Augmented Reality for Real-World Enhancement :

Enabling Object Recognition and Scenario Interpretation through Smart Specs

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19-04-2024

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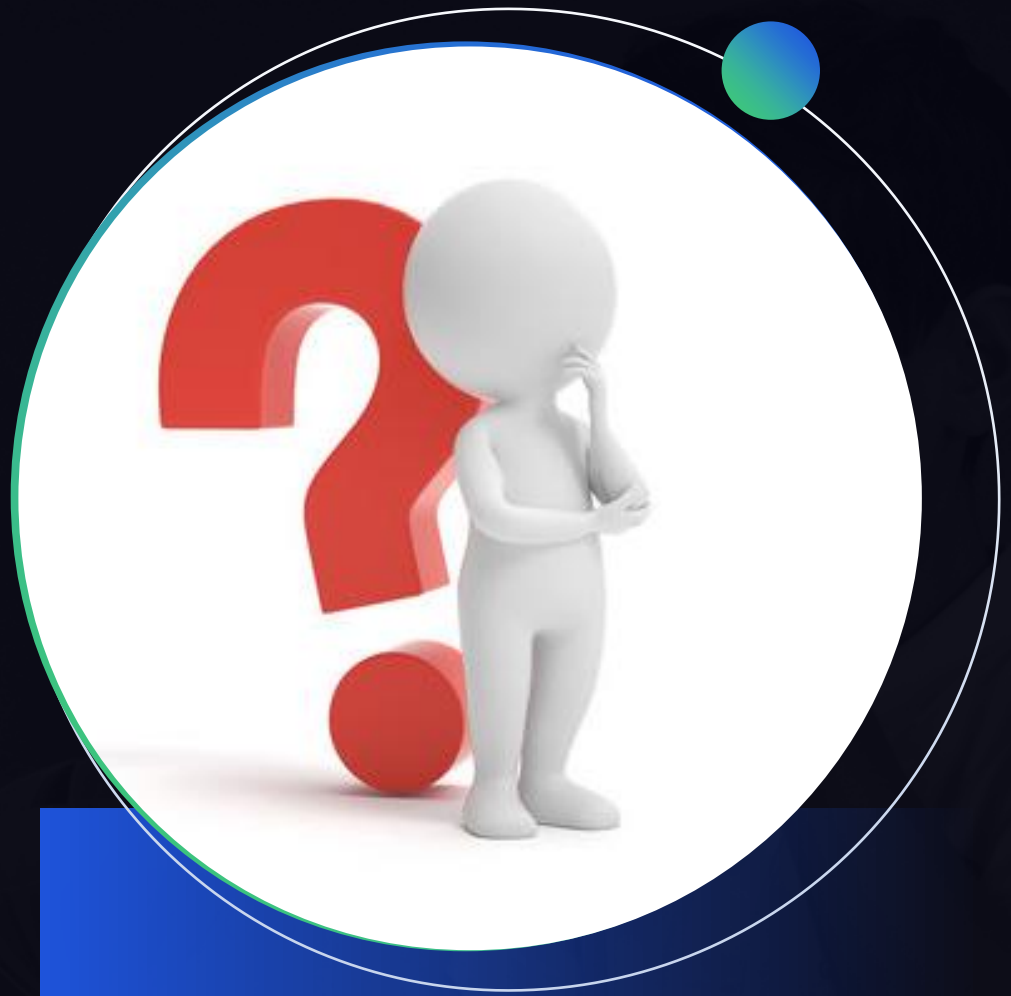
About Smart Glasses

The smart glasses are wearable devices that can work as an extension, for heads-up display (HUD) or remote control of the phone and alert the user to communication data such as calls, SMS messages, emails, and calendar invites.

Literature Review

PAPER	SPECIFICATION	AUTHOR	YEAR
Virtual Smart Glass for Blind using Object Detection	Portable camera based device, used android features , development of an AR device for blind	V.P.Gowtham Raj; E.Esakki Vigneswaran; M. Deshnaa; K. RajPrasanth	2022
Face Recognition-Based Smart Glass for Alzheimer's Patients	To identify a person using face recognition technology. Hardware consists of the Raspberry Pi 4, Pi camera, ultrasonic sensor, and GPS module	Neven Saleh; Aya Ali; Omar Ezzat	2022
Development of an Assistive Device via Smart Glasses	An image enhancement function is used to captured texts that can be expanded and enlarged in the projection monitor of glasses based on face recognition, memory recall mechanism is carried out	Chia-Sui Wang; Wesley Huang; Yih-Feng Chang; Chia-Mao Yeh; Zhi-Yao Xu	2021
Drawing View Method Based On AR Smart Glasses For Auxiliary Assembly Operation	the interactive way of dynamically consulting and displaying the assembly drawing with the head action is proposed in this paper. the experiment of drawing display is designed and the actual running effect is given	Q. Zhao; X. Li; K. Xu	2020

Problem Statement



Existing smart glasses are only for enhancing the user experience , there's no support for differently abled people

Cost of the Smart glasses are really high.

No alternatives for Hands-free experience by visual method.

Our Objective

Helping the Differently abled

To do the Speech-text conversion and Scenario Interpretation

Information Display

To show real-time data, such as weather updates, notifications from different apps in smartphone

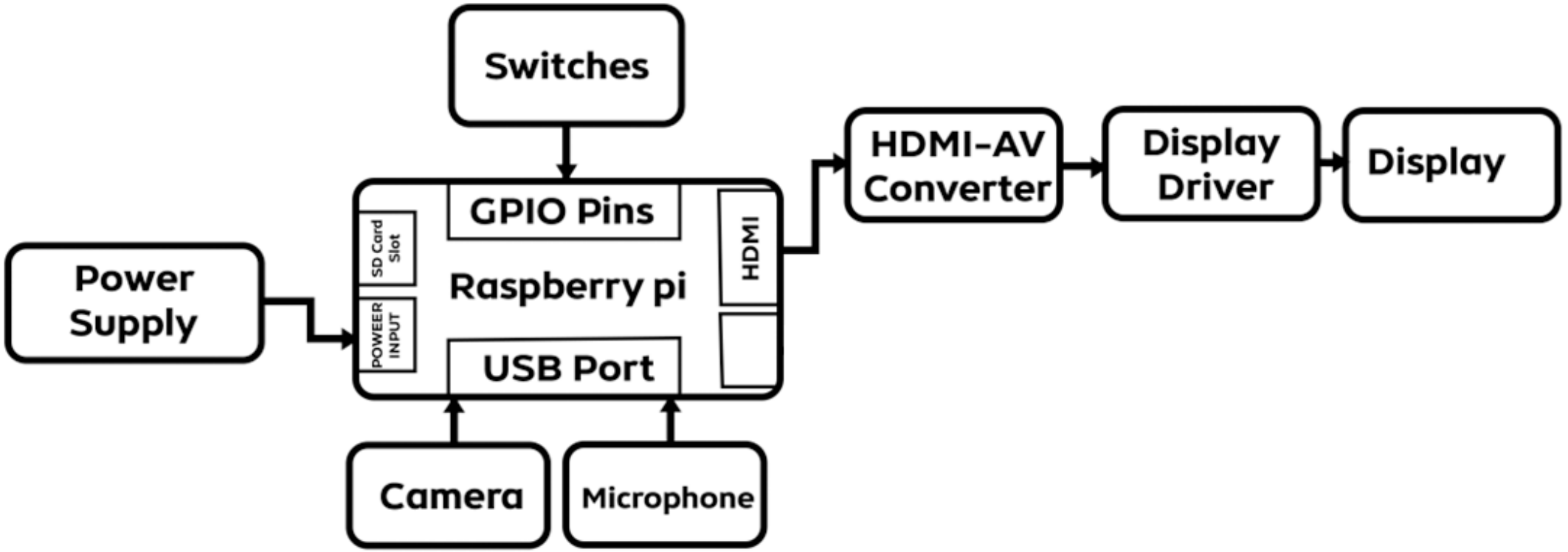
Hand-free Functionality

To make voice enabled functions like google assistant , Alexa

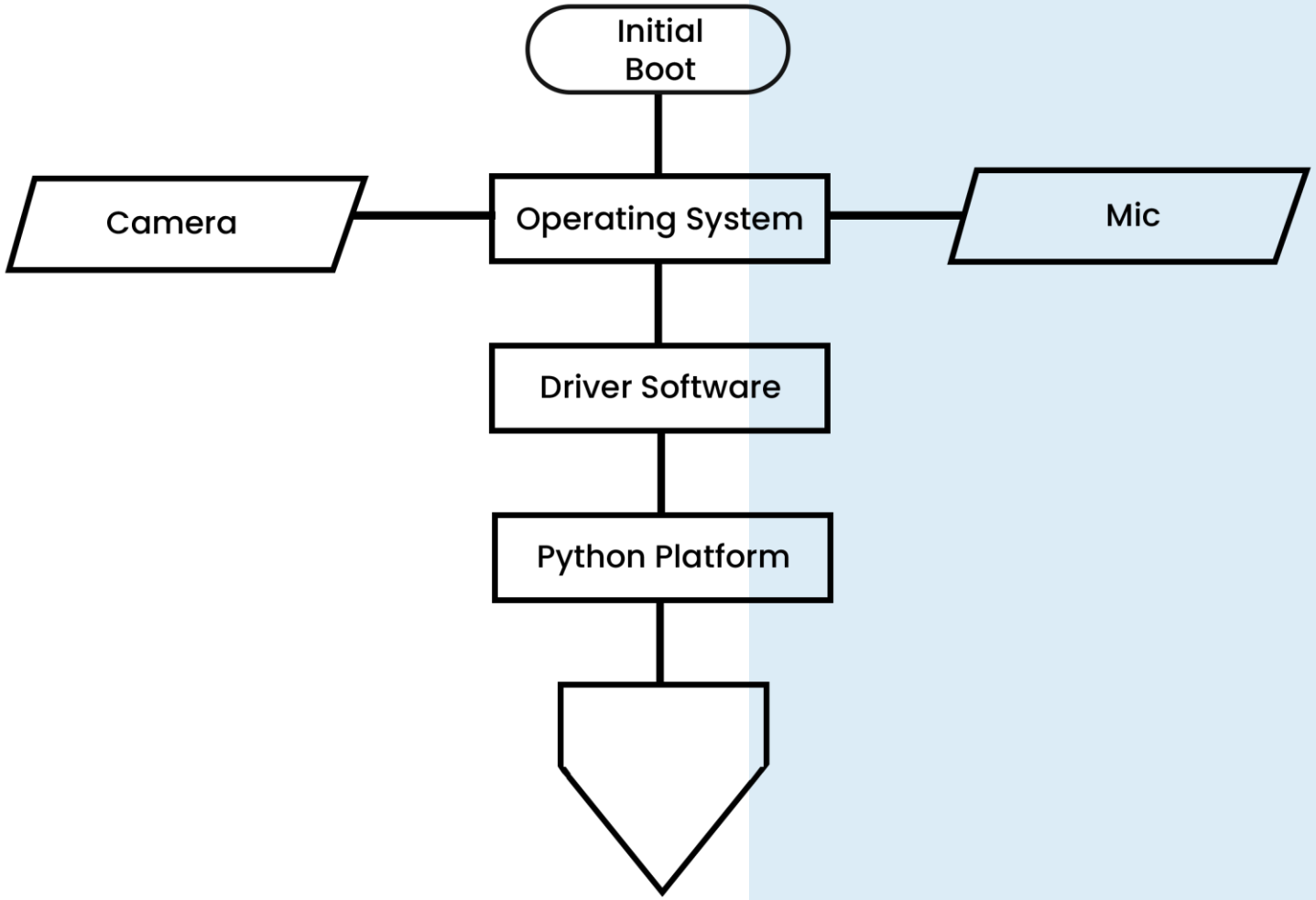
Be futuristic

To explore the new ways of Augmented & Virtual Reality

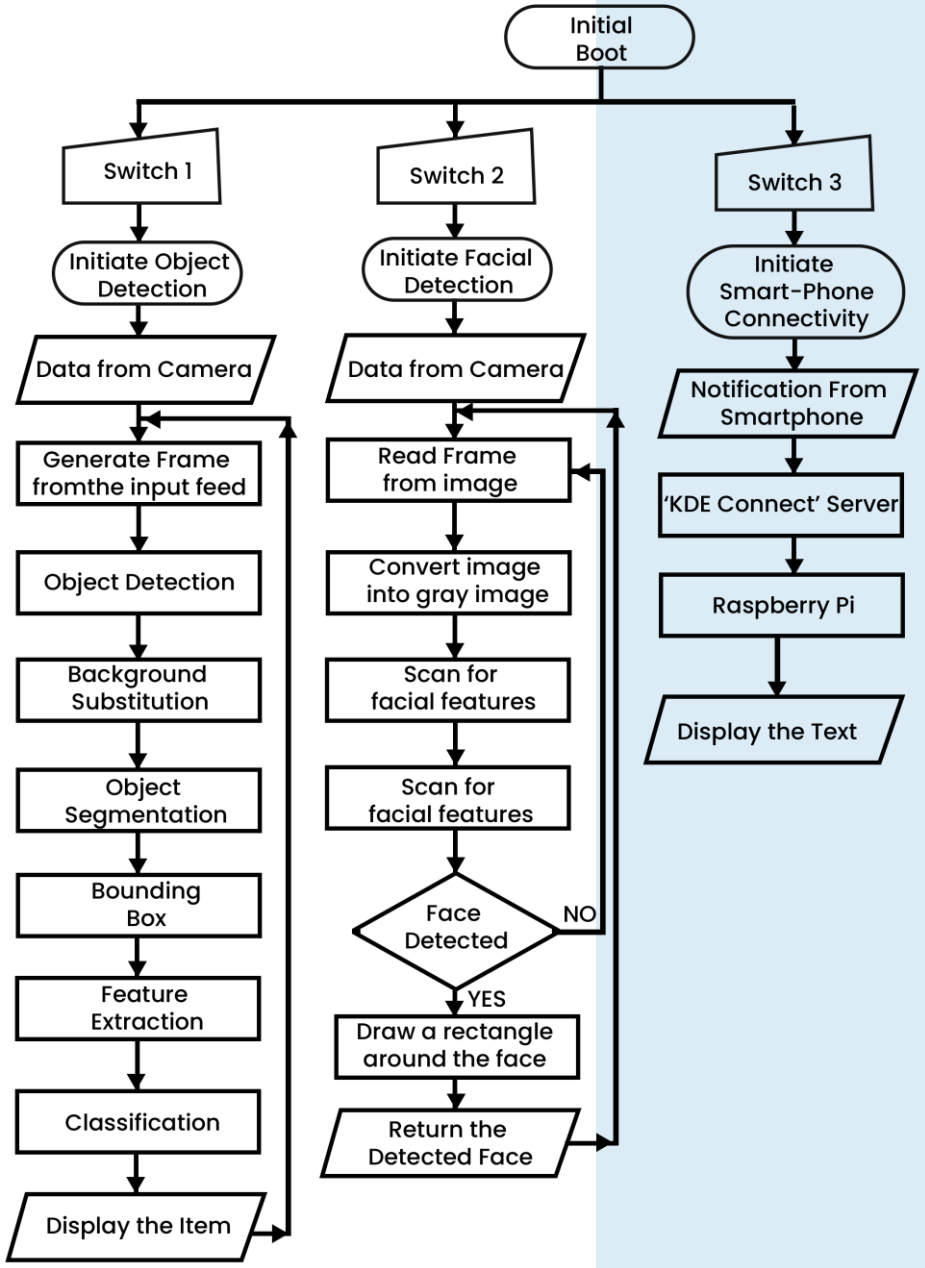
Block Diagram



Flowchart


Initial Boot
Camera
Operating System
Mic
Driver Software
Python Platform

Flowchart


Initial Boot
Switch 1
Initiate Object Detection
Data from Camera
Generate Frame fromthe input feed
Object Detection
Background Substitution
Object Segmentation
Bounding Box
Feature Extraction
Classification
Display the Item
Switch 2
Initiate Facial Detection
Data from Camera
Read Frame from image
Convert image into gray image
Scan for facial features
Scan for facial features
Face Detected
NO
YES
Draw a rectangle around the face
Return the Detected Face
Switch 3
Initiate Smart-Phone Connectivity
Notification From Smartphone
'KDE Connect' Server
Raspberry Pi
Display the Text

COMPONENTS REQUIRED

Hardware

01.

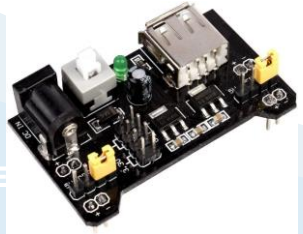
Stereoscopic Display

02.

Display

03.

Raspberry Pi 5



04.

Power Supply

05.

USB Web Camera

06.

Earphone Speaker

07.

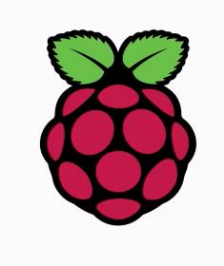
USB Microphone

08.

HDMI-AV

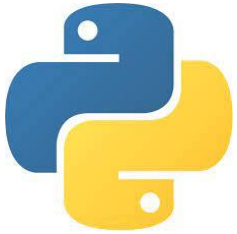
COMPONENTS REQUIRED

Software



01.

Raspbian OS



02.

Python Language

03.

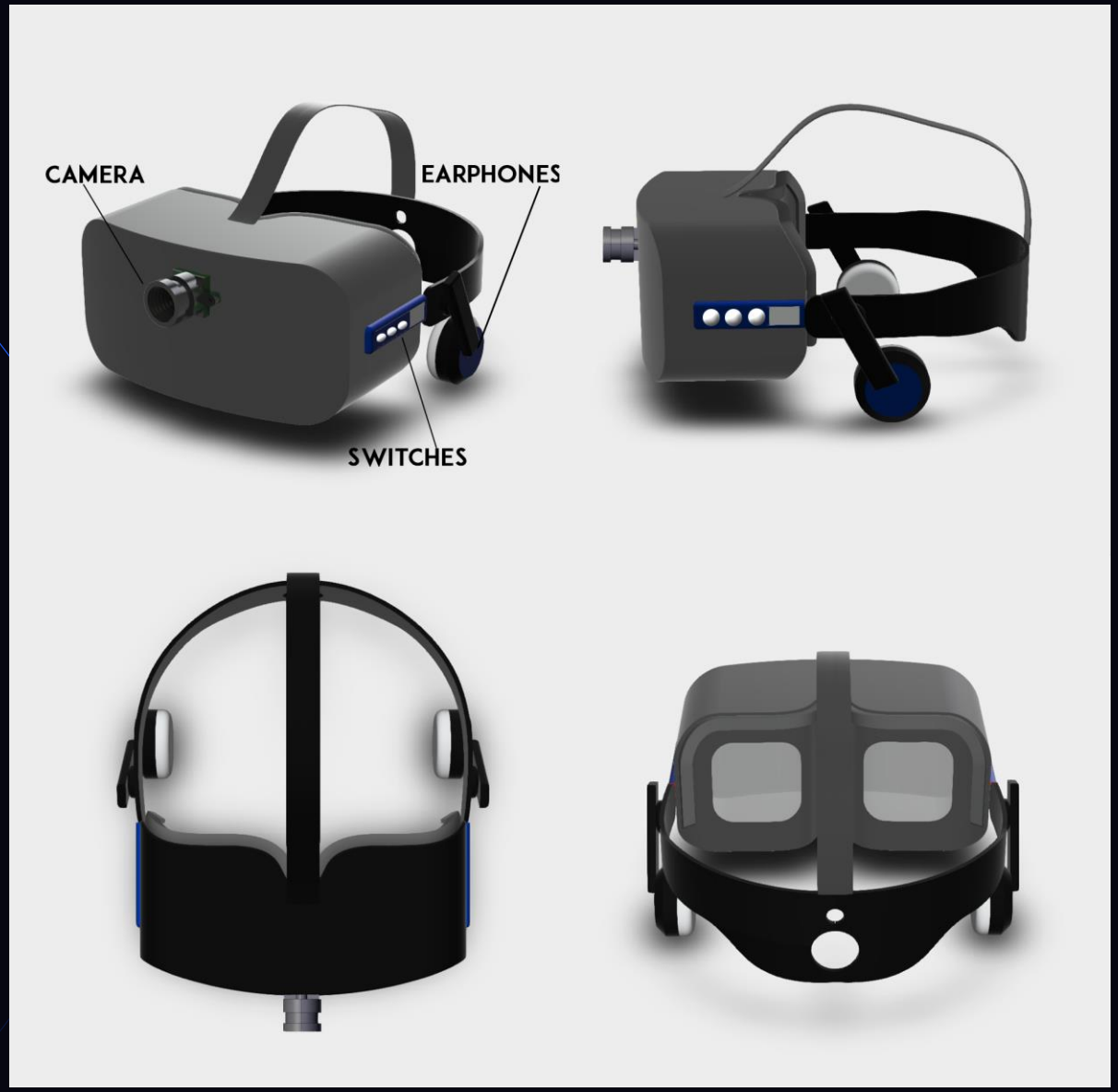
Unity 3D

04.

Open CV

Proposed System

- It can be made as a single unit by combining a stereoscopic display and Raspberry Pi.
- A camera is used to capture live footages and it is then processed using Raspberry pi and it is fed back to display inside the display unit.
- By using a set of switches or by voice commands, the modes or featured can be changed.



Hardware Setup

Result & Observation

Result & Observation

- The ‘Object Detection’ , ‘Face Recognition’ & ‘Smart phone Connectivity ‘ part has been successfully executed in the Raspberry pi .

- Since Raspberry pi is a low power hardware with limited GPU support, the parallel execution of these two applications will be a challenge. The preferred method will be serial execution when the program has been triggered with an external switch.

- The Accuracy test of these Applications are tested and the results are discussed in the coming slides.

Result & Observation

- **Object Detection :**

It’s a pretrained model of objects and animals from COCO Library (Common Object in Context). The library used here will enable our Raspberry Pi will be able to identify 91 unique objects/animals and provide a constantly updating confidence rating.

When it comes to accuracy, it has 87% of accuracy for YOLO algorithm , it clearly identifies and detects the object when the lighting condition is good and has a nice contrast from the background

Result & Observation

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Result & Observation

- As the lighting and contrast becomes low, when there’s a lot of objects lying around, It tends to misinterpret the objects and it provides faulty information.

- The Camera quality also plays a major role in this process. There’s an unsolved issue with the Pi 5s with the camera module, USB web cameras are the only choice left with. The frame rate is lower compared to the camera modules.

Result & Observation

- If the object is big and the frame is full. The Confidence rate will be high. The confidence values and information tends to go wrong as the objects becomes smaller or the distance between the camera and object increases.

Result & Observation

Car is 50 feet away from the camera

All the Below Discussed scenarios are captured early in the morning with poor lighting conditions.

- Based on the Camera we're using It can now detect a car with camera closely placed within 2 feet and from a long distance of 50 feet.

Result & Observation

It classified the wall as a ‘bench’ because it looked like a seat.

Result & Observation

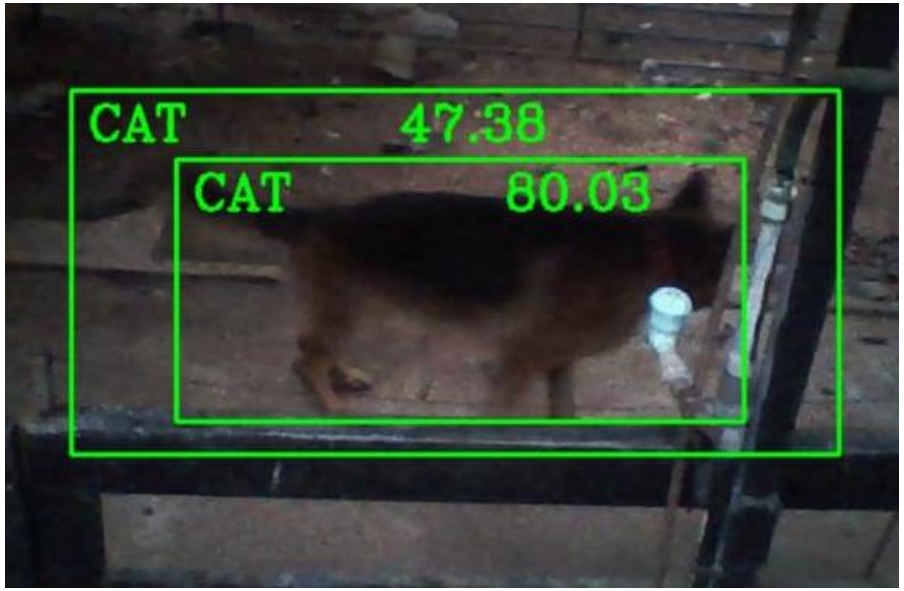
It is capable of detecting a car from all angles

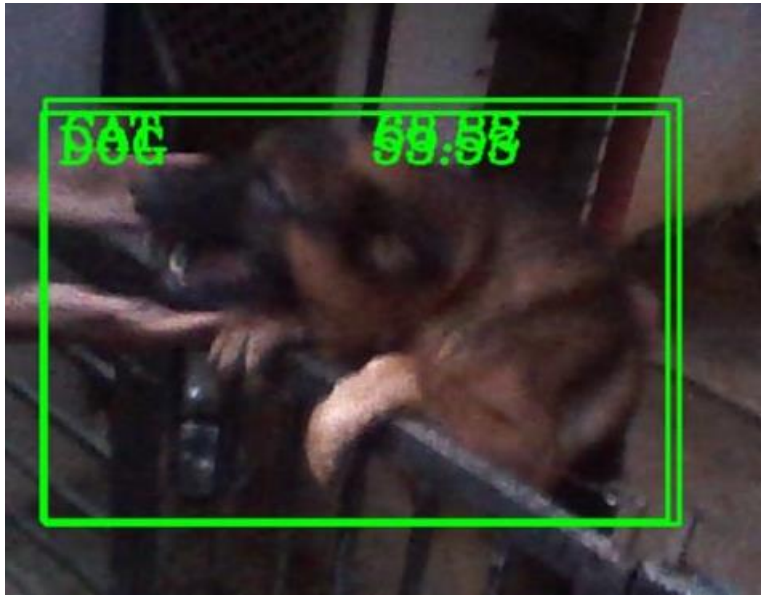
Result & Observation

It misinterpreted the car as ‘truck’ and ‘suitcase’

in two scenarios. (Due to bad lighting)

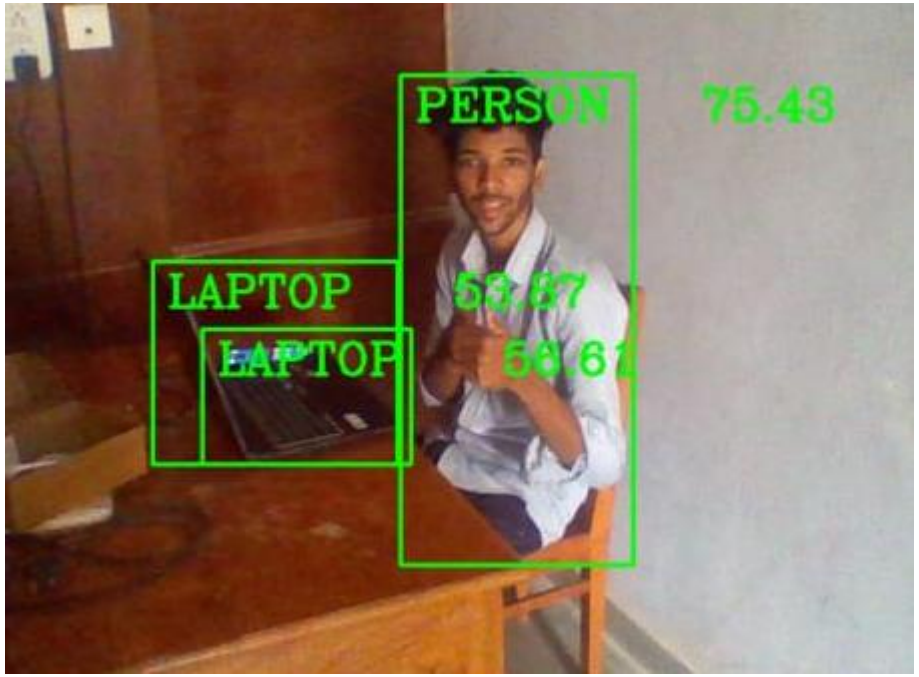
Result & Observation

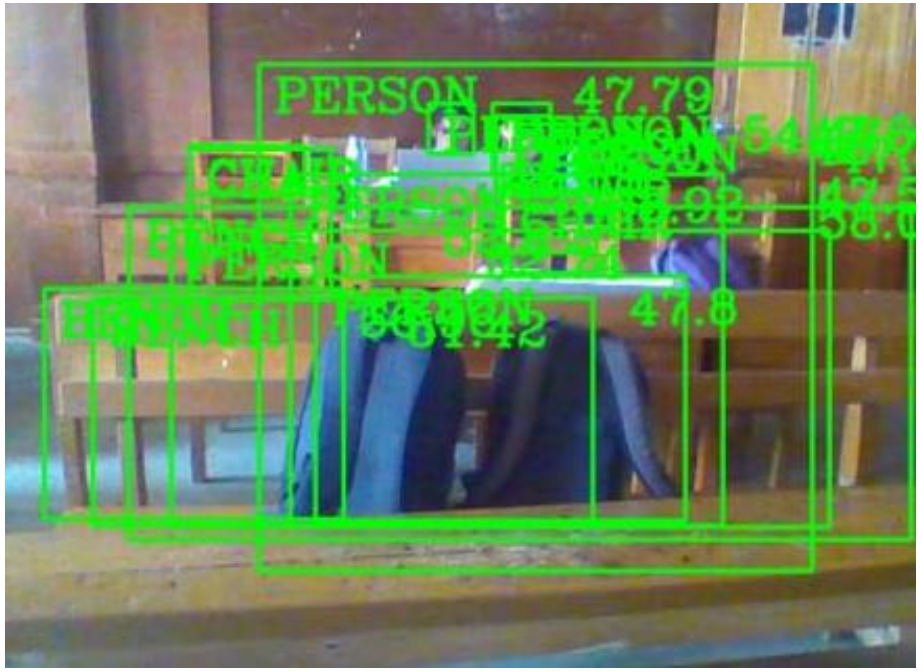




In the all 3 attempted scenarios the Dog was not clearly detected. It got confused with a cat.

Result & Observation

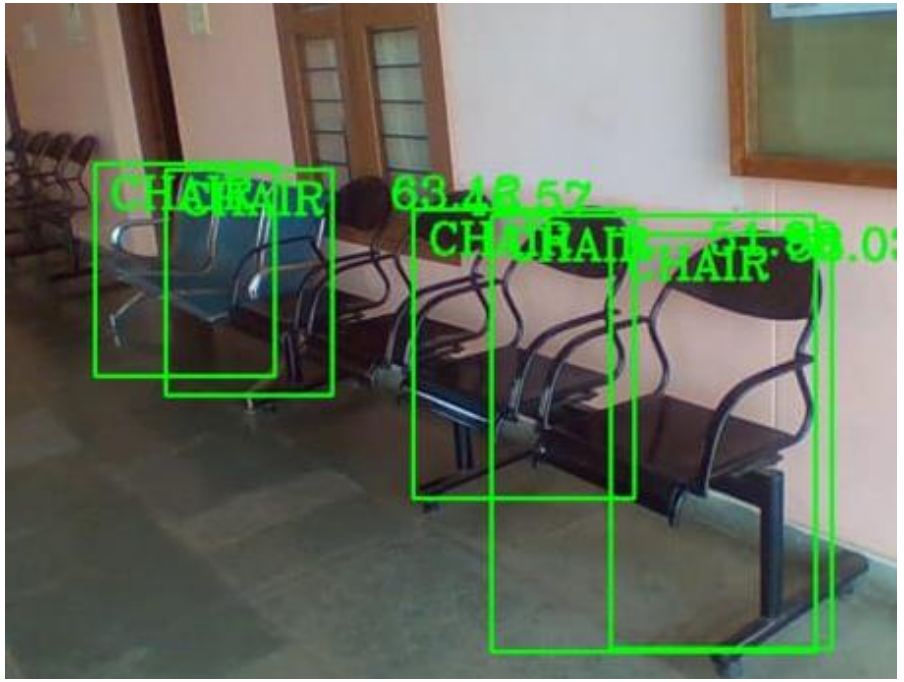




Objects are detected with good accuracy at indoor lighting condition

Result & Observation

All the Below Discussed scenarios are captured in the morning with Good lighting conditions.



Result & Observation

In Outdoor with good lighting condition , the output was accurate to an extend

Result & Observation

The Cars were misinterpreted as cellphones due to variation in angles

Result & Observation

- **Face Recognition :**

It uses Haar Cascade Algorithm for face recognition process and it is not a pretrained library. We've to train the model with the dataset of each individual.

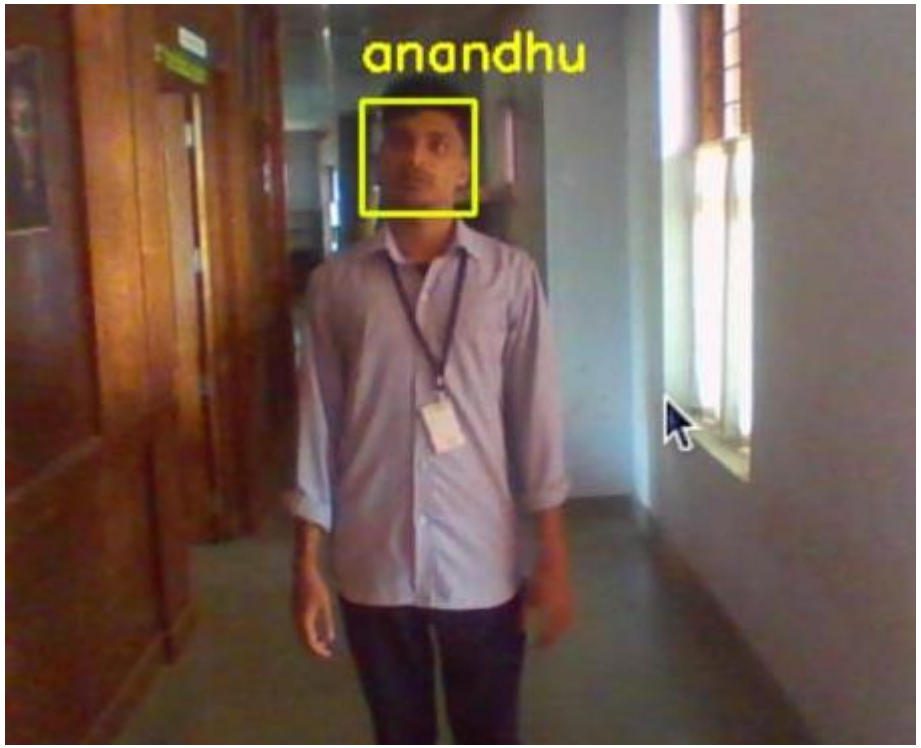
As the number of photos used in training increases the accuracy also improves. Since Raspberry is a low power device there are limitations in increasing the quantity of dataset.

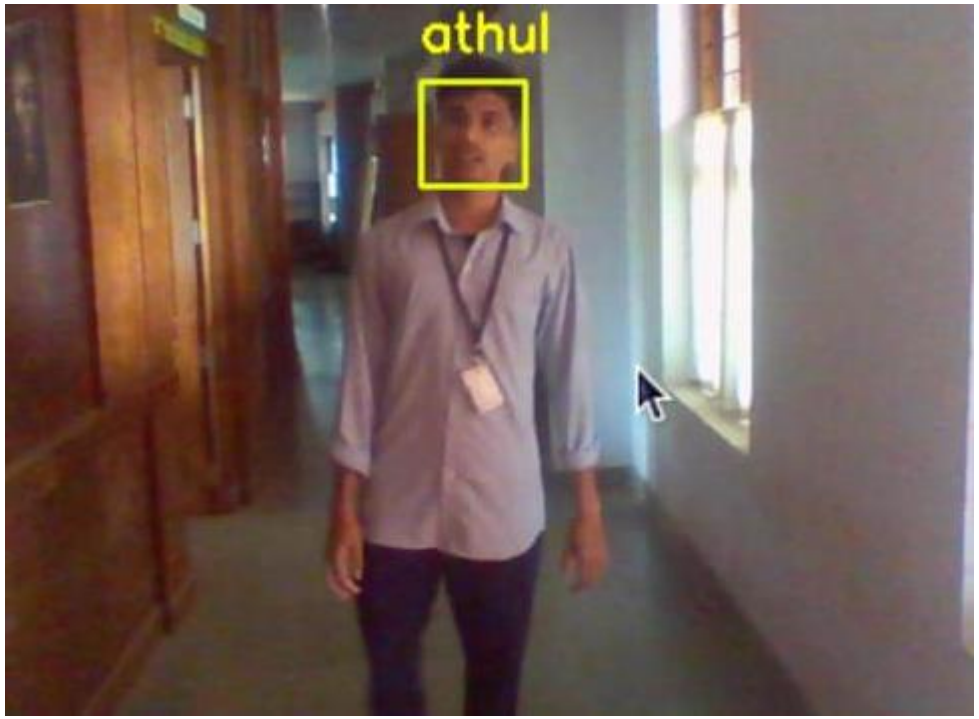
Result & Observation

As of now the data of 7 persons are trained and it’s able to detect the person with good lighting condition, similarly like object detection all the factors mentioned earlier also matters here.

But the problem with the facial recognition is that since this is not a pretrained model, the processing is heavy for the hardware and device struggles when the number of persons in the frame increases. Frame drops and lagging occurs. It is recommended to appear one person in frame at a time.

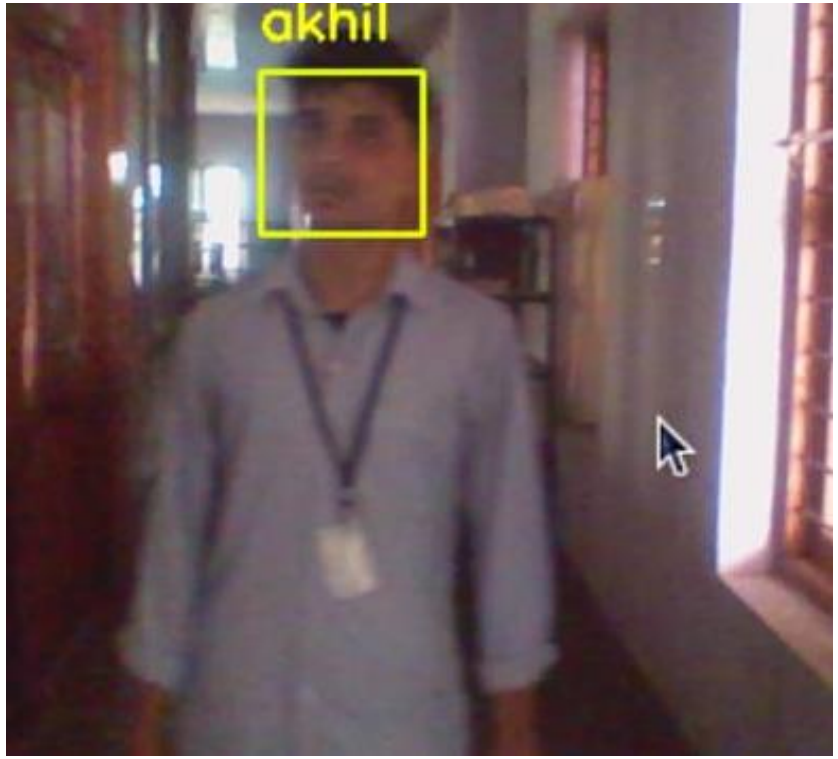
Result & Observation





In poor lighting condition the results are wrong

Result & Observation



Sometimes it shows correctly even at poor lighting situations.

Result & Observation

In the outdoor light, the results were accurate

Result & Observation

Side view data was not trained and it can detect face at a slight angle

Result & Observation

Smart Phone Connectivity :

Connectivity feature is enabled with the help of a platform called ‘ KDEConnect ‘. The Pi is able to fetch the Text Messages from the smartphone. Since it is in the developing stage it’s only able to display Text messages. Social media noitification acces is still under process.

ADVANTAGES

AR Capabilities

They can overlay digital information onto the physical world, providing valuable context and enhancing experiences in fields like medicine, engineering, and gaming.

Information Access

Users can access information such as notifications, directions, or even video calls directly in their field of vision, reducing the need to constantly check a smartphone or another device.

Enhanced Productivity

In work environments, smart glasses can aid in tasks that require real-time data or instructions, offering hands-free guidance and assistance.

Accessibility

They can assist people with visual/ hearing impairments by providing audio descriptions or enhancing their ability to perceive the world around them.

Hands-Free Functionality

Smart glasses allow users to access information without having to use their hands, enabling multitasking and convenience in various activities.

CHALLENGES

Privacy Concerns

Recording capabilities in smart glasses raise privacy issues, as they can capture images or videos without the knowledge of those around the user.

Social Acceptance

The conspicuous nature of smart glasses can make wearers stand out, leading to social acceptance issues in some contexts.

Limited Battery Life

Many smart glasses have limited battery life, which might be a challenge for users who require prolonged usage.

Technical Limitations

Current technology may not be advanced enough to seamlessly integrate with a wide range of applications, leading to technical glitches or limited functionality.

Cost

Smart glasses can be expensive due to their internal components which might make them inaccessible to many potential users.

APPLICATIONS

- Object Detection
- Facial Detection
- Smartphone Connectivity

Proposed Budget

Raspberry pi 5	Rs. 8,650
USB Web Camera	Rs. 2,200
Display unit	RS. 2,000
HDMI – AV Converter	RS. 300
Miscellaneous	Rs.700
Total Cost	Rs. 13,850

Project Plan

MONTH	WEEK	PROPOSED IDEA	STATUS
SEPTEMBER	1st Week	Literature Review discussion	Discussed
	3rd Week		
OCTOBER	1st Week	Research about the Proposal Idea	Proposal Idea Created
	3rd Week		
NOVEMBER	1st Week	Research about the Components	Created the List of Required Components
	3rd Week	Preparation of Presentation	PPT Prepared
DECEMBER	1st Week	Project phase 1 final presentation	Completed
	3rd Week	Ordering required components	Components Received

Project Plan

MONTH	WEEK	PROPOSED IDEA	STATUS
FEBRUARY	1st Week	Assembling of Hardware Parts	Completed
	3rd Week	Integration of software & Hardware	
MARCH	1st Week	Project Completion	90% Completed
	3rd Week	Conference Presentation Preparation	Completed
APRIL	1st Week	Preparation of Report	Report Preparation 80% completed
	3rd Week	Final Presentation	Pending

REFERENCES

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Thank You !