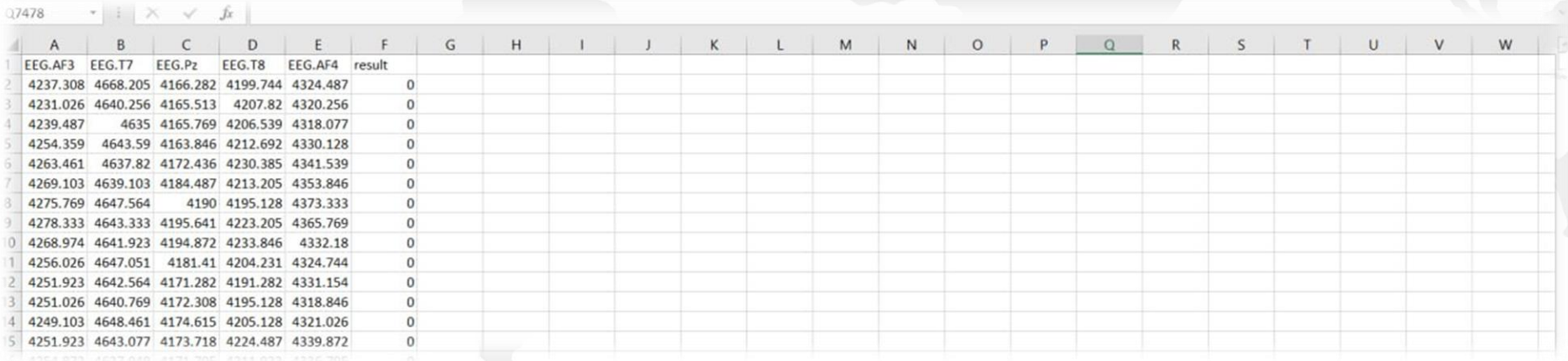


Before data preparation



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	title:ahme	start time	stop time:	headset ty	headset se	headset fi	channels::	sampling r	samples:7	version:2.													
2	Timestamp	OriginalTin	EEG.Count	EEG.Interp	EEG.AF3	EEG.T7	EEG.Pz	EEG.T8	EEG.AF4	EEG.RawC	EEG.Batte	EEG.Batte	MarkerInd	MarkerTyp	MarkerVal	EEG.Mark	CQ.AF3	CQ.T7	CQ.Pz	CQ.T8	CQ.AF4	CQ.Overal	EQ.Sample
3	1.68E+09	1.68E+09	23	0	4475.256	4192.051	4144.615	4218.461	4289.103	0	3	74				0	4	4	4	4	4	100	
4	1.68E+09	1.68E+09	24	0	4499.231	4191.795	4150.897	4238.333	4310.897	0	3	74				0	4	4	4	4	4	100	
5	1.68E+09	1.68E+09	25	0	4510.256	4217.308	4150.769	4237.308	4322.82	0	3	74				0	4	4	4	4	4	100	
6	1.68E+09	1.68E+09	26	0	4510.128	4225.769	4137.308	4217.051	4312.308	0	3	74				0	4	4	4	4	4	100	
7	1.68E+09	1.68E+09	27	0	4527.18	4211.539	4144.103	4212.949	4320.897	0	3	74				0	4	4	4	4	4	100	
8	1.68E+09	1.68E+09	28	0	4551.282	4222.18	4177.564	4239.487	4342.564	0	3	74				0	4	4	4	4	4	100	
9	1.68E+09	1.68E+09	29	0	4564.103	4250.385	4198.718	4270.641	4348.718	0	3	74				0	4	4	4	4	4	100	
10	1.68E+09	1.68E+09	30	0	4564.615	4246.795	4194.744	4281.026	4349.231	0	3	74				0	4	4	4	4	4	100	
11	1.68E+09	1.68E+09	31	0	4564.615	4229.615	4192.18	4275.769	4353.846	0	3	74				0	4	4	4	4	4	100	
12	1.68E+09	1.68E+09	32	0	4570.641	4228.974	4191.795	4264.231	4354.872	0	3	74				0	4	4	4	4	4	100	
13	1.68E+09	1.68E+09	33	0	4568.077	4226.41	4175.513	4250.385	4347.82	0	3	74				0	4	4	4	4	4	100	
14	1.68E+09	1.68E+09	34	0	4557.692	4223.718	4161.282	4246.026	4333.974	0	3	74				0	4	4	4	4	4	100	
15	1.68E+09	1.68E+09	35	0	4561.026	4229.615	4162.949	4246.923	4324.231	0	3	74				0	4	4	4	4	4	100	
16	1.68E+09	1.68E+09	36	0	4565.769	4225.641	4158.974	4239.103	4328.974	0	3	74				0	4	4	4	4	4	100	
17	1.68E+09	1.68E+09	37	0	4557.051	4227.051	4153.461	4237.308	4343.333	0	3	74				0	4	4	4	4	4	100	

After data preparation



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	EEG.AF3	EEG.T7	EEG.Pz	EEG.T8	EEG.AF4	result																	
2	4237.308	4668.205	4166.282	4199.744	4324.487	0																	
3	4231.026	4640.256	4165.513	4207.82	4320.256	0																	
4	4239.487	4635	4165.769	4206.539	4318.077	0																	
5	4254.359	4643.59	4163.846	4212.692	4330.128	0																	
6	4263.461	4637.82	4172.436	4230.385	4341.539	0																	
7	4269.103	4639.103	4184.487	4213.205	4353.846	0																	
8	4275.769	4647.564	4190	4195.128	4373.333	0																	
9	4278.333	4643.333	4195.641	4223.205	4365.769	0																	
10	4268.974	4641.923	4194.872	4233.846	4332.18	0																	
11	4256.026	4647.051	4181.41	4204.231	4324.744	0																	
12	4251.923	4642.564	4171.282	4191.282	4331.154	0																	
13	4251.026	4640.769	4172.308	4195.128	4318.846	0																	
14	4249.103	4648.461	4174.615	4205.128	4321.026	0																	
15	4251.923	4643.077	4173.718	4224.487	4339.872	0																	

AI Libraries

Classification Algorithms

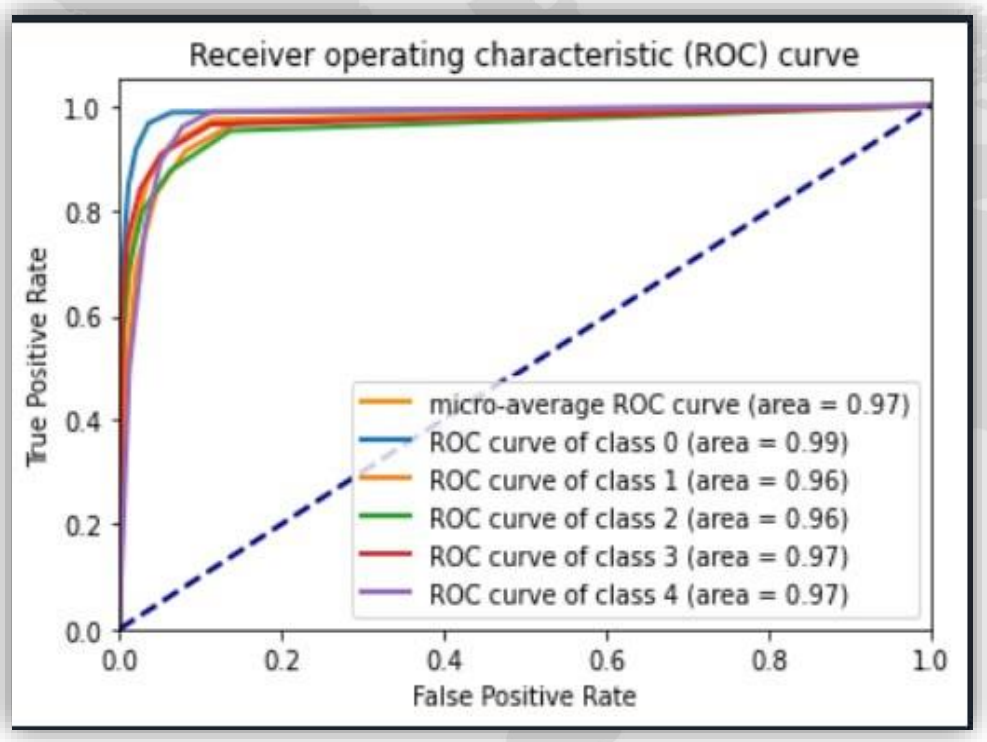
Trails

Polynomial features

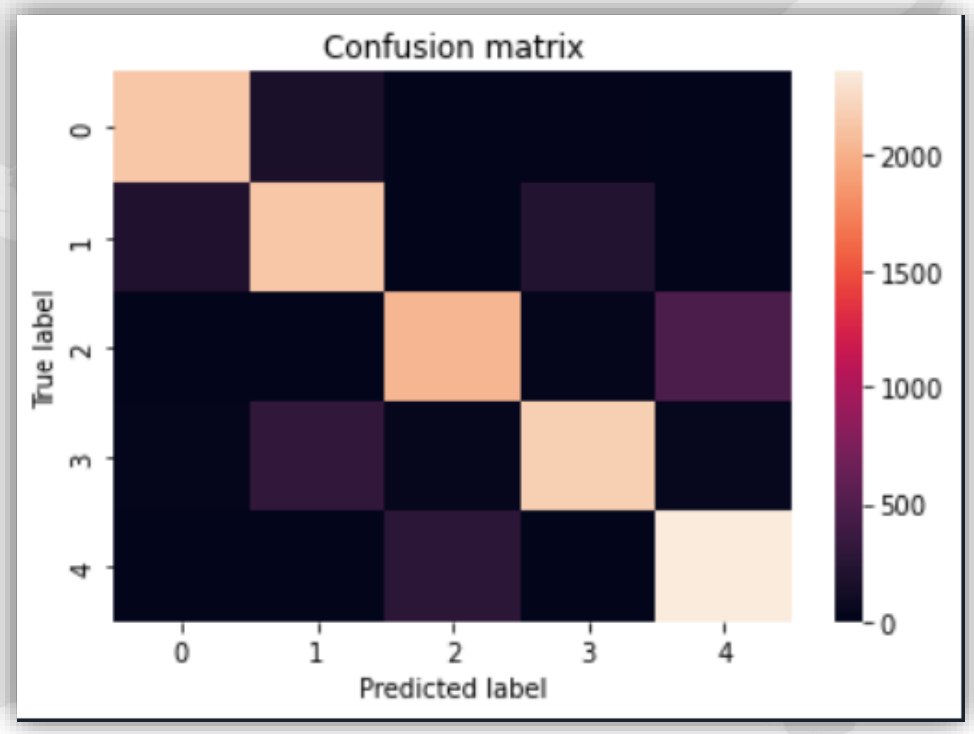
Feature selection by using random forest

Polynomial features

ROC curve



Confusion matrix

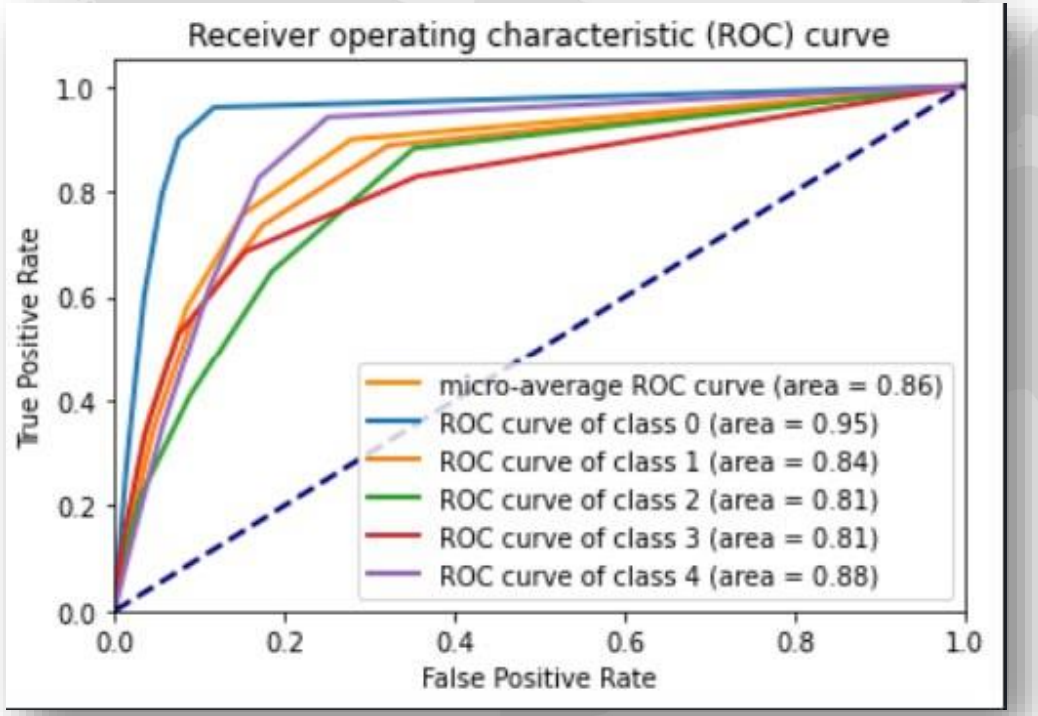


Accuracy score=(TP+TN)/total=85.94%

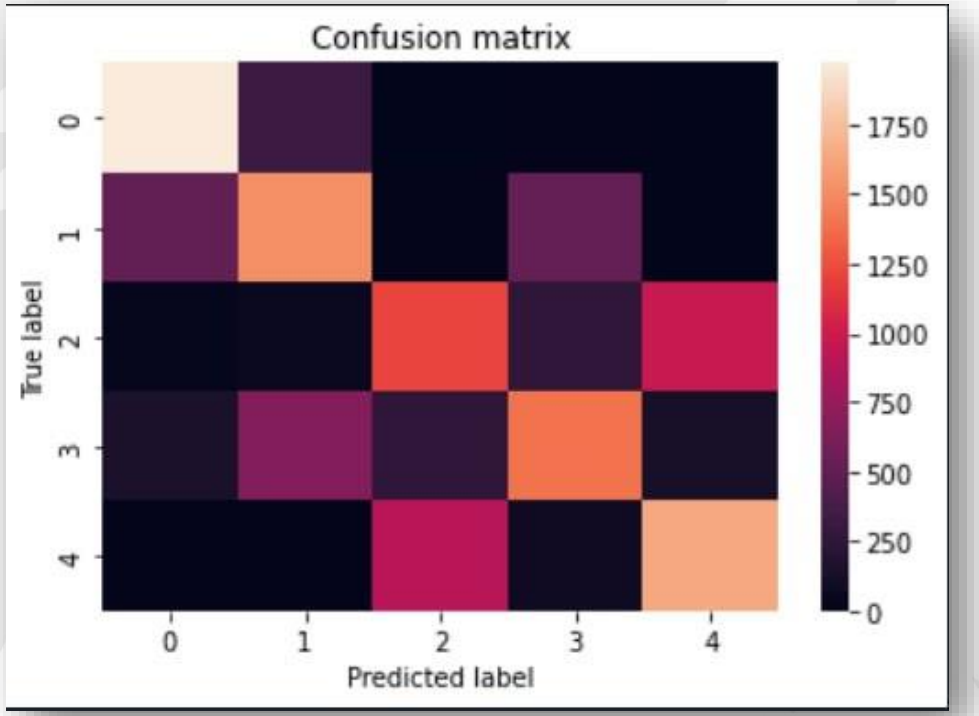
Misclassification rate=(FP+FN)/total=14.05%

Feature selection by using random forest

ROC curve



Confusion matrix

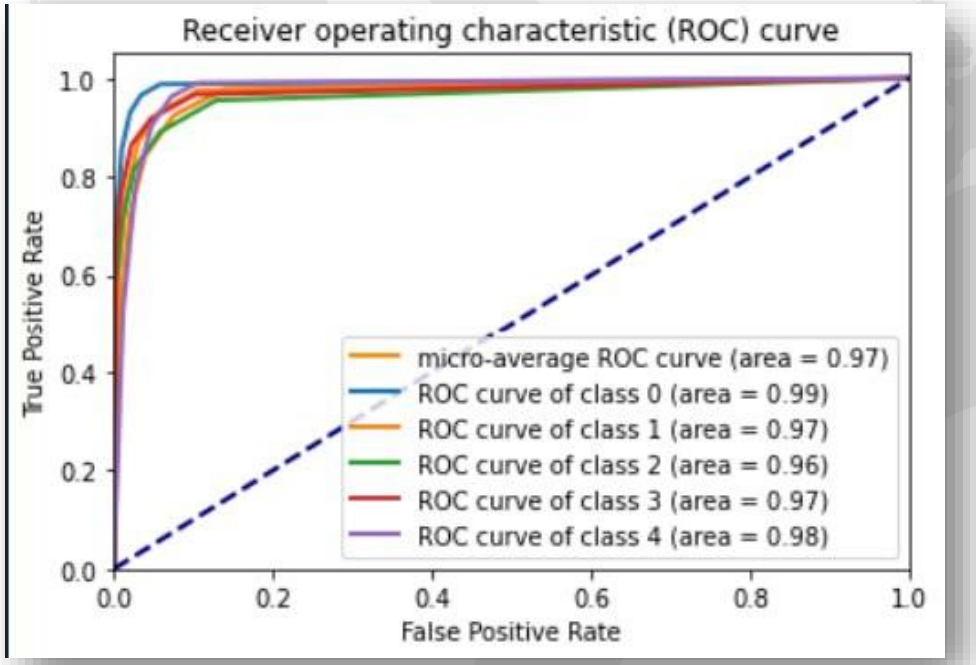


Accuracy score=(TP+TN)/total=61.34%

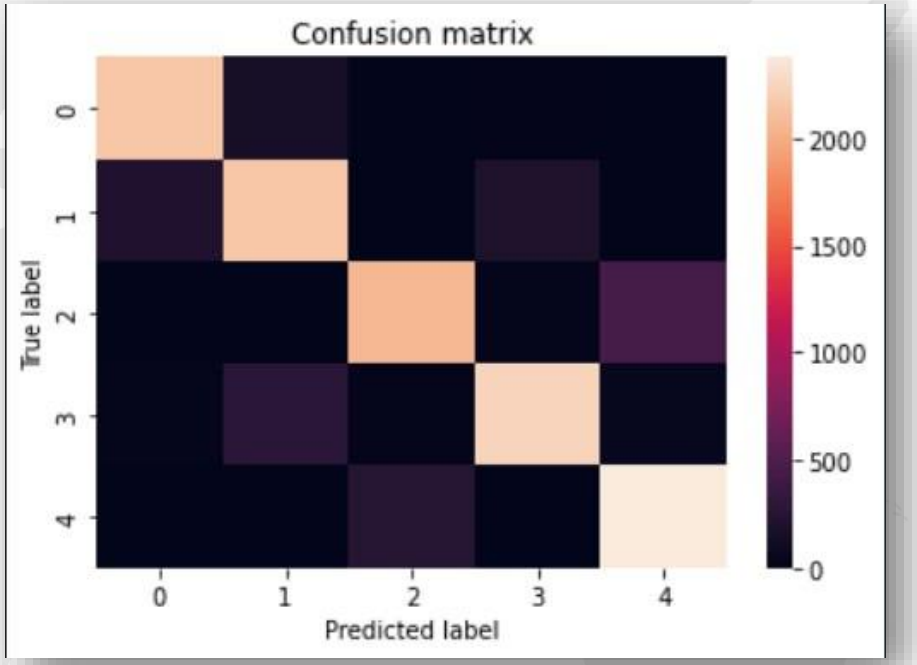
Misclassification rate=(FP+FN)/total=38.65%

KNN Algorithm

ROC curve

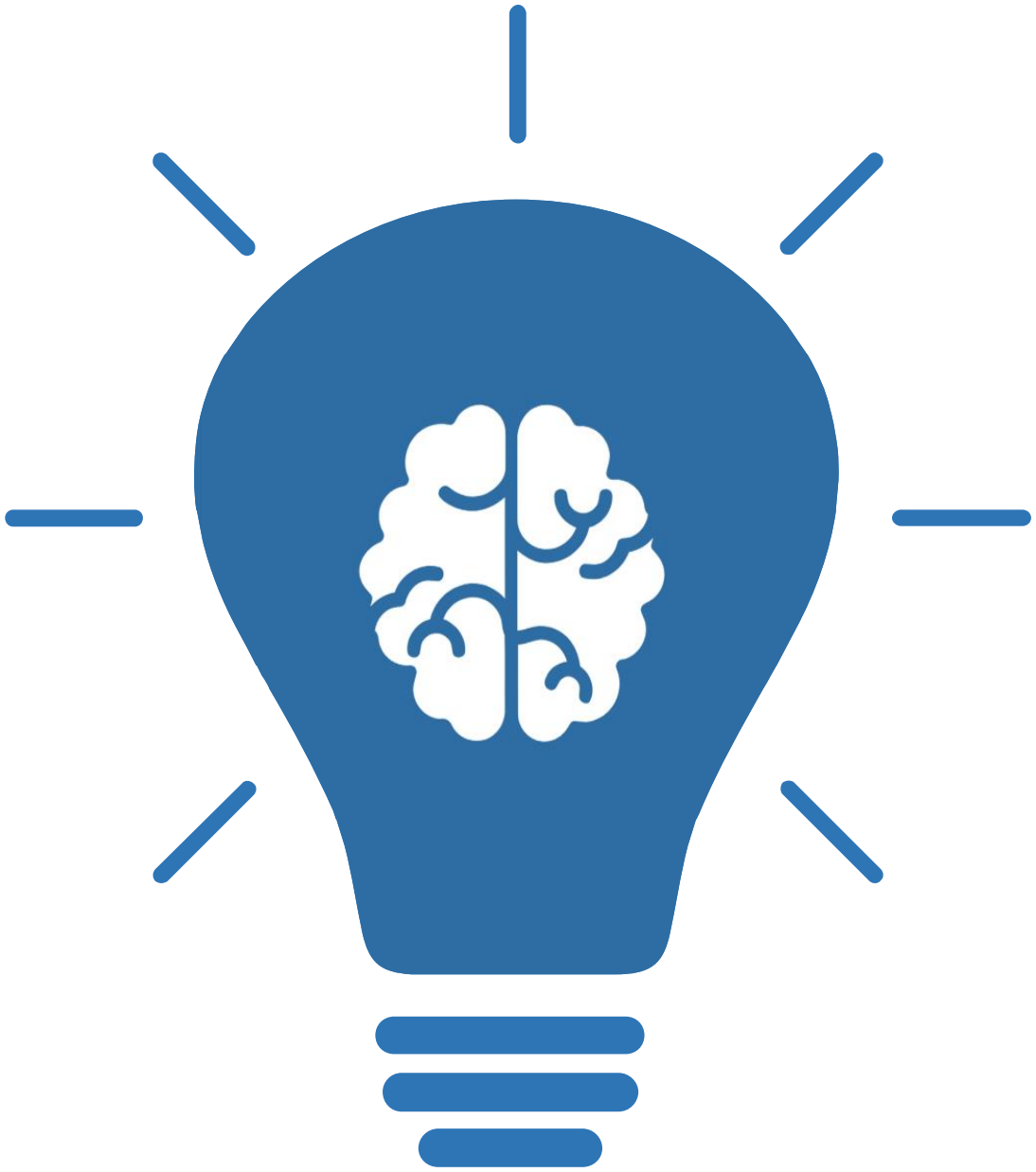


Confusion matrix



Acurracy score=(TP+TN)/total=87.25%

Misclassification rate=(FP+FN)/total=12.8%

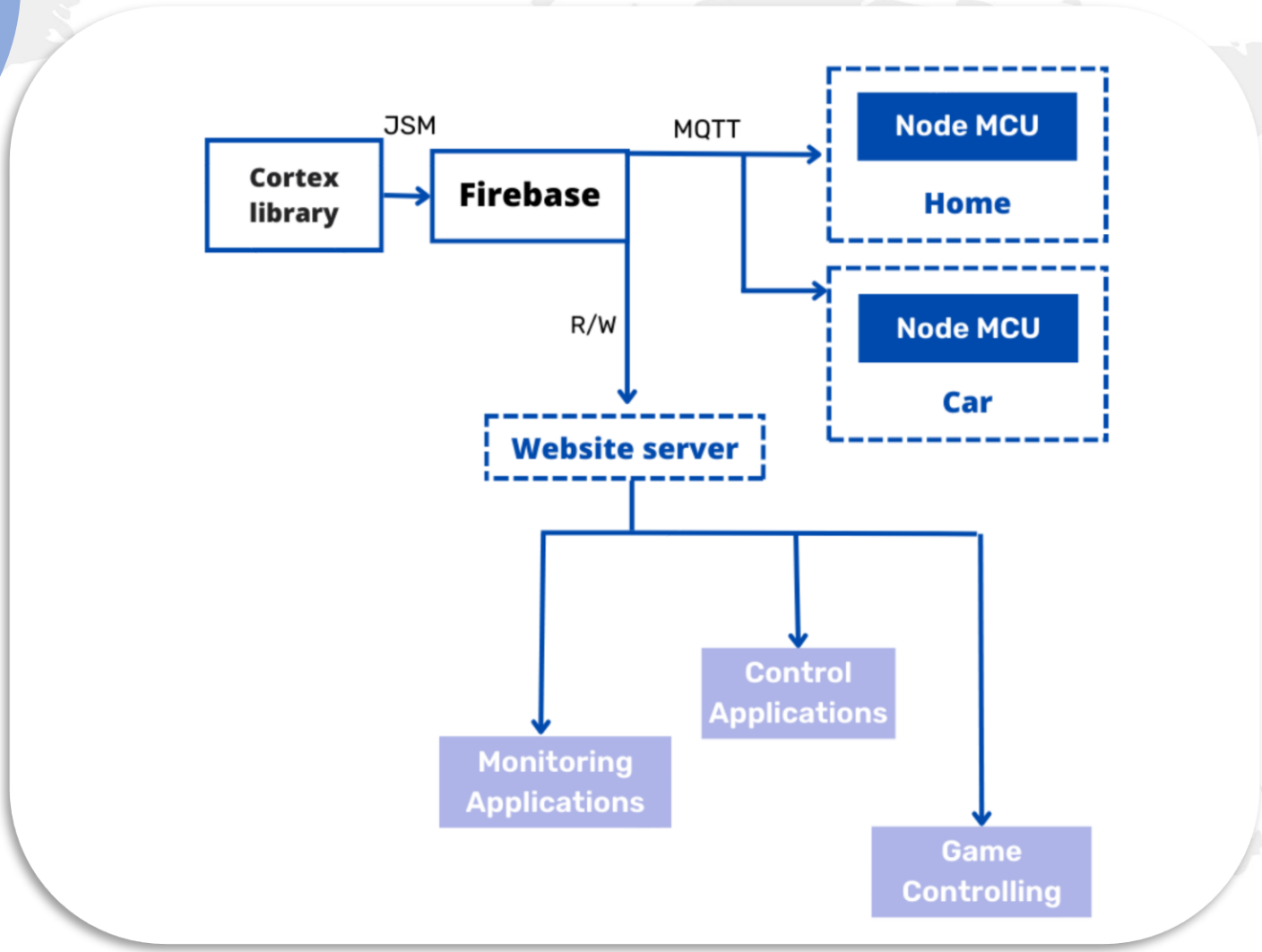


IoT

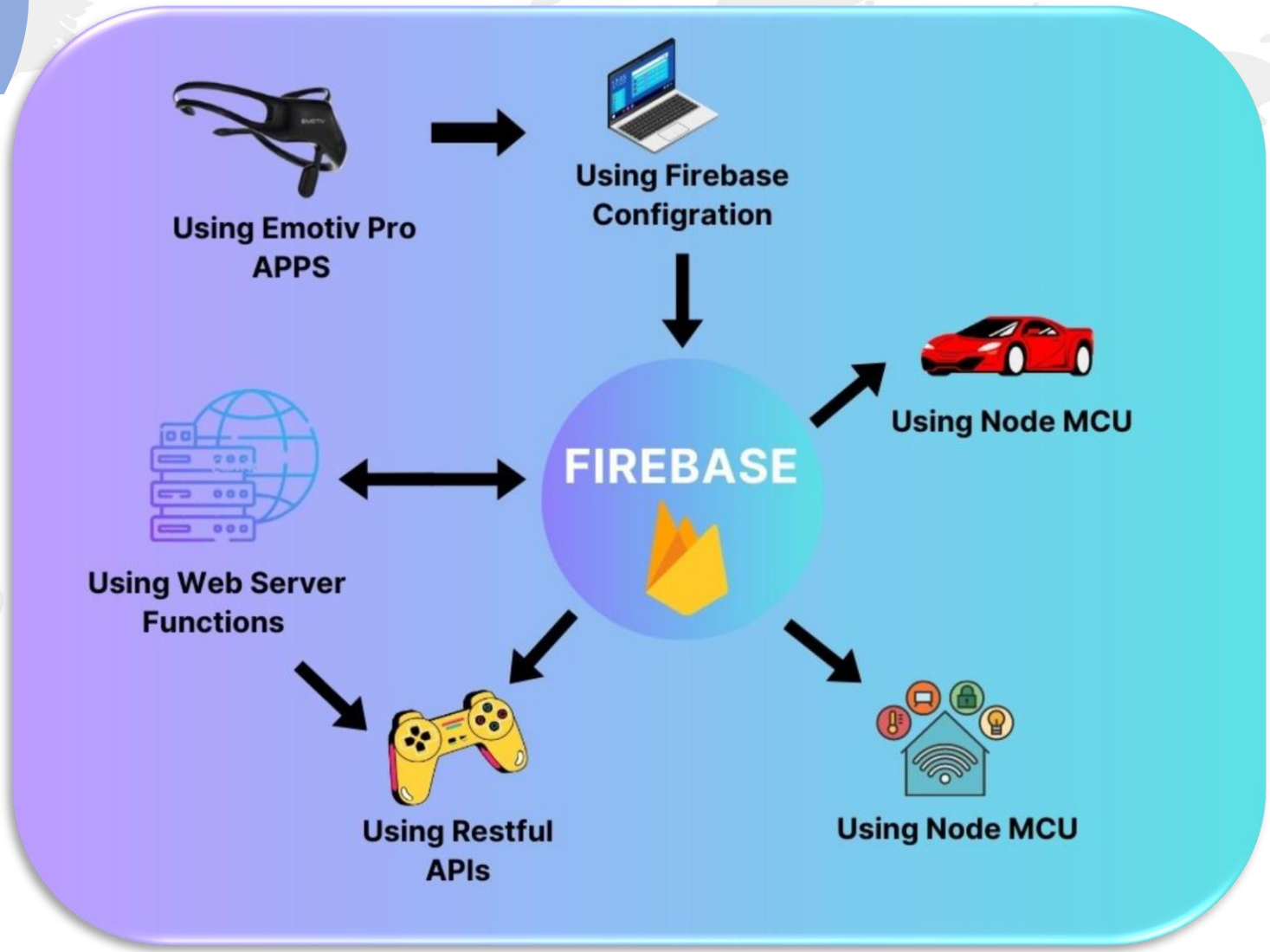
IoT

The term IoT, or Internet of Things, refers to the collective network of connected devices and the technology that facilitates communication between devices and the cloud, as well as between the devices themselves.

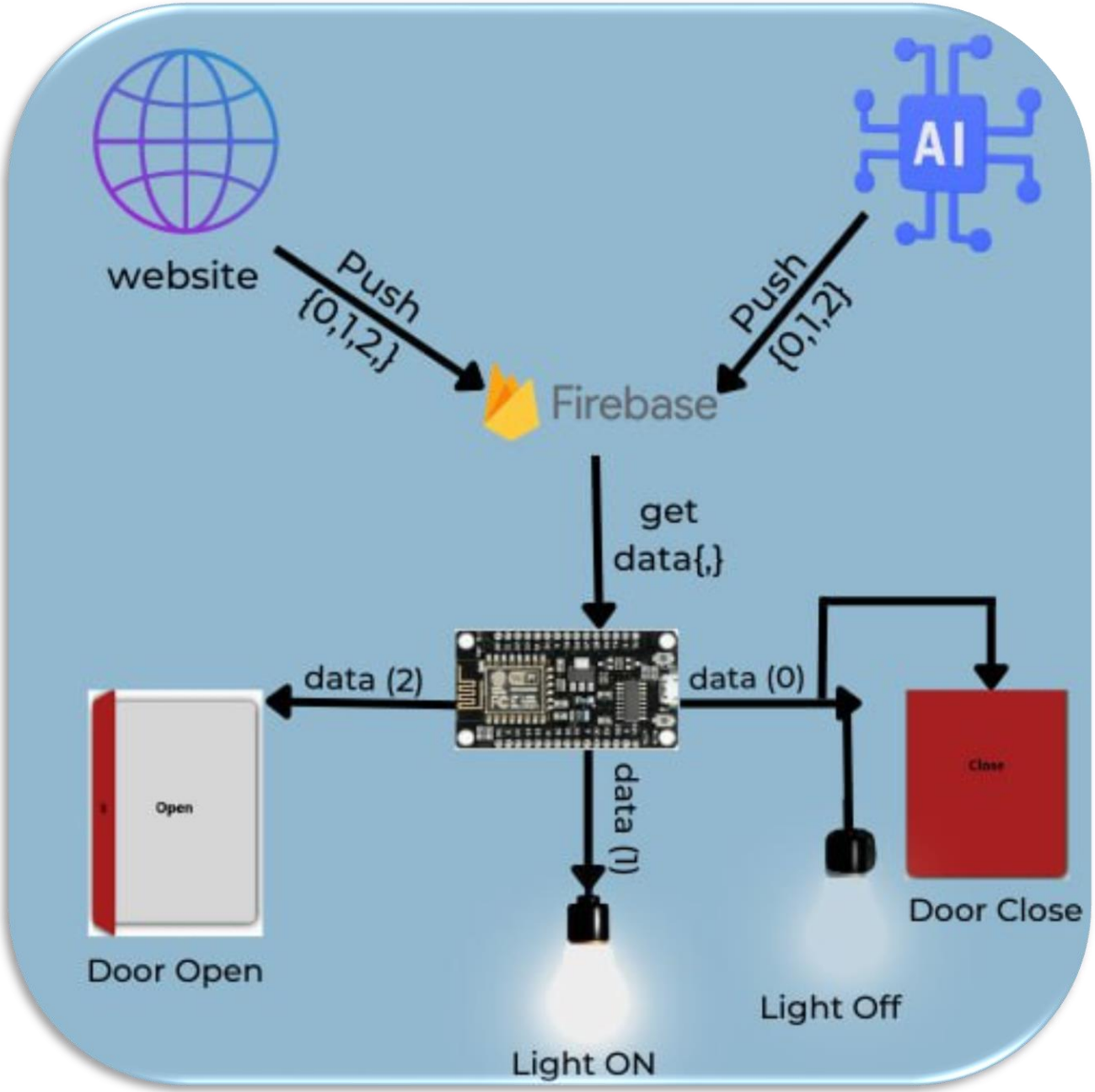
IoT infograph



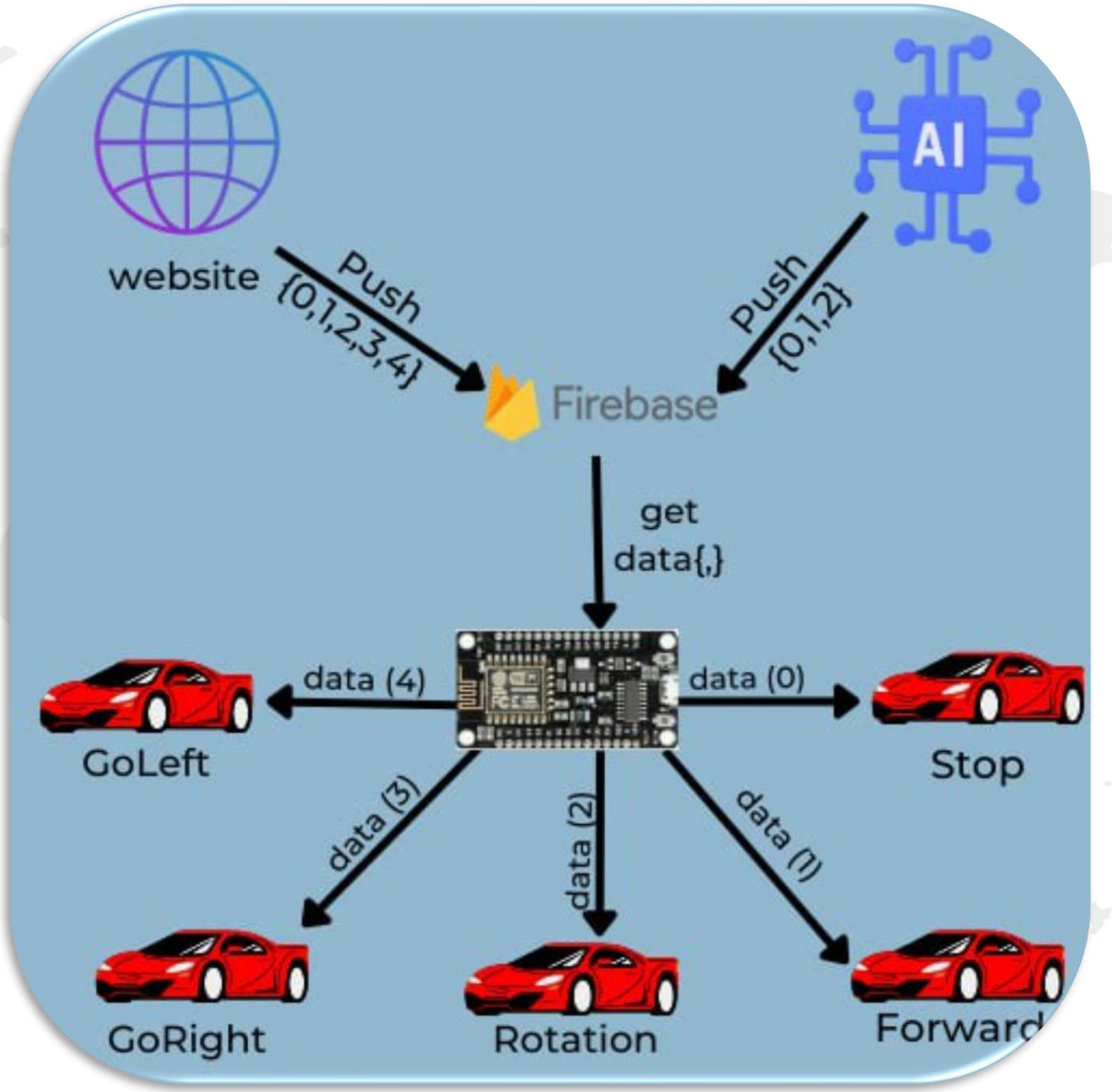
Firebase overview

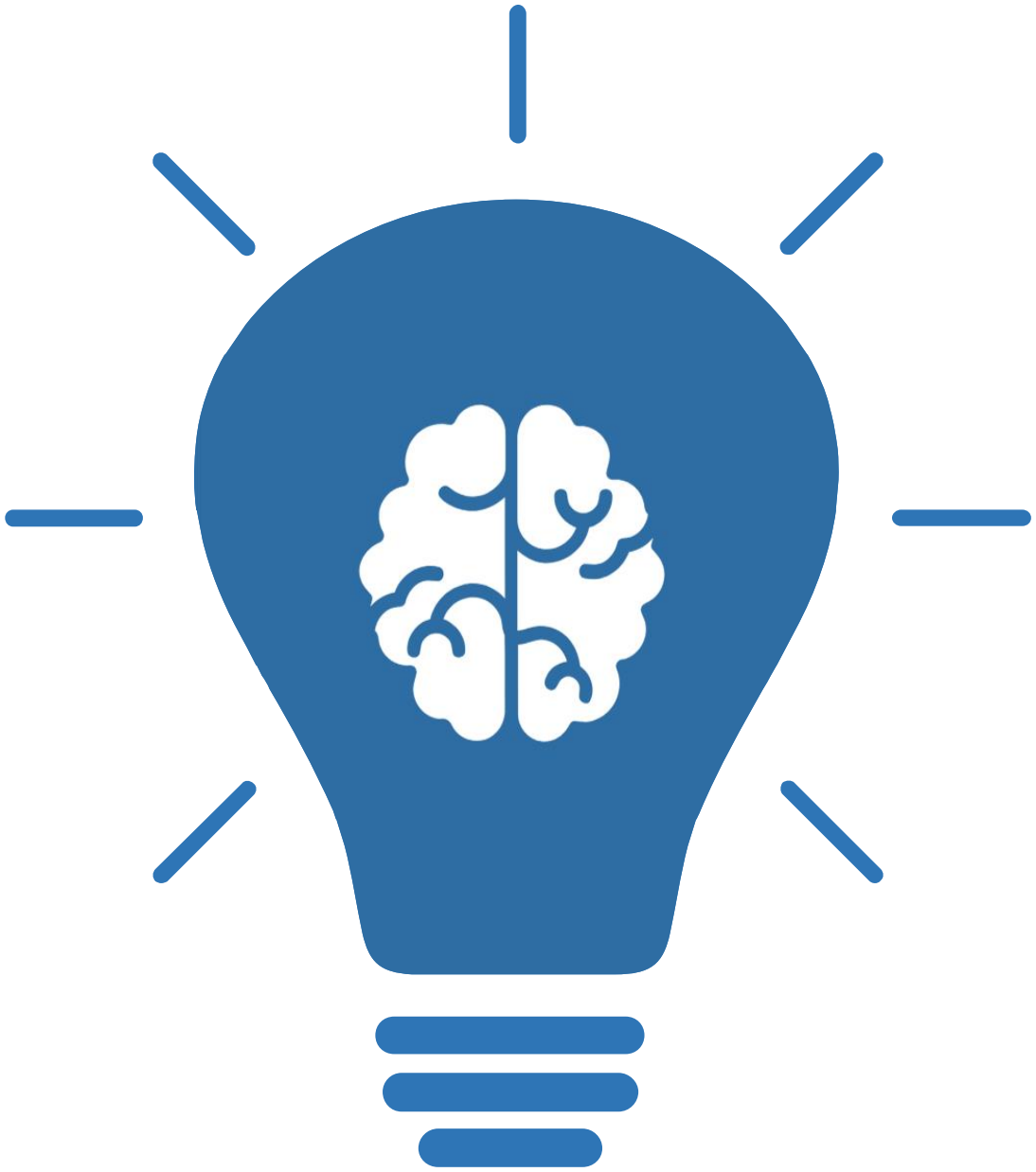


IoT of smart home



Smart car


website
Push
{0,1,2,3,4}
AI
Push
{0,1,2}
Firebase
get
data{,}
data (4)
GoLeft
data (0)
Stop
data (3)
GoRight
data (2)
Rotation
data (1)
Forward



Mobile Application

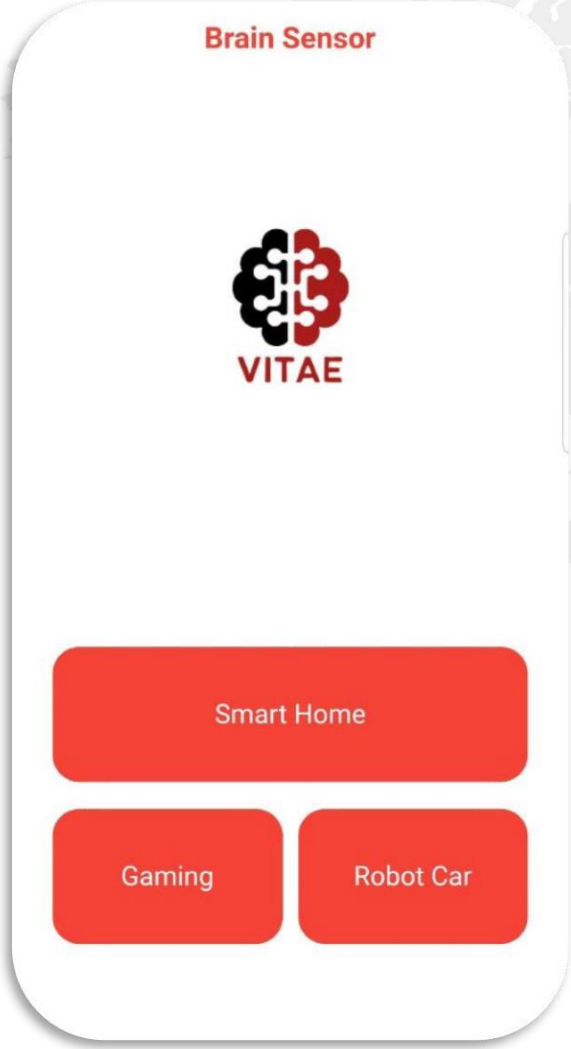
Mobile Application

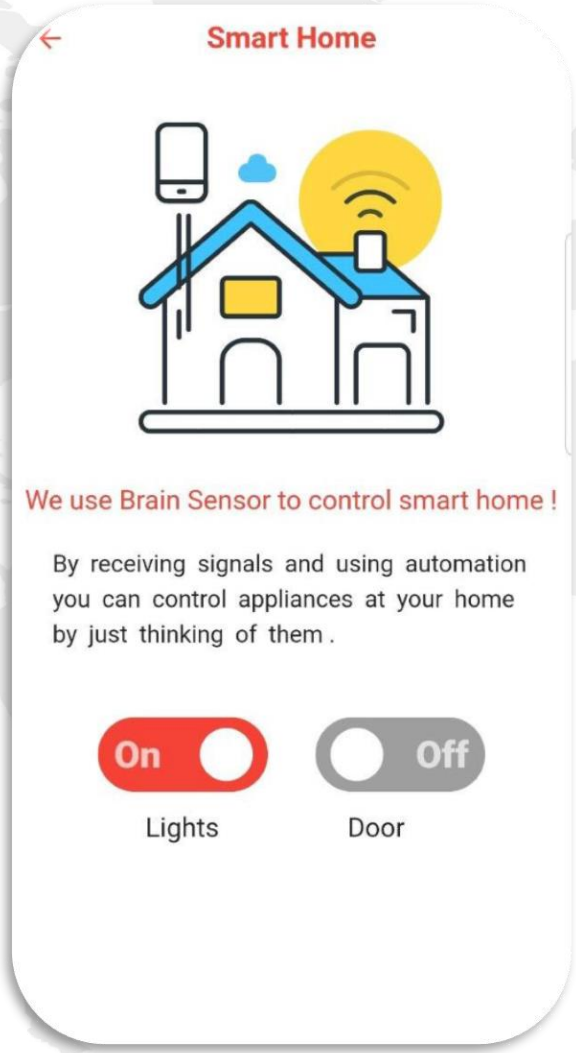
We used Flutter

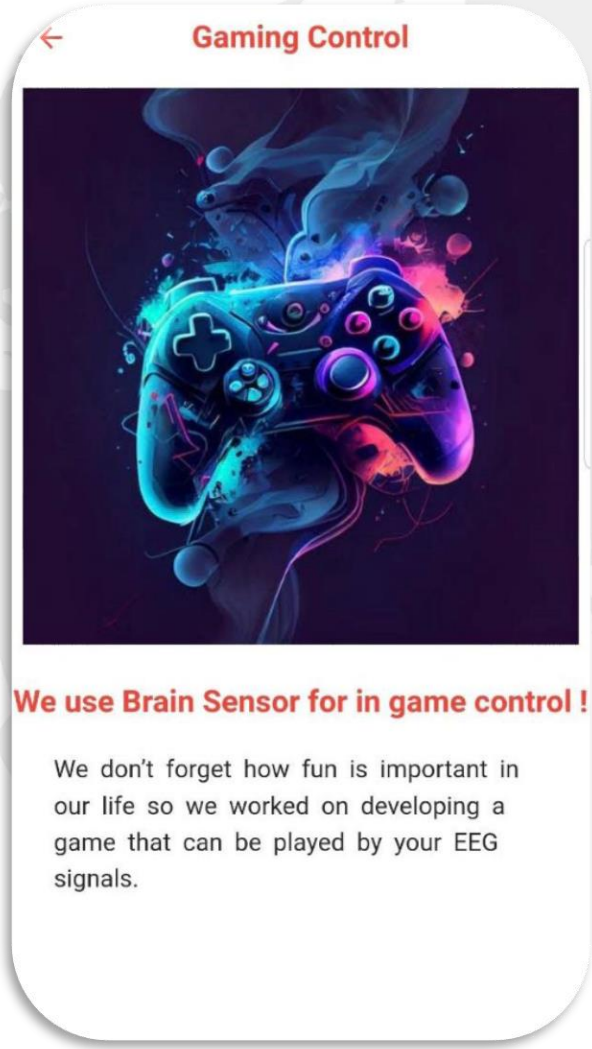
And its essential concepts and skills as

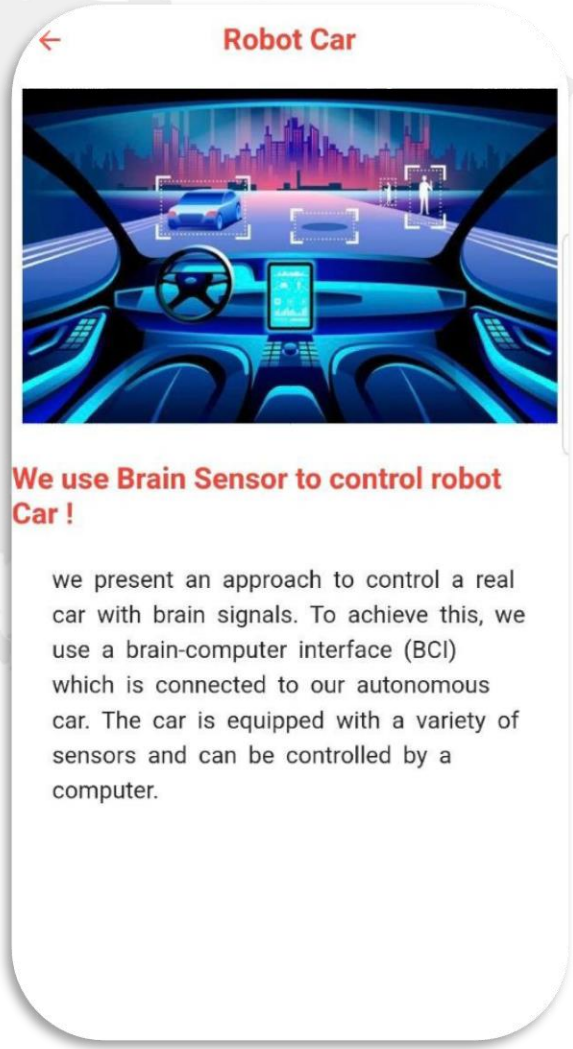
- Dart
- Widgets
- Layout
- Styling

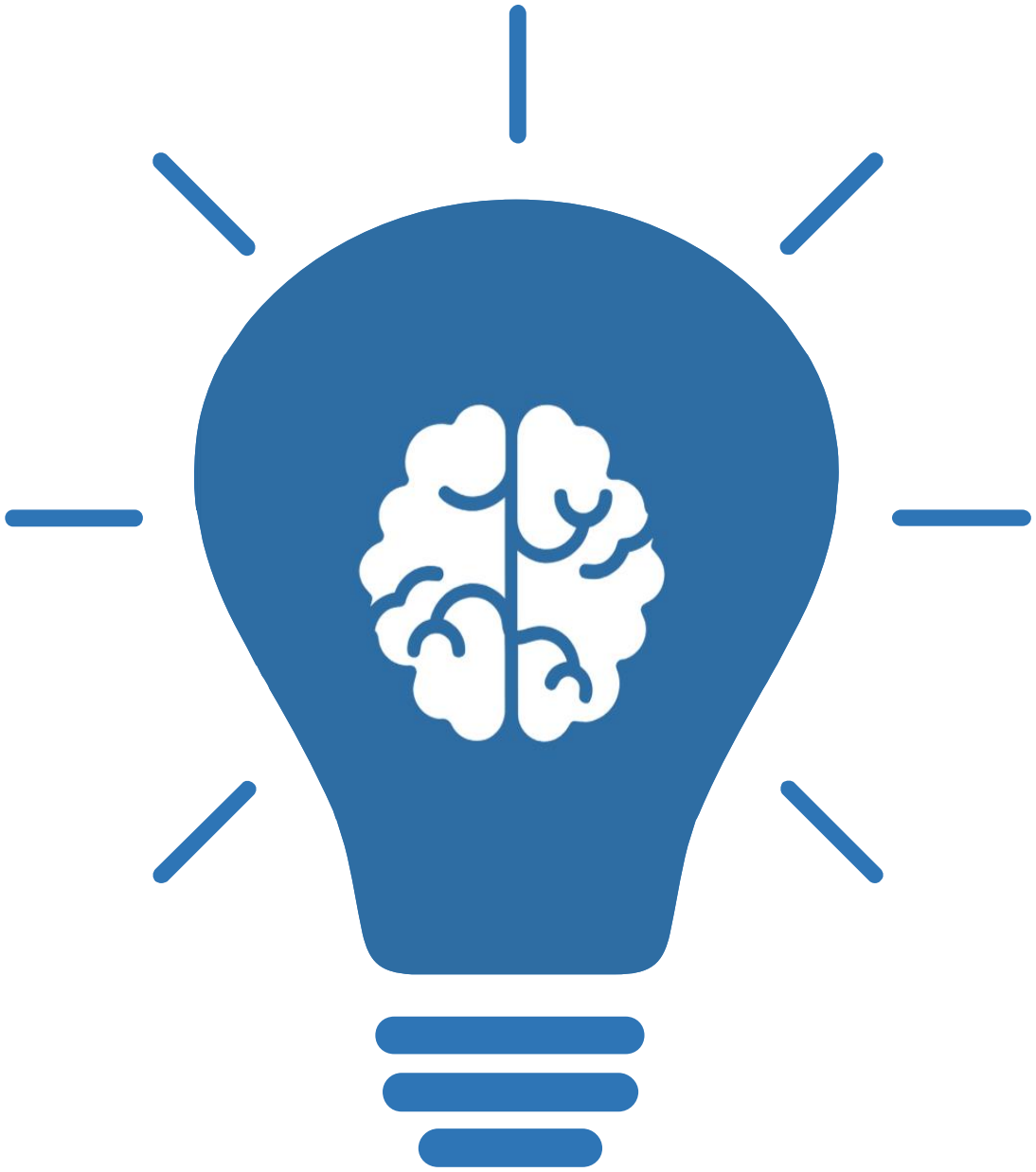
Application Layout





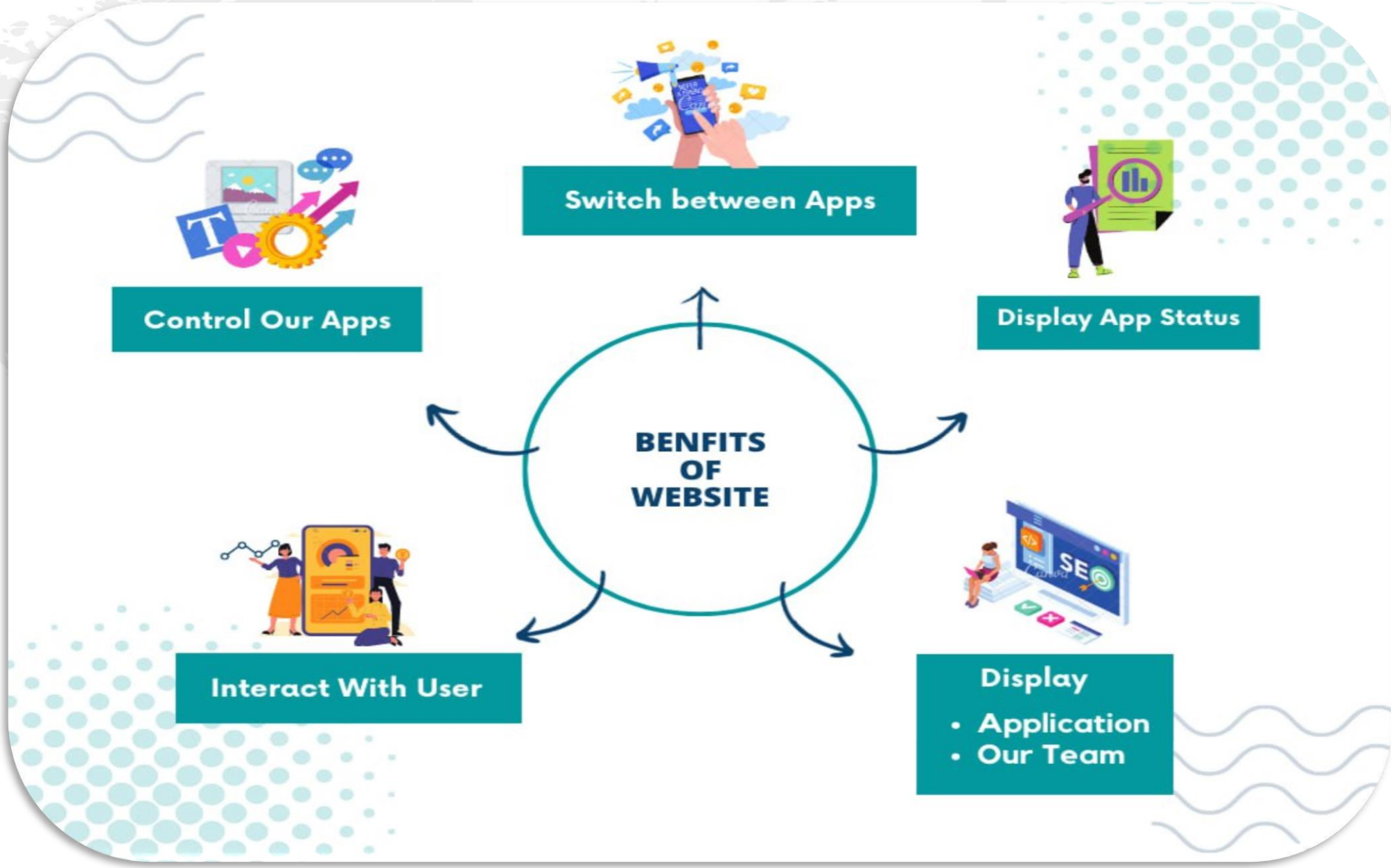




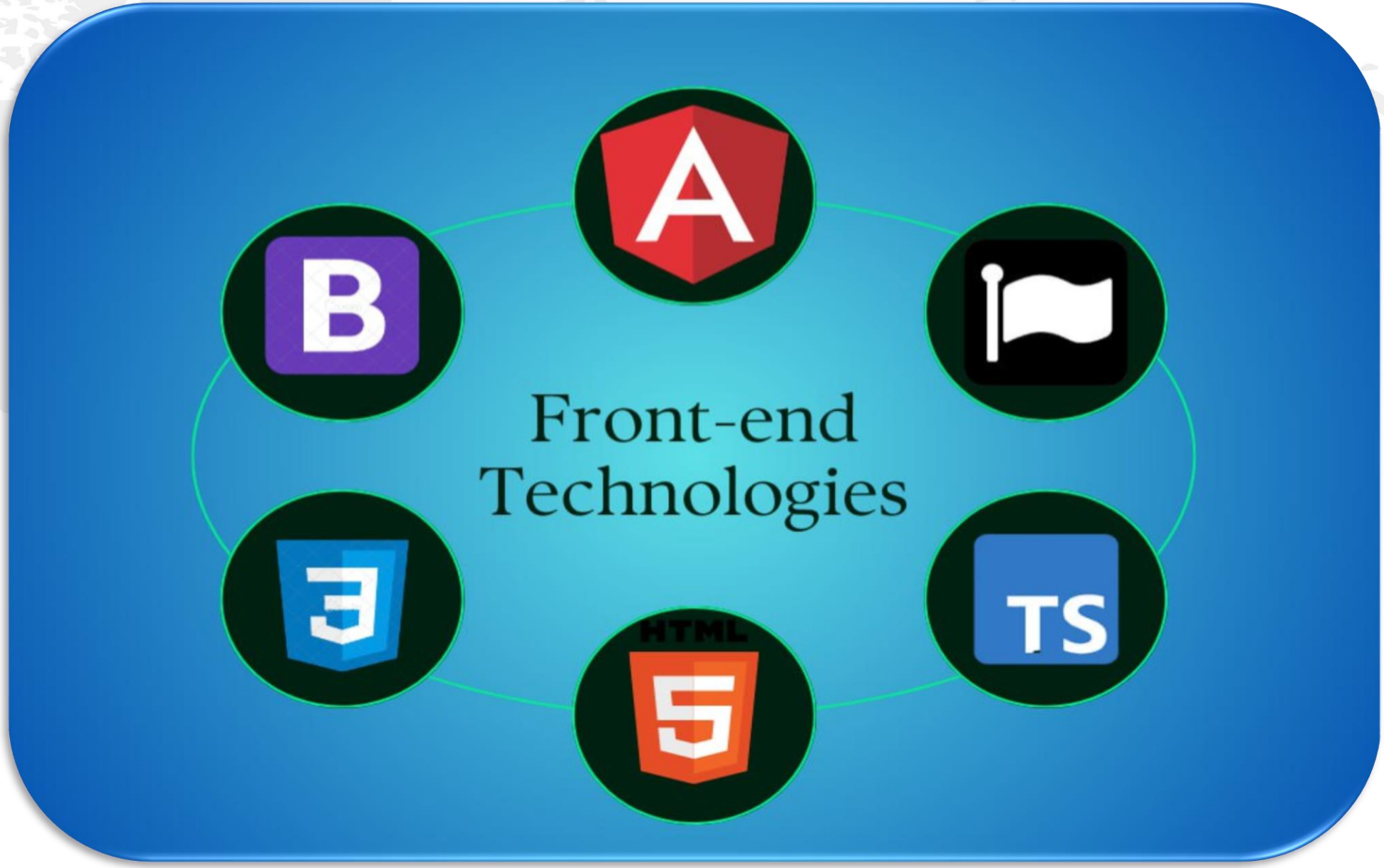


Web Application

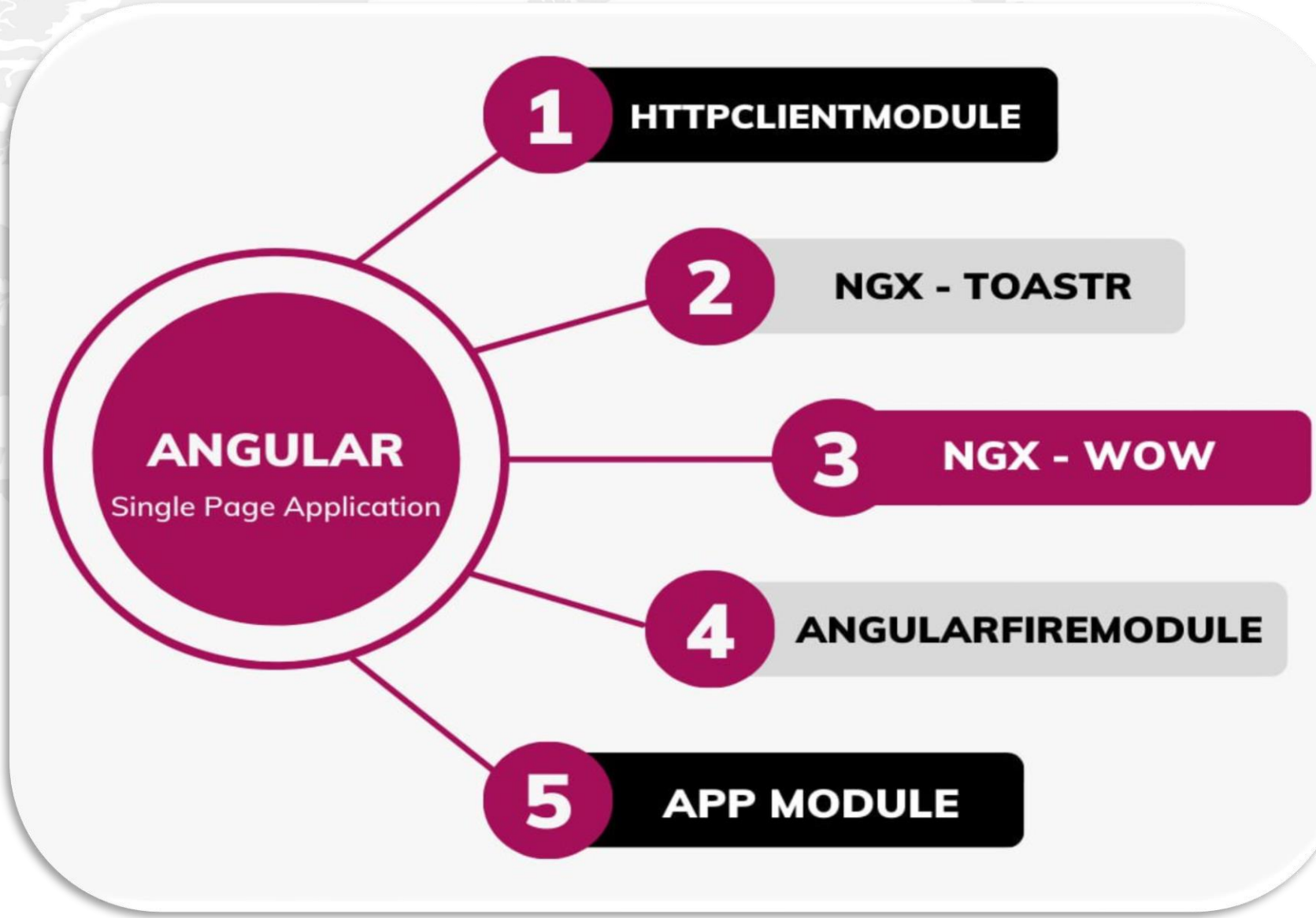
Benefits of website



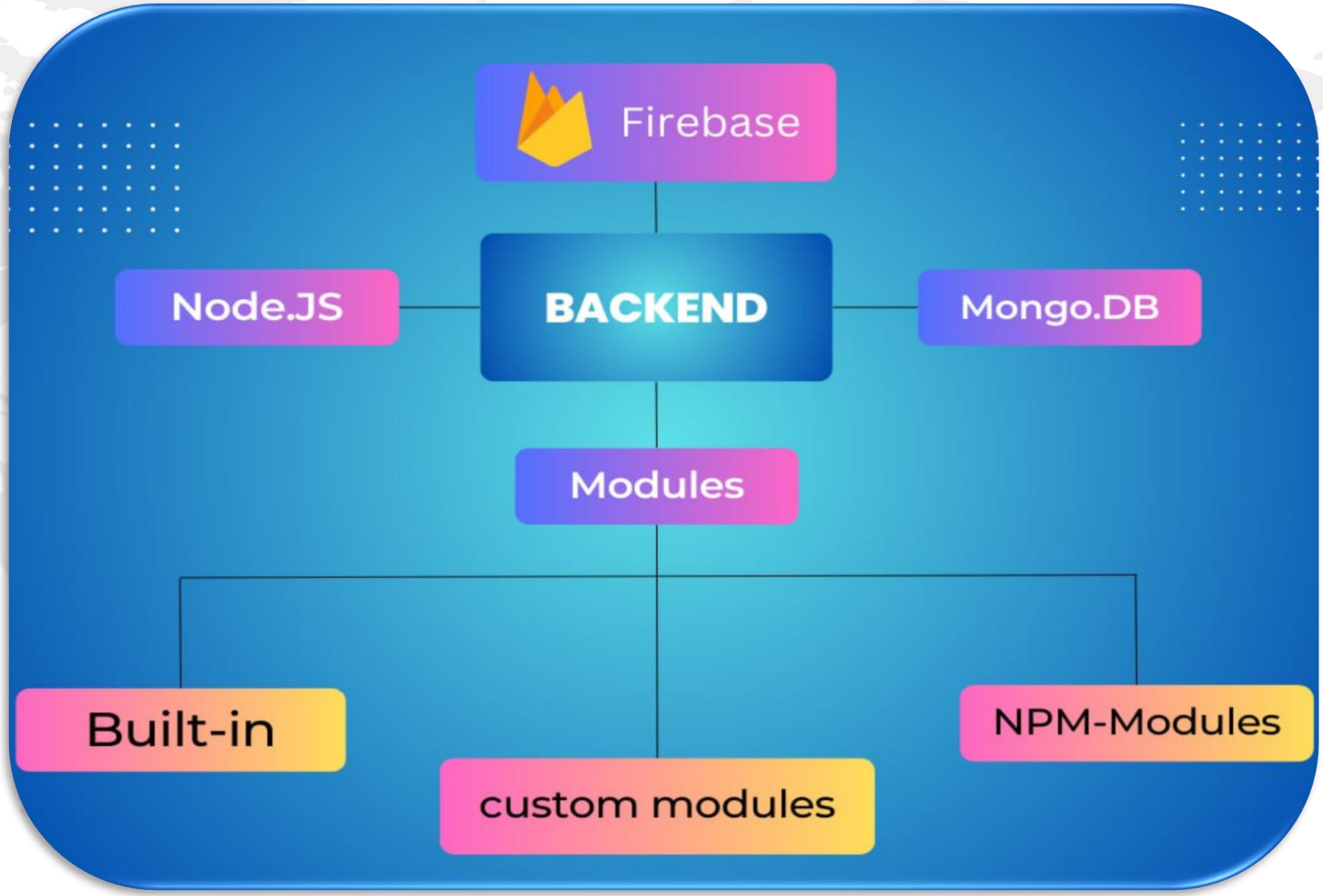
Front-End Technologies



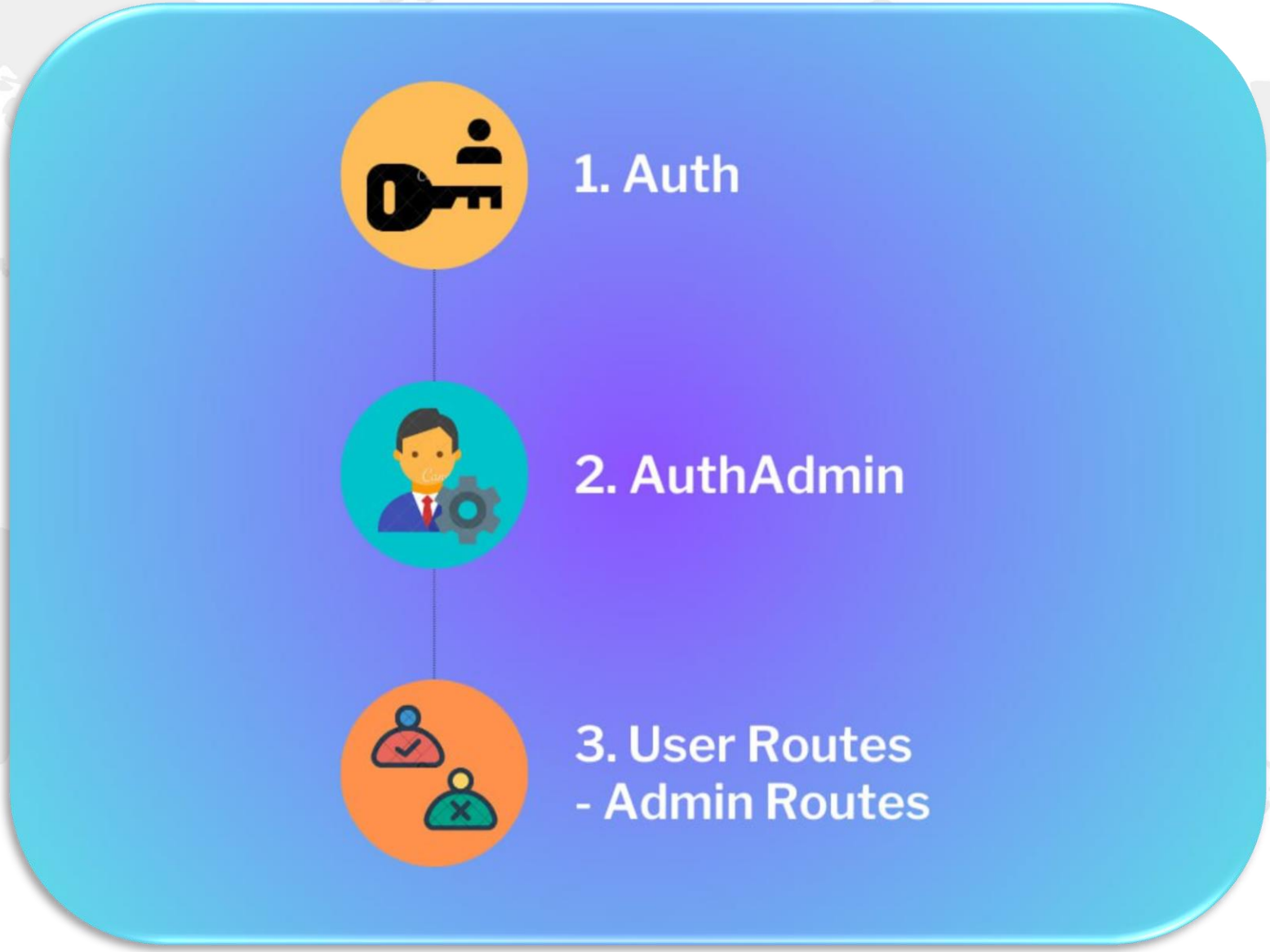
Website Framework



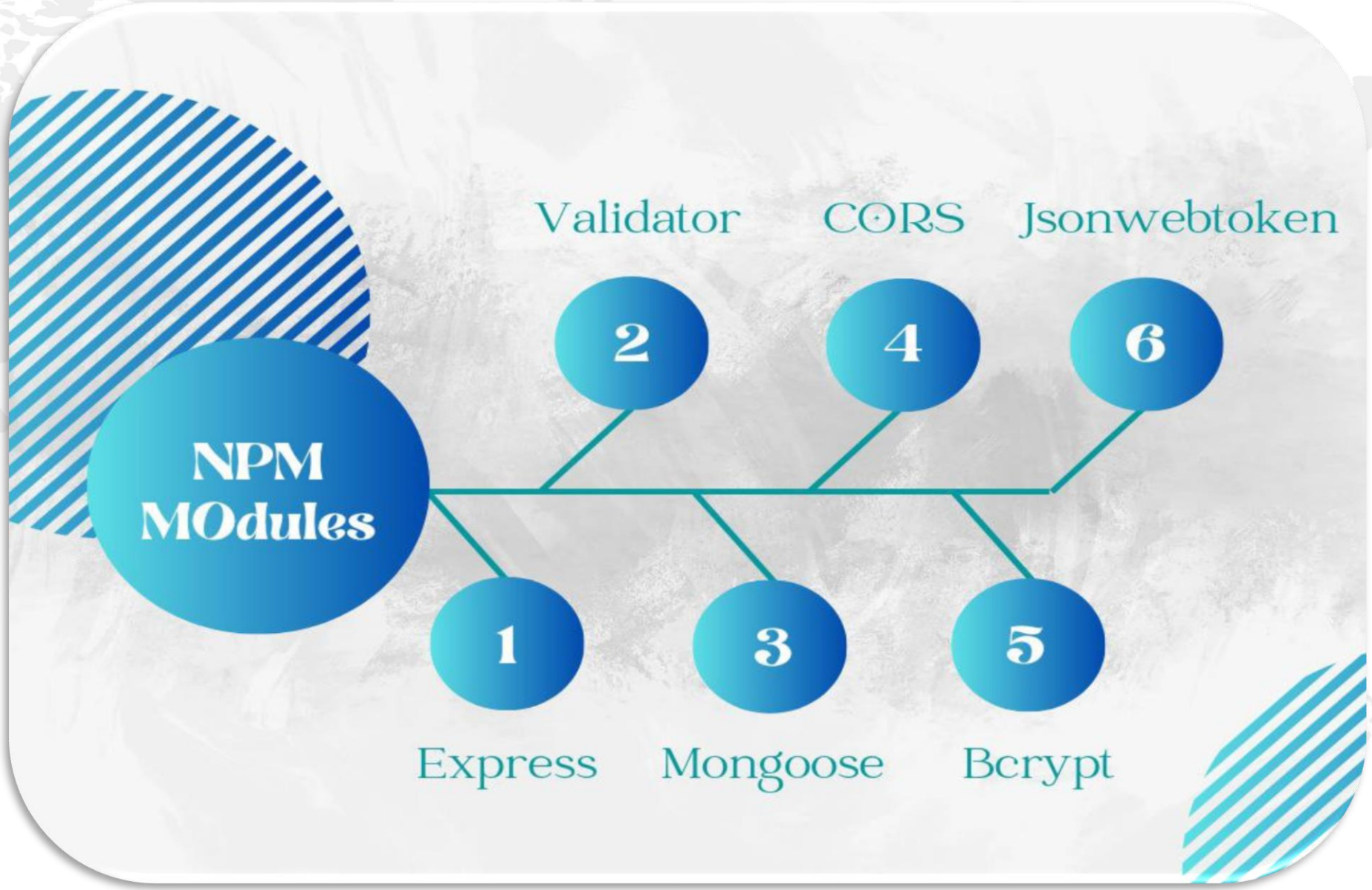
Backend (Node.JS overview)



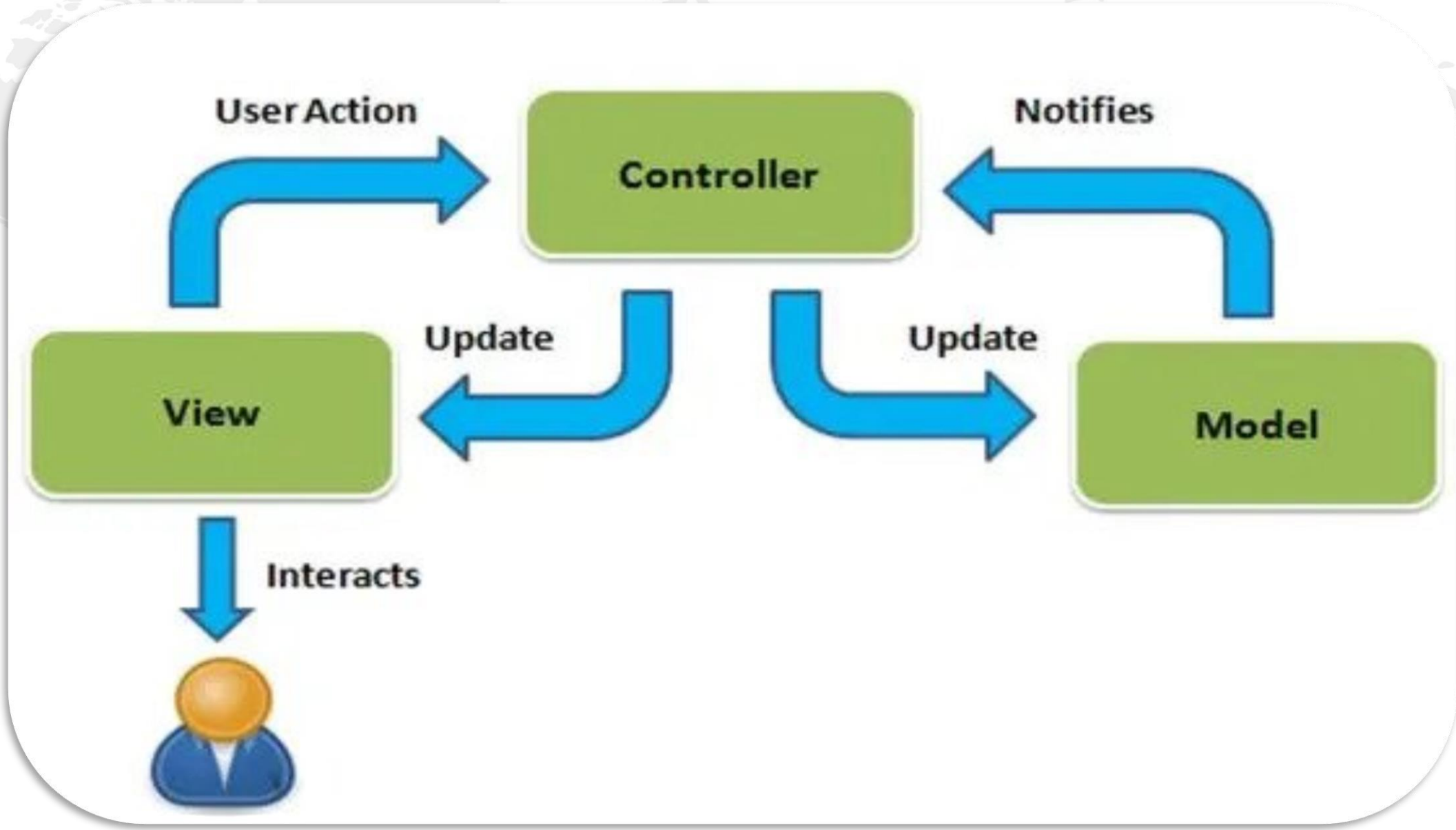
Node.JS custom modules



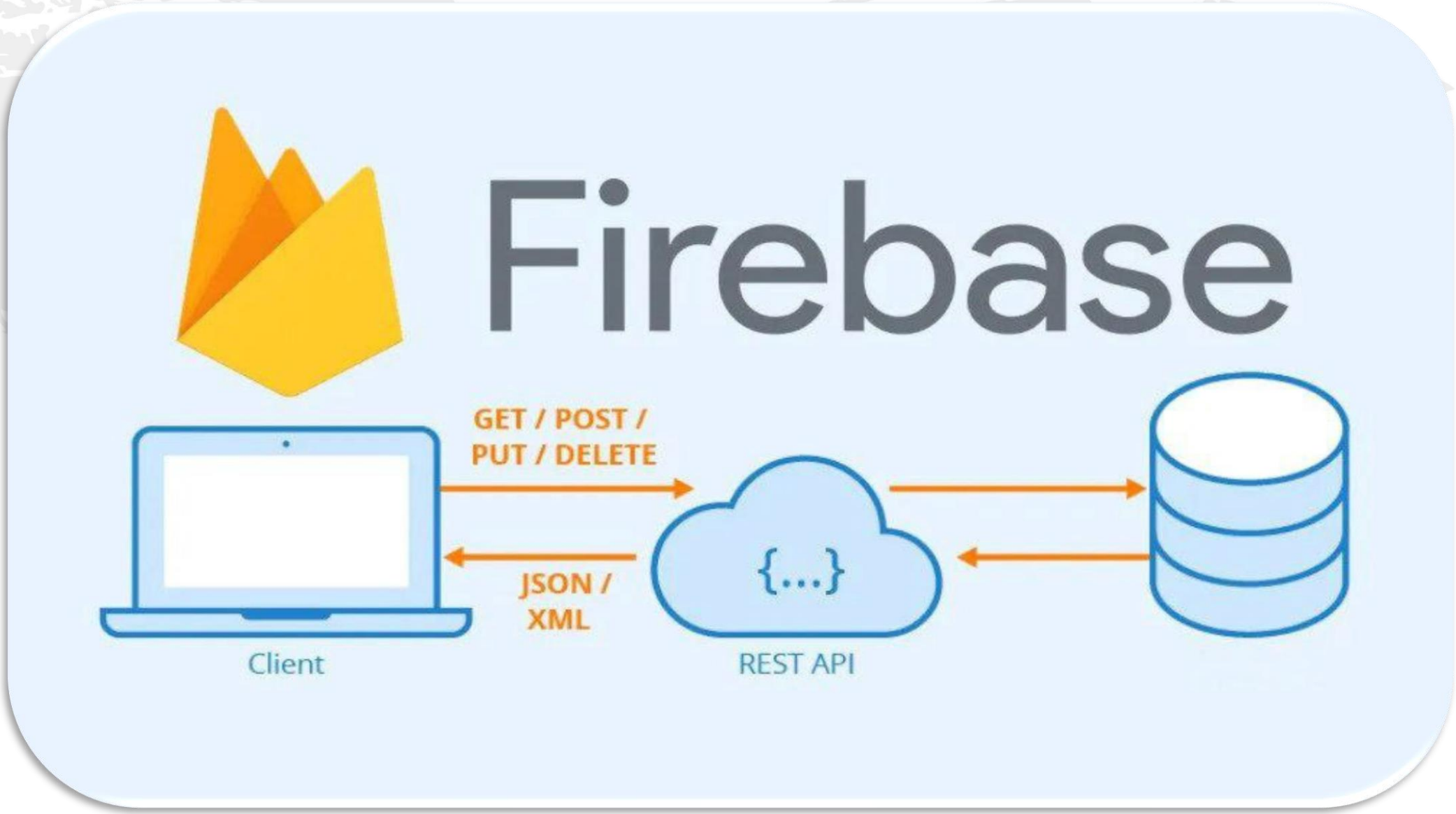
Node module


NPM
MOdules
1
Express
2
Validator
3
Mongoose
4
CORS
5
Bcrypt
6
Jsonwebtoken

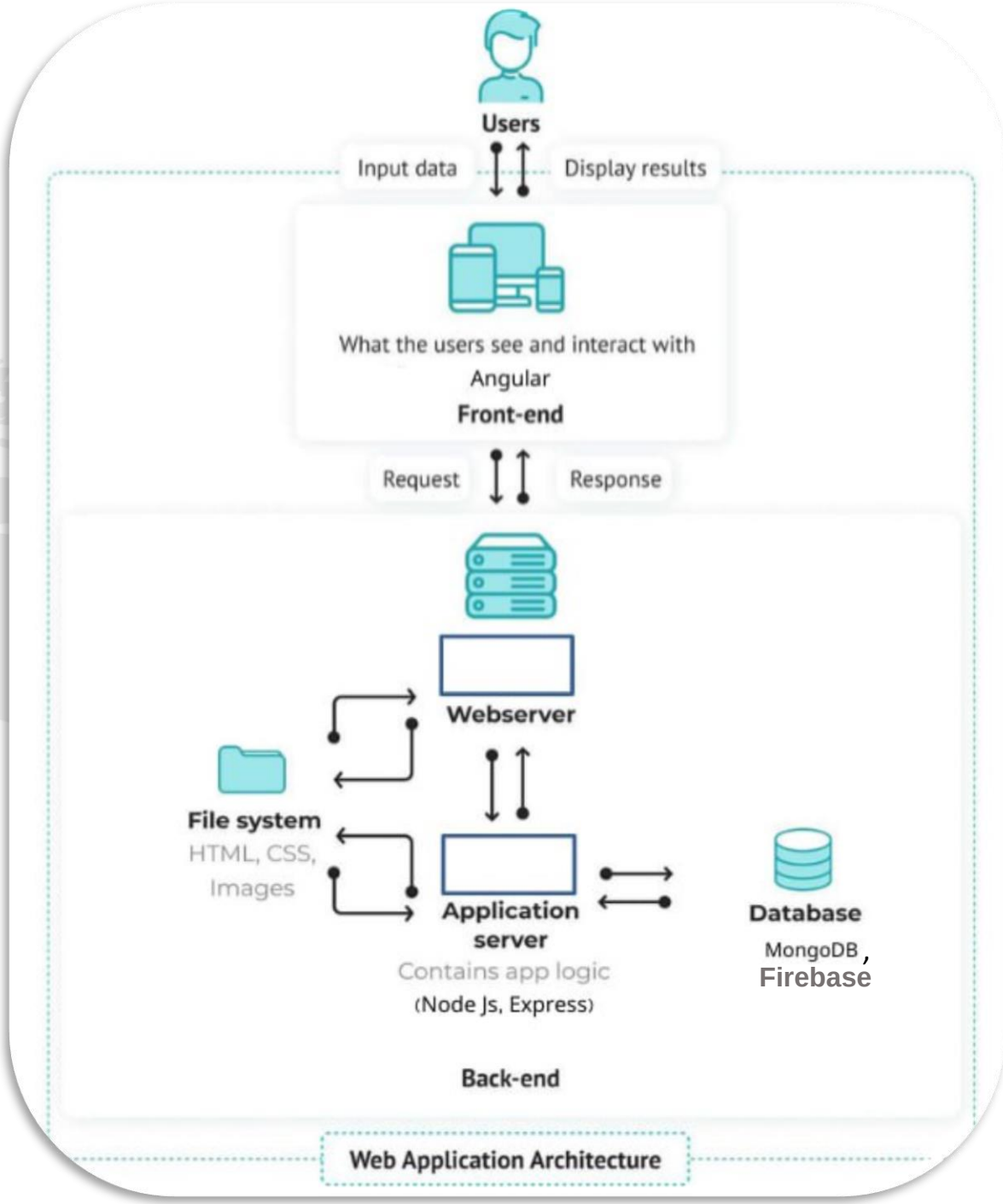
Architecture pattern



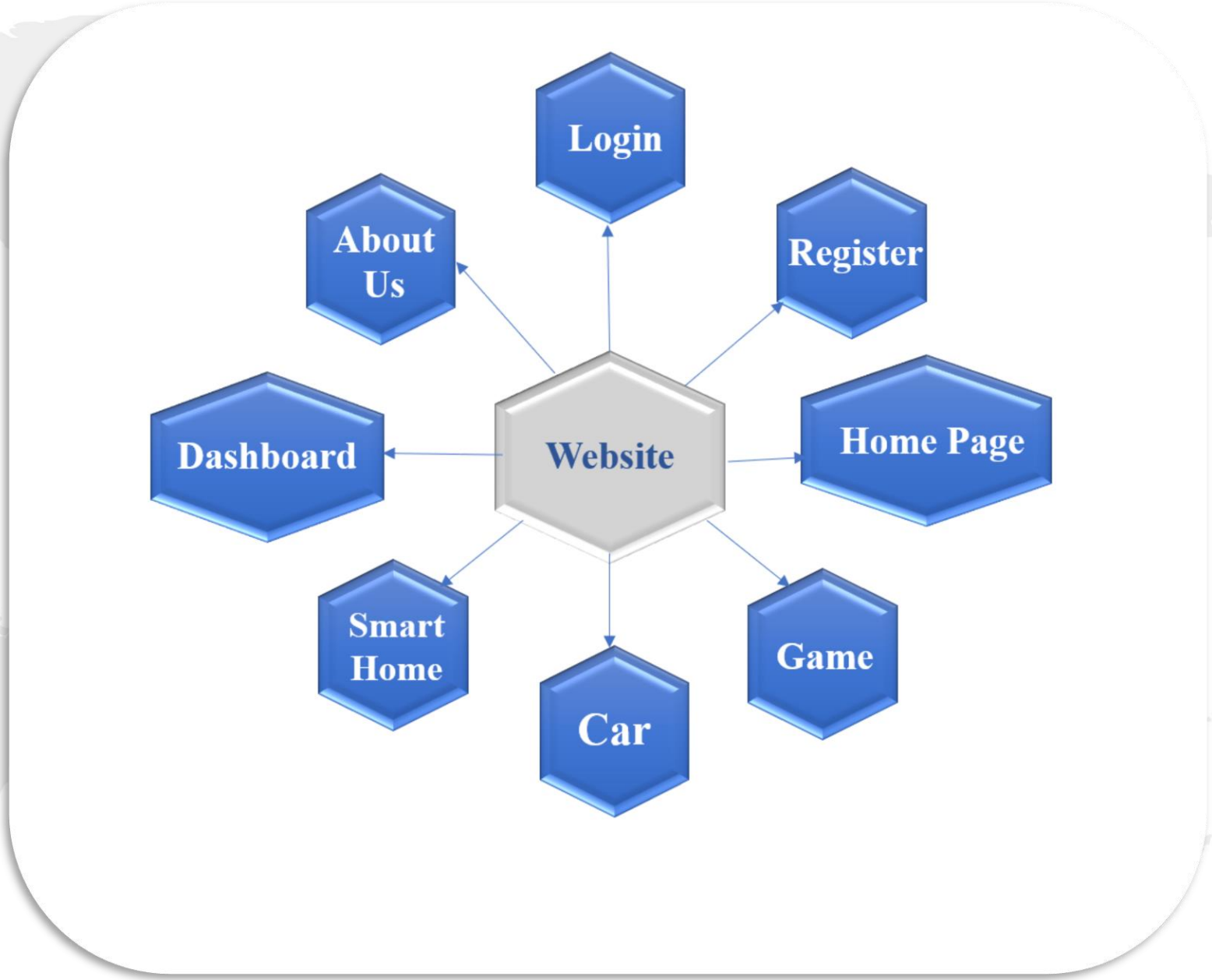
Firebase overview



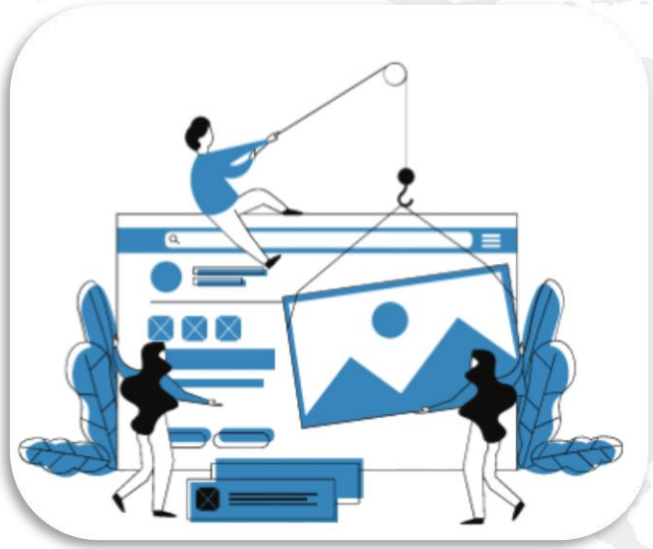
Website Database

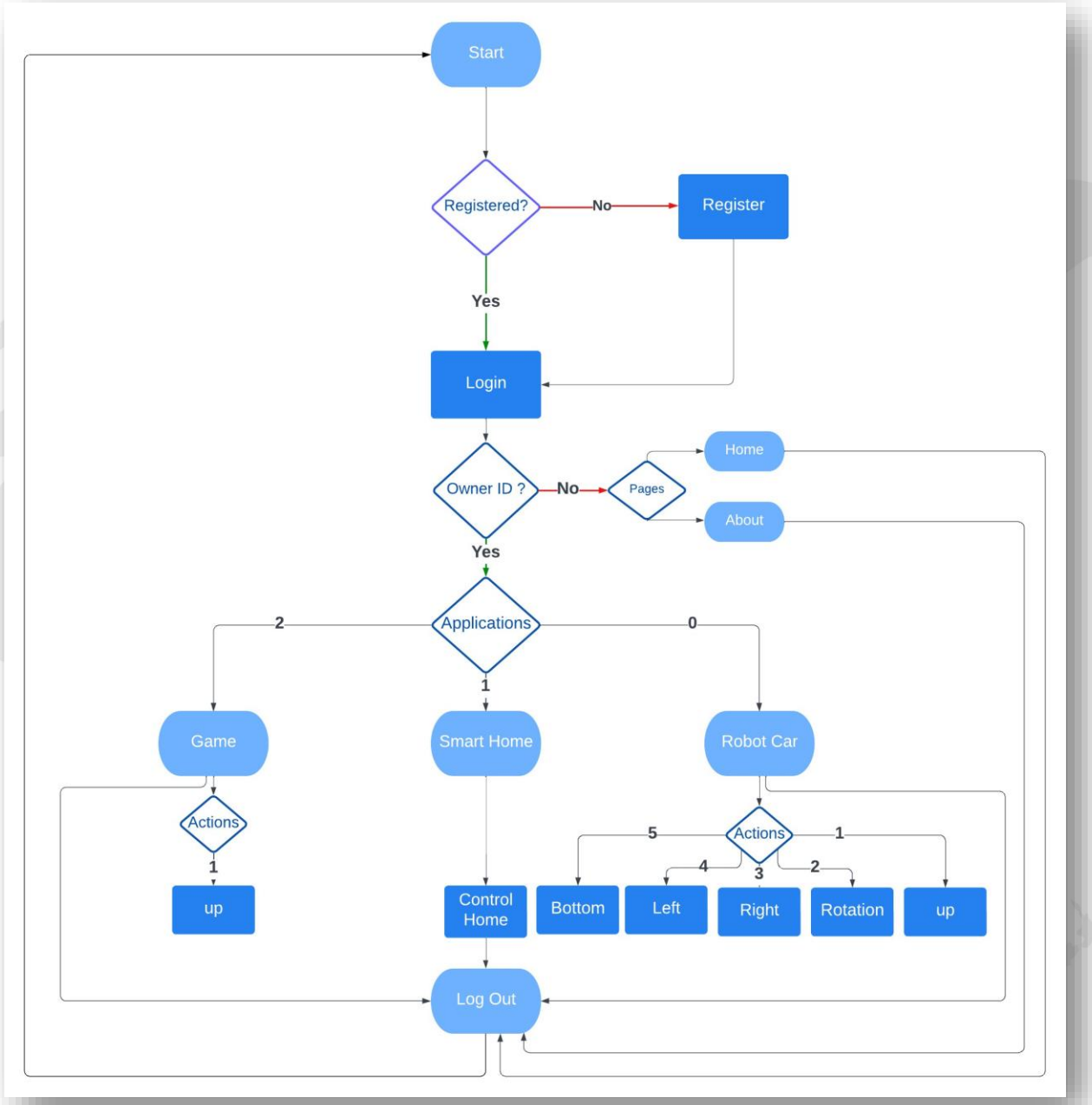


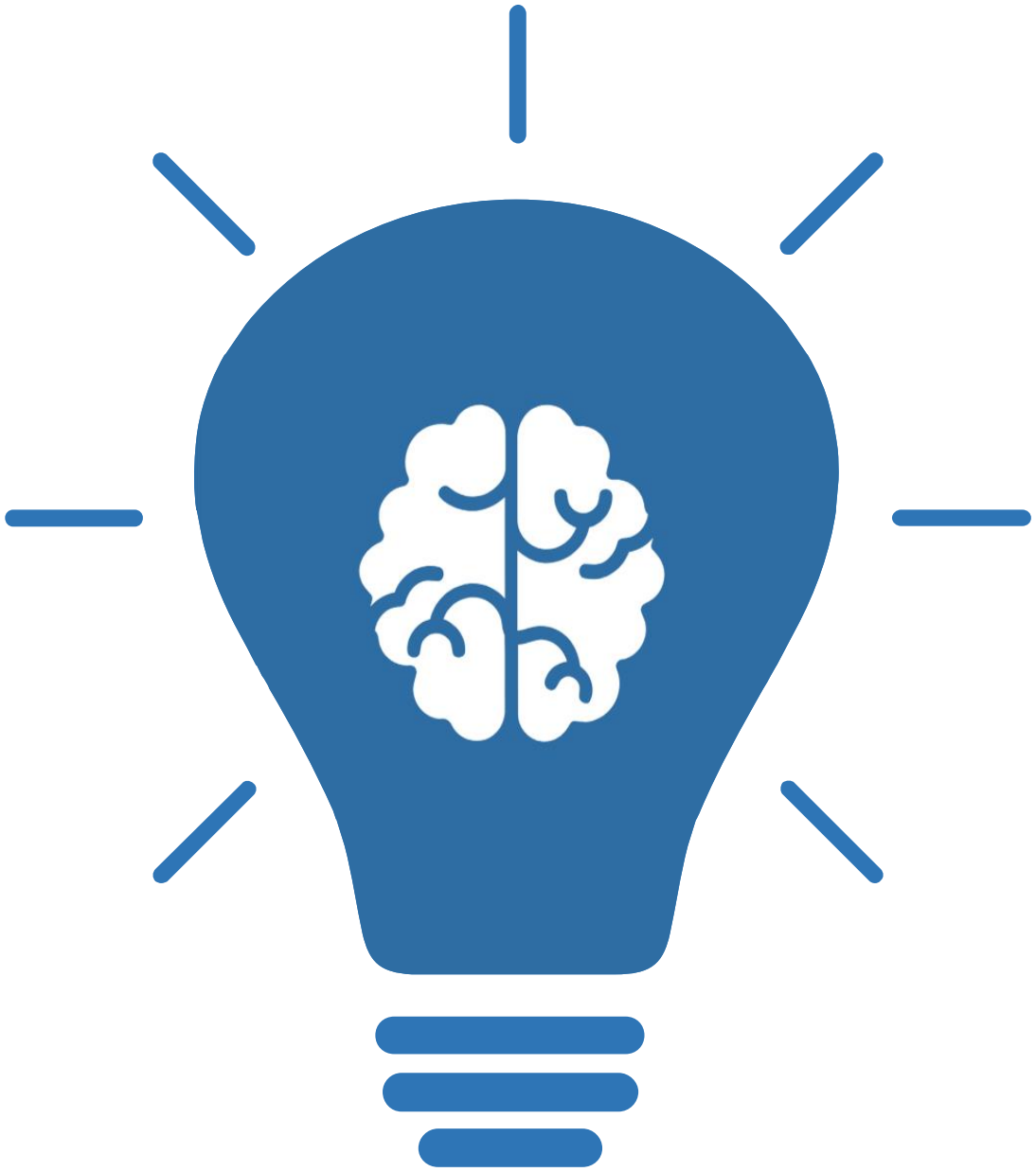
Website


Login
About Us
Register
Dashboard
Website
Home Page
Smart Home
Car
Game

Website Flowchart





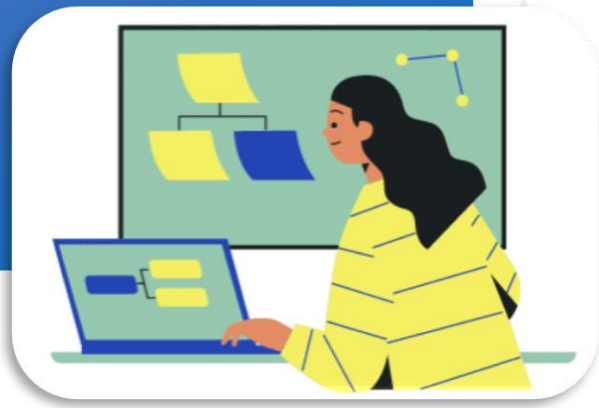


Conclusion

Conclusion

This project gives the disabled a comfortable atmosphere and makes their life natural as possible.

Using brain signals to control various applications without making any effort.



Business plan

ITAC Graduation Project Fund

ITAC Graduation Project <itacgp@itida.gov.eg> Thu, Mar 23, 4:03 PM

to yasser, Nourhanashraf663@gmail.com, ah1733446@gmail.com, kerolossadek22@gmail.com, nano20

Dear Applicant

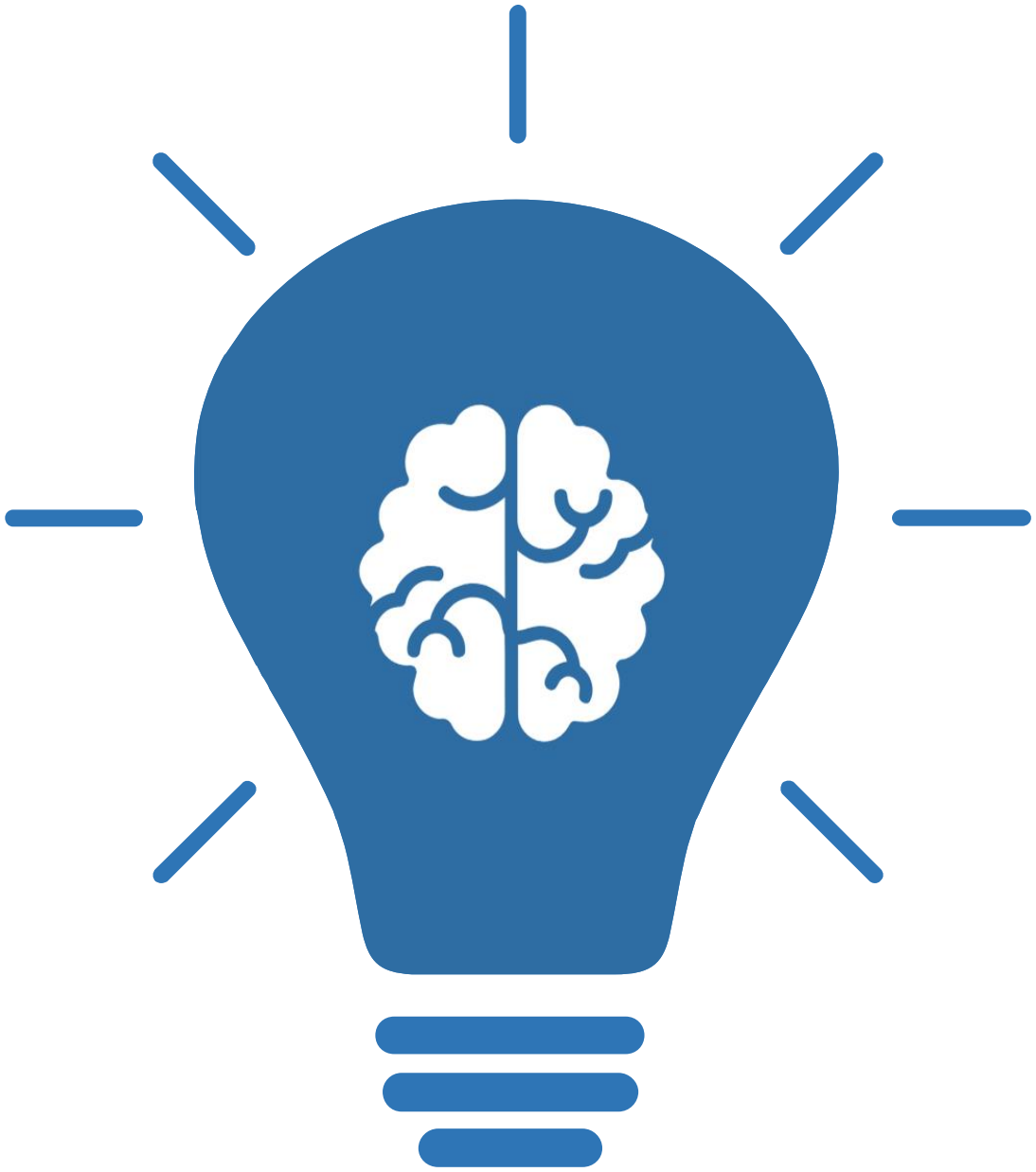
Congratulations! Your proposal is accepted for funding

Project ID: GP2023.R18.161

Project Title: Using EEG headset based on AI and IOT techniques to help the handicapped

The next step will be to refer to the attached Graduation Projects Financial Guidelines and fill in the budget form and send it to: gbudget@itida.gov.eg. Please note that the budget form must be sent via the Project Supervisor e-mail in order to be accepted. The deadline for sending the budget forms is **Thursday 20th April 2023.**

Best regards,



Future work

Future work

- Fixing the accuracy problem.
- Using for more applications.


thank
you