ACADEMY OF TECHNOLOGY

Department: ECE

Subject Code: EC-881

Semester: 8th

Final Year Project Progression Report

OBJECT IDENTIFICATION & MOTION DETECTION USING DEEP LEARNING

SUBMITTED BY:

- MAINAK BHATTARJEE (16900320076)
- SAYAN PACHHAL (16900320087)
- KOUSTAV MAJI (16900320088)
- SARBADRITA BHATTACHARJEE (16900320091)
- ABIR BHOWMICK (16901620026)

MENTOR:

PROF. BASAB CHATTERJEE

CONTENT

PROGRESSION MAP

1 UNDERSTAND

The increasing demand of the security lead us to select this topic. At first we read how the things work from different site , take help from a course form COURSERA. Then sum up the things to build our plan

2 DEFINE

We have noticed that only Motion detection will not make us different from the others. So we planned to add Object Identification part too. And our main motto was to provide this things at reasonable price.

3 IDEATE

We have divided our team into 3 segment & each part of our team working on the different portion of the project

4 COMPLETION OF SOFTWERE PART

Till now we have done the coding part for the motion detection part & working on the object detection part. Later on we will be exporting all these into hardware for testing the same

5 TESTING & FUTURE PLAN

Importing all our code in the hardware, we will be testing it in real-life scenario to achieve better observation & result. Later we will think to scale up this project in future

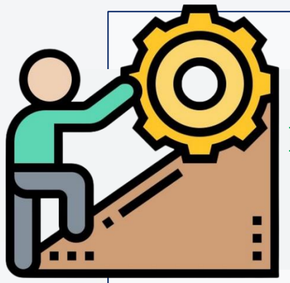
ABSTRACT

IMPORTANCE

Object identification and motion detection are vital in computer vision for applications like security, traffic management, and self-driving cars.

FOCUS

Develop a robust and accurate method for object detection and tracking.



CHALLANGES

Detecting and tracking moving objects amidst dynamic scenes with variable backgrounds and lighting poses a significant challenge.

METHODOLOGY

Utilize advanced techniques such as deep learning and neural networks to enhance accuracy and adaptability to changing conditions.

OBJECTIVE

Propose an AI-based approach leveraging deep learning and neural networks.

APPLICATIONS

The proposed approach has implications across various sectors including security, transportation, and autonomous vehicles.

INTRODUCTION

SCOPE

Focus on image processing, particularly object identification and classification.

OBJECTIVE

Develop a software toolkit for object recognition.

CHALLANGES

Address complexities including diverse objects, backgrounds, and lighting conditions.

IMPACT

Empower users to analyze and recognize objects in images of unknown content for various applications.

TASKS

Divided into image classification, object localization, and detection.

FRAMEWORK

Leverage OpenCV, a versatile open-source library for computer vision and image processing.

ALGORITHM

Optical flow (for motion detection) & YOLO v8 (for object identification).

APPROACH

Utilize AI techniques like deep learning and neural networks.

REVIEW OF PREVIOUS WORK

- Existing security surveillance cameras only provide the visual feed of the place where they are installed, which requires constant human monitoring.
- Our device provides the feed as well as the warning mail and alarm if any movement happens at the proctored area, which reduces the need for human intervention.
- Our device also tries to identify the type of the object that is moving, which adds an extra benefit for security and analysis.

PRICE COMPARISON

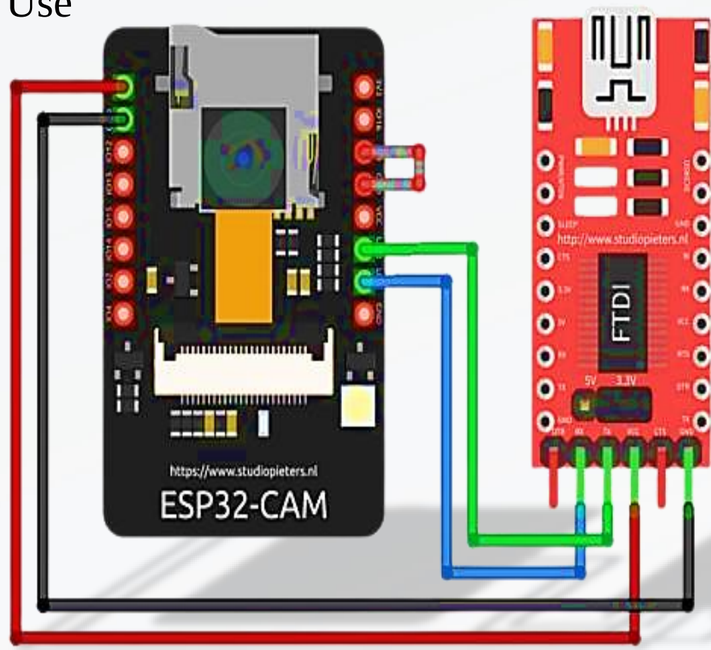
Already available product

- ✓ For Indoor Security Camera Use
- ✓ Night Vision Feature
- ✓ Smart Motion Detection
- ✓ SD Card Capacity: 128 GB
- ✓ HD Quality Video
- ✓ Smartphone Viewing
- ✓ Supports Onvif

Regular Price: **₹2,399.00**
Sale Price: **₹1,699.00**

Our Product

- ✓ For Indoor Security Camera Use
- ✓ Night Vision Feature
- ✓ Motion Detection
- ✓ Object Identification
- ✓ Storage Enhancement
- ✓ Less power consumption
- ✓ Instant mail alert



Estimated Price				
ESP32	**FTDI**	**Micro-USB Cable**	**Jumper Wire**	**Total**
₹1079	₹249	₹149	₹84	₹1561

THEORETICAL BACKGROUND

Key Technologies of Computer Vision: Object Identification & Motion Detection are two key technologies of Computer Vision

Motion Detection Algorithm: Optical flow algorithm are a subfield of computer vision that quantify the motion of objects between consecutive frames captured by a camera. They capture the apparent motion of brightness patterns in an image and calculate a velocity for points within it. .

Theoretical Background

Detection of Object Type Causing the Motion: The object which is responsible to creating the motion depending on which response will be provided to user

Object identification Algorithm: The YOLO(You Look Only Once) algorithm divides the input image into a grid of cells, and for each cell, it predicts the probability of the presence of an object and the bounding box coordinates of the object..

LITERATURE SURVEY

Deep learning-based object identification

Deep learning algorithms have been shown to be very effective for object identification tasks. Deep learning-based object identification algorithms are able to learn complex patterns in data, which allows them to identify objects even in challenging environments.
https://www.mdpi.com/2076-3417/10/9/3280

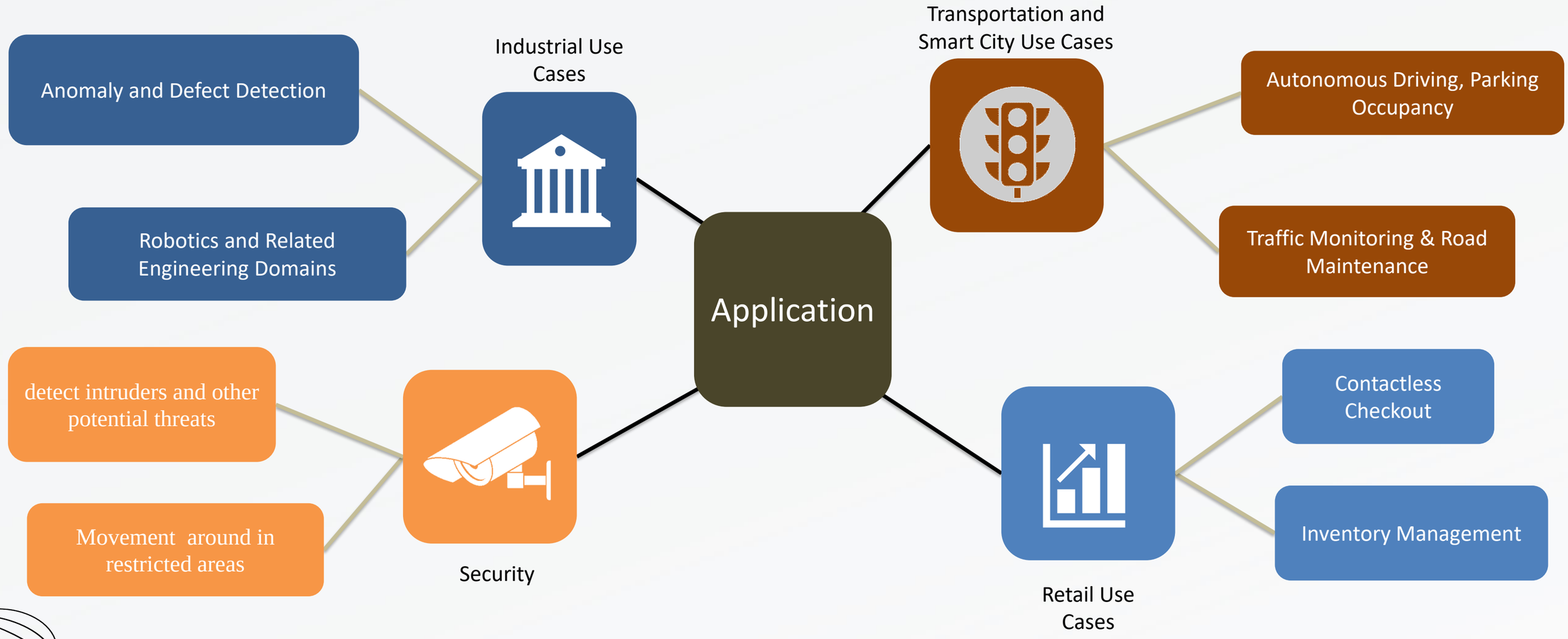
3D object identification

3D object identification is a challenging problem, but there has been significant progress in recent years. 3D object identification algorithms can now be used to identify objects in real-time from video sequences.
https://www.sciencedirect.com/topics/computer-science/3d-object-detection

Motion sensing with low-cost sensors

Researchers have developed new motion sensing algorithms that can be used with low-cost sensors such as cameras and ultrasonic sensors. This has made it possible to develop affordable motion sensing systems for a wide range of applications.
https://www.mdpi.com/1424-8220/20/23/6819

APPLICATION



REQUIREMENTS

Hardware Requirements

- USB cable: Features two sets of wires. One set carries the current, other transfers the data signals.
- Jumper wires (female to female): used to connect any development board, have connector pins at each end, allow them to connect two points to each other.
- ESP32 cam Module: A single 2.4 GHz Wi-Fi-and-Bluetooth combo chip. low-power technology
- OV2640 Camera:2MP Mini CCM Compact Camera Modules Compatible with ESP32 Development Board
- FTDI: implement the USB protocol stack, which allows them to tell the computer what they are so that the computer can load the correct driver, also manage data transactions with the computer.

Software Requirements

- Python: High-level programming language known for its simplicity, readability. Python modules used in this project are: OpenCV, YOLO, Supervision, MIME etc.
- Arduino UNO: User-friendly integrated development environment (IDE) tailored for programming Arduino microcontroller boards.
- PyCharm: A popular integrated development environment (IDE) for Python programming

DESIGNING PROCESS

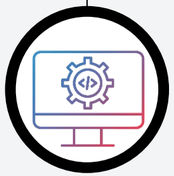
Step-1
Hardware Setup

Connect ESP32 to FTDI and then to a laptop/desktop using a USB cable. This step establishes the physical connection between your ESP32 and your development environment.

Step-2
Controller Configuration

Write the script in the Arduino IDE for programming the Controller Board (ESP32) and to obtain its IPV4 address in URL form.

Step-3
Software Development



Develop a Python script in any IDE (like PyCharm, VS code etc.) for object identification and motion detection which will use that URL obtained from the Arduino IDE to communicate with ESP32.

Step-4
Project Deployment

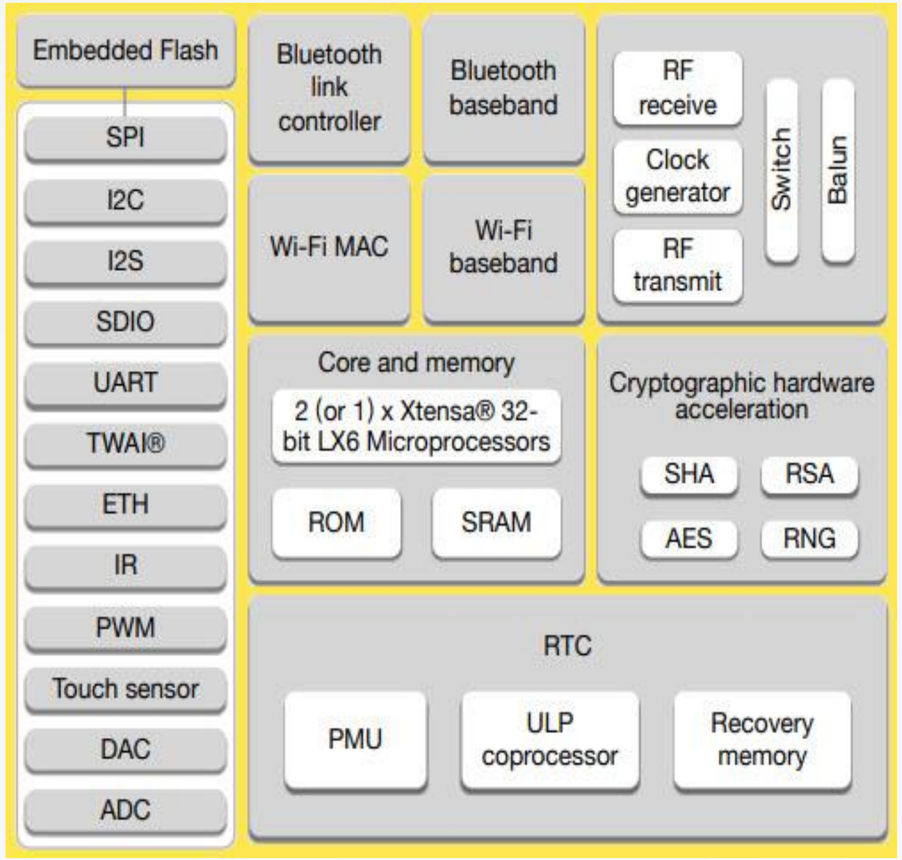
Deploy and test the system in a real-world environment where you want to monitor for movement.

Step-5
Alert System

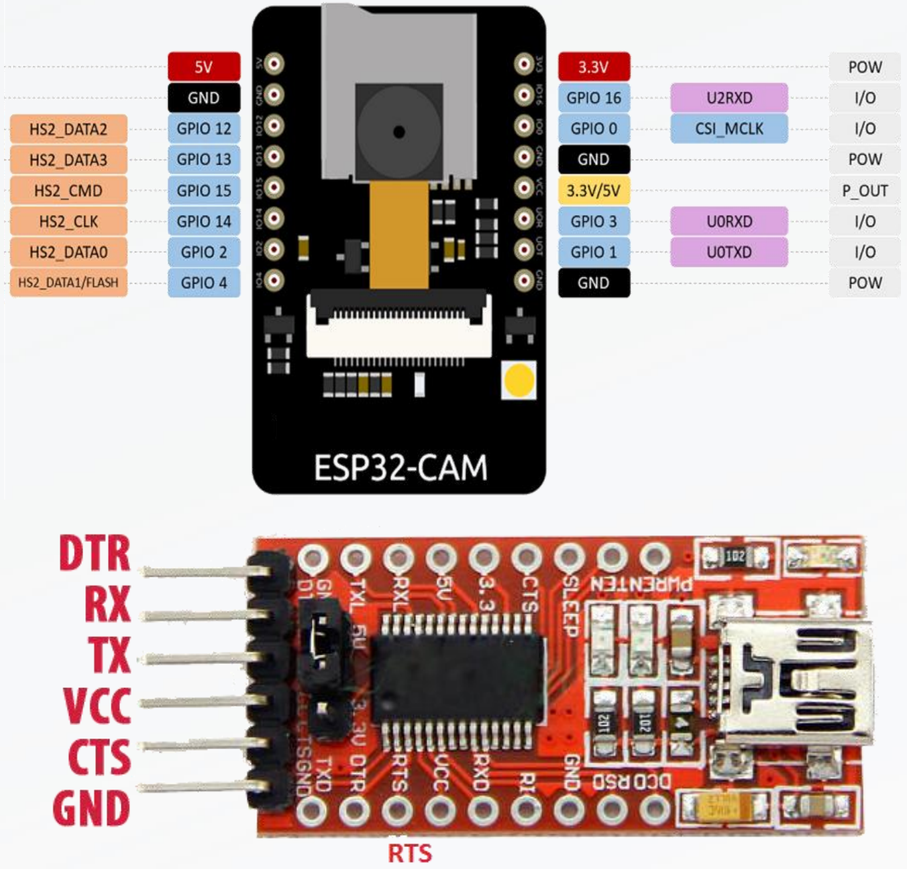
Implement an alert system in your Python script to send an email notification whenever motion is detected. The email includes e the name of detected object that creating the movement.

FUNCTIONAL DIAGRAM

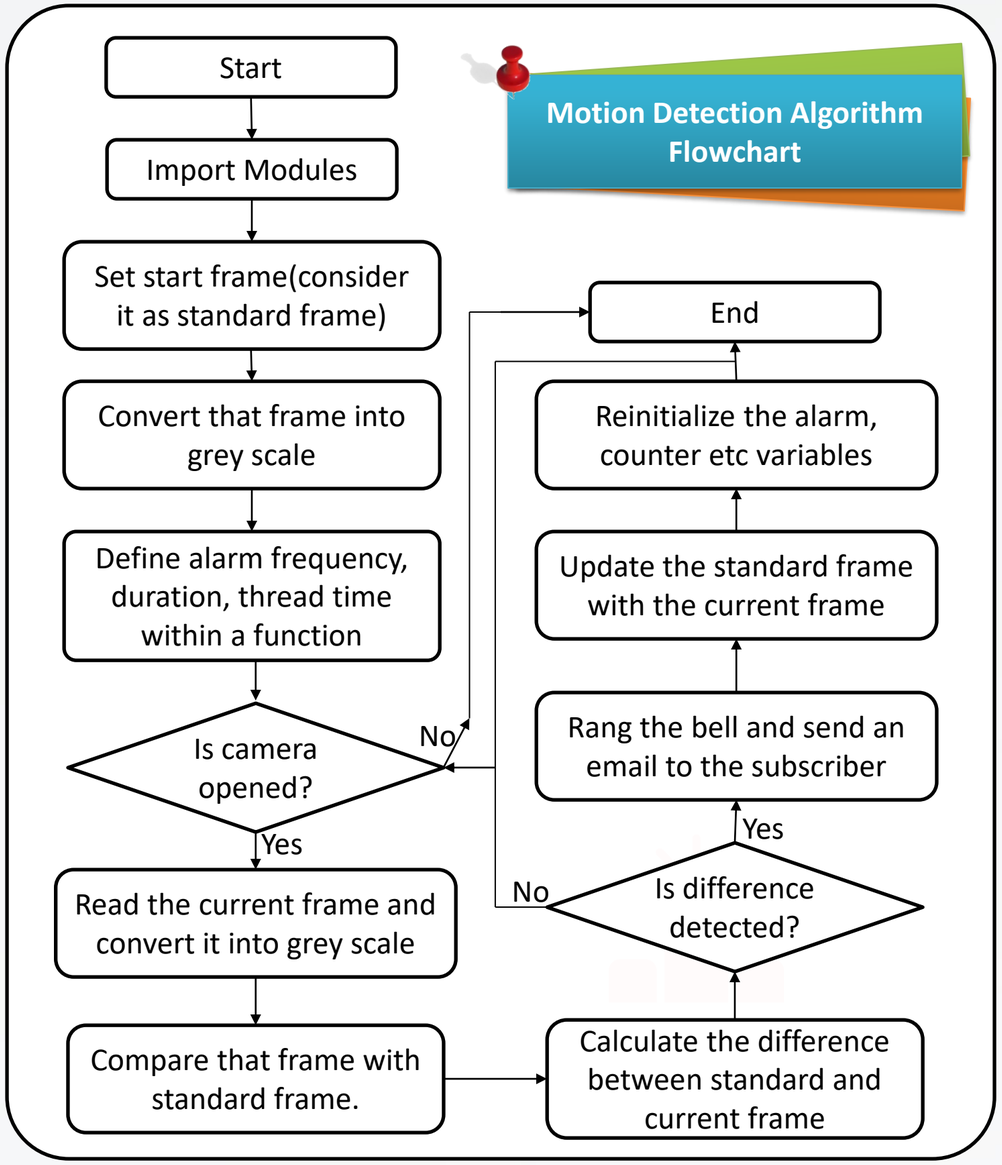
BLOCK DIAGRAM

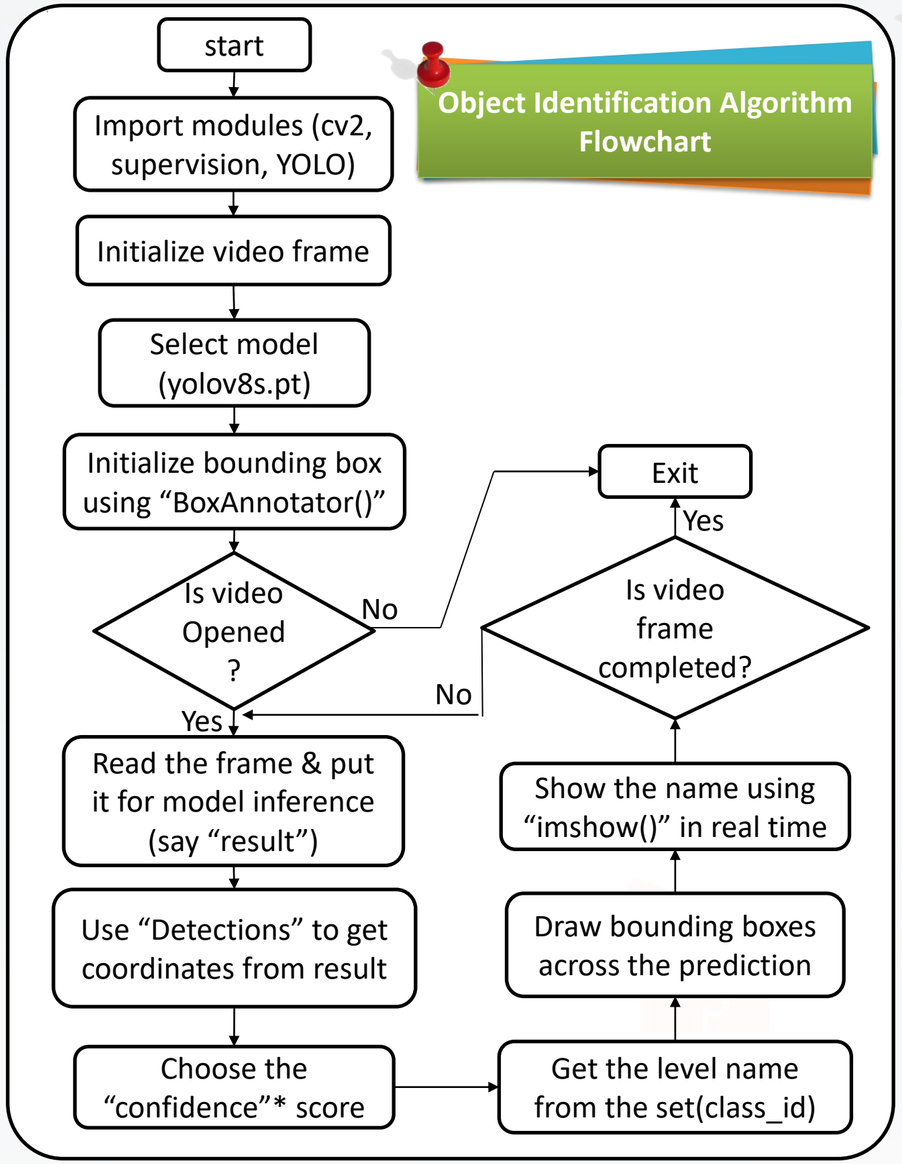


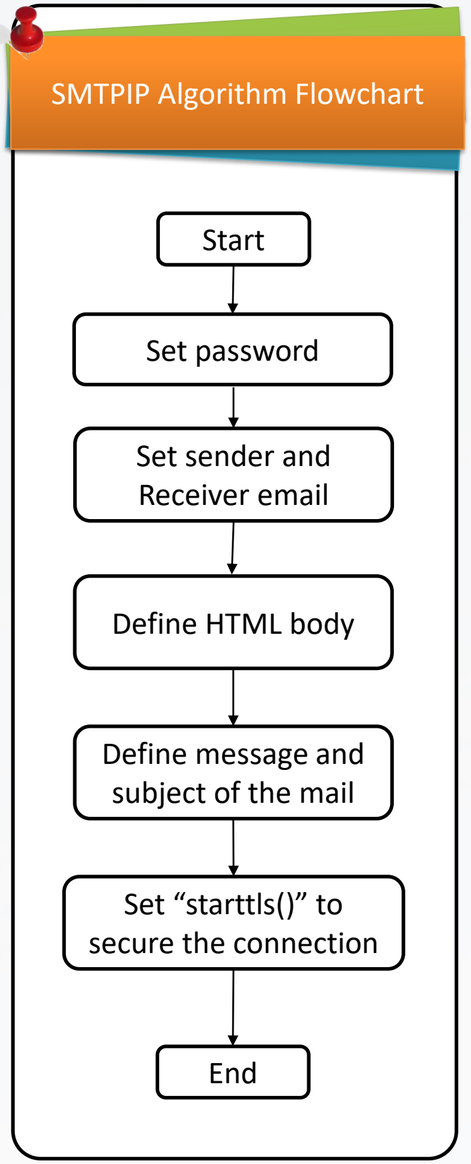
PIN DIAGRAM



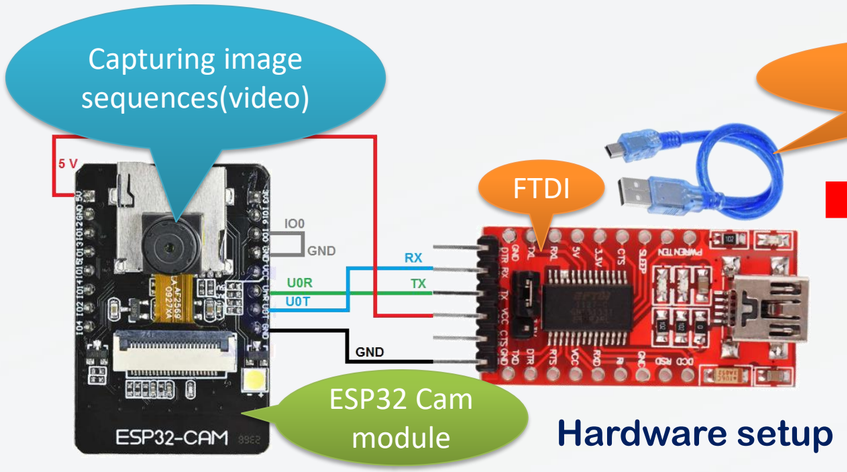
FLOWCHART

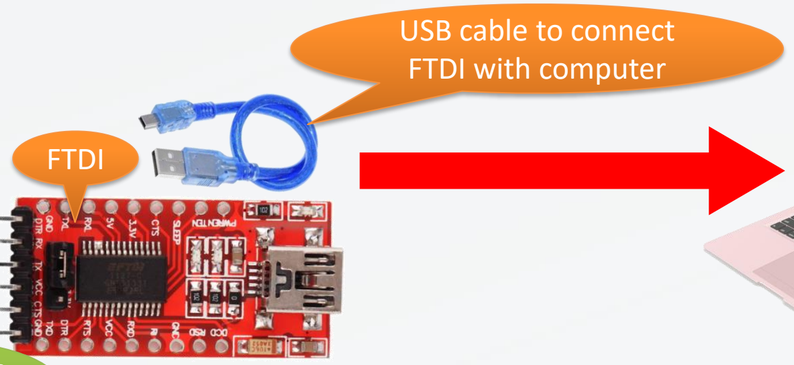

Motion Detection Algorithm Flowchart
Start
Import Modules
Set start frame(consider it as standard frame)
Convert that frame into grey scale
Define alarm frequency, duration, thread time within a function
Is camera opened?
No
Yes
Read the current frame and convert it into grey scale
Compare that frame with standard frame.
Calculate the difference between standard and current frame
Is difference detected?
No
Yes
Rang the bell and send an email to the subscriber
Update the standard frame with the current frame
Reinitialize the alarm, counter etc variables
End


Object Identification Algorithm Flowchart
start
Import modules (cv2, supervision, YOLO)
Initialize video frame
Select model (yolov8s.pt)
Initialize bounding box using “BoxAnnotator()”
Is video Opened ?
No
Yes
Read the frame & put it for model inference (say “result”)
Use “Detections” to get coordinates from result
Choose the “confidence”* score
Get the level name from the set(class_id)
Draw bounding boxes across the prediction
Show the name using “imshow()” in real time
Is video frame completed?
Yes
No
Exit


SMTPIP Algorithm Flowchart
Start
Set password
Set sender and Receiver email
Define HTML body
Define message and subject of the mail
Set “starttls()” to secure the connection
End

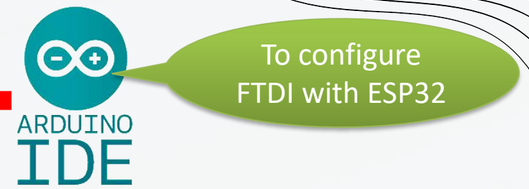
HOW IT WORKS



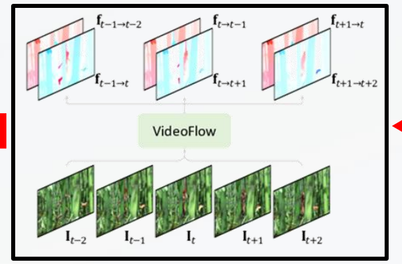


Hardware setup

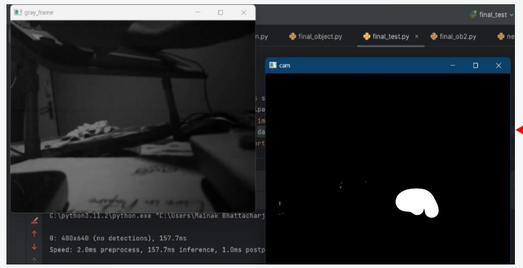
Computer to write and run the code



Python program has developed in PyCharm software to run



One by one video frame comparison



Motion Detected

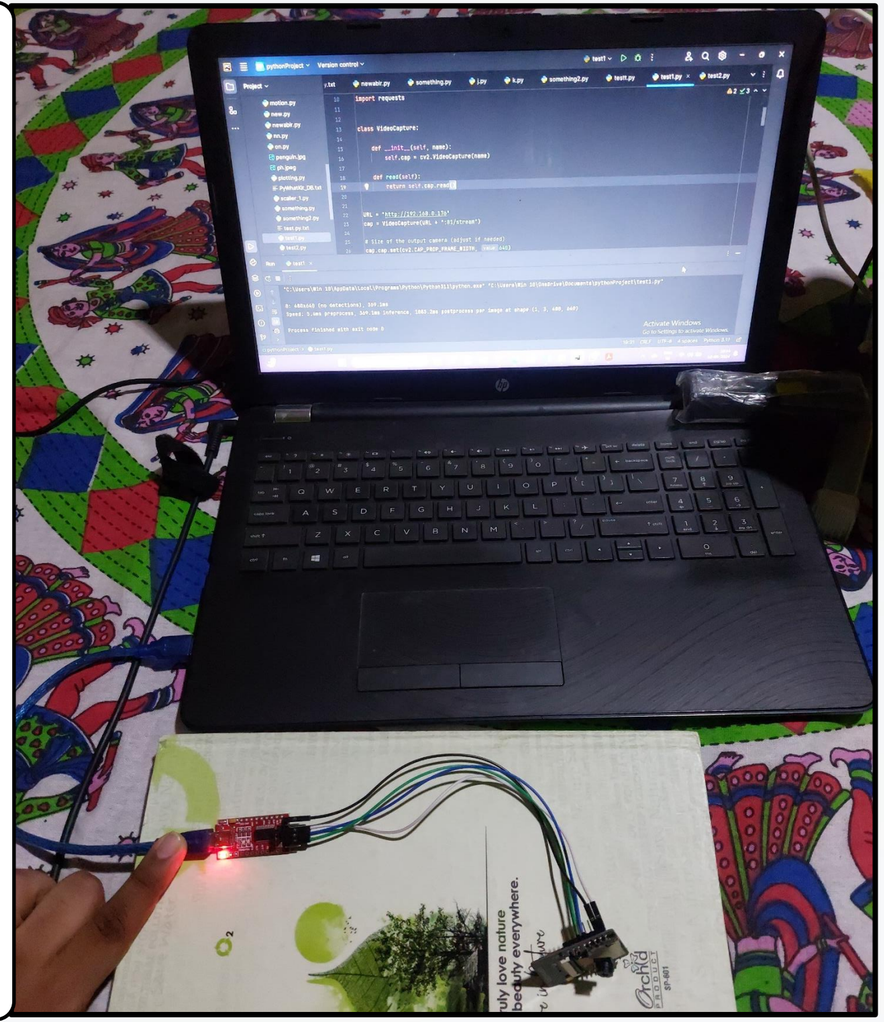
The code will find the similarity percentage from the inbuild dataset and will predict the object's name which is creating movement

Output

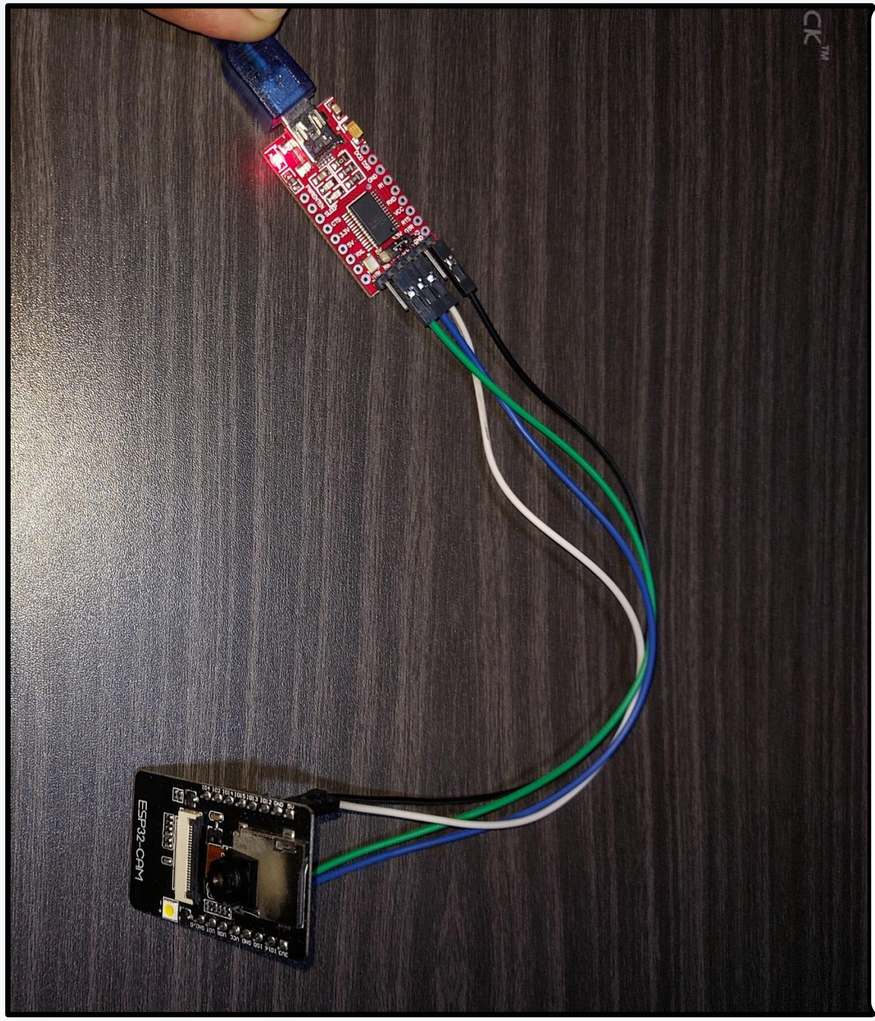
The alert mail

CONNECTIONS

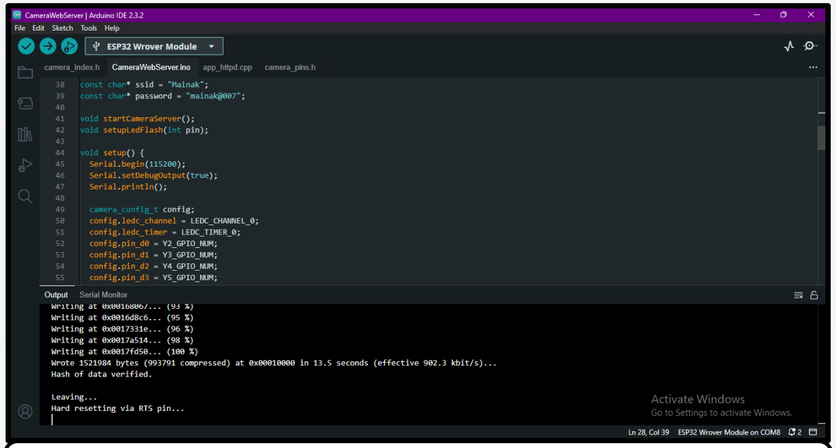
1. Connection of ESP32 with FTDI and Laptop



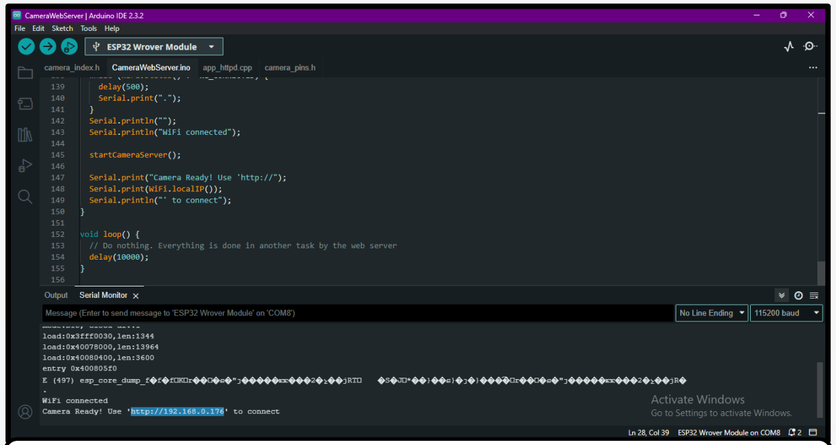
2. Connection of ESP32 with FTDI



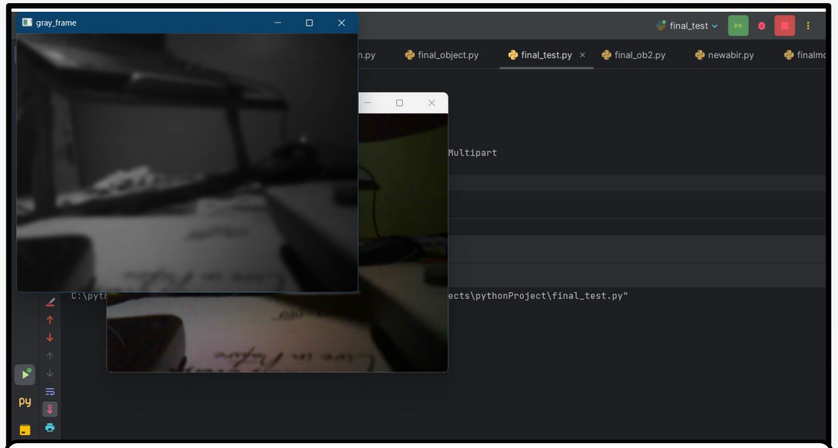
RESULT



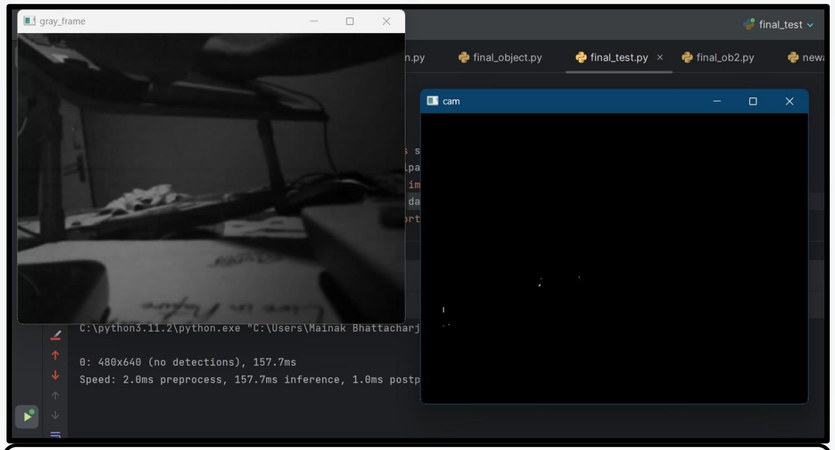
1. Connecting FTDI with ESP32 CAM



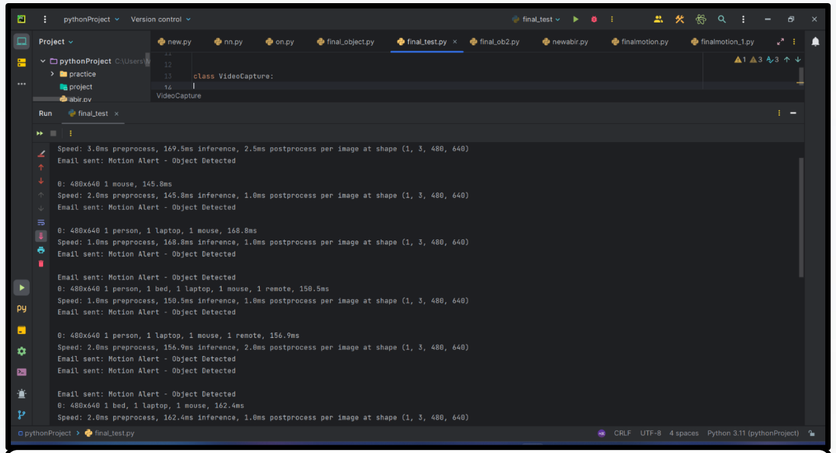
2. Getting IPV4 address from Arduino IDE



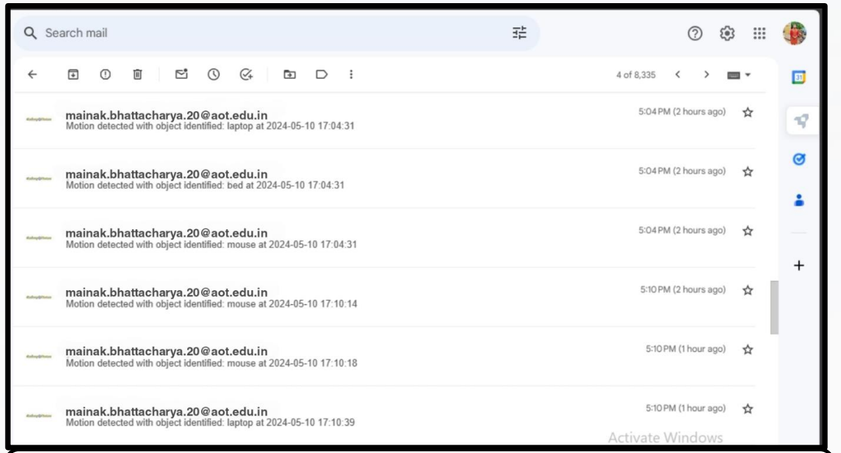
3. Initializing the camera, converting the frame in grey scale



4. Tracking of white spot by comparing (i.e. the motion)



5. Getting output as the name of moving object



6. Sending Alert Mail to the subscriber

RESULT

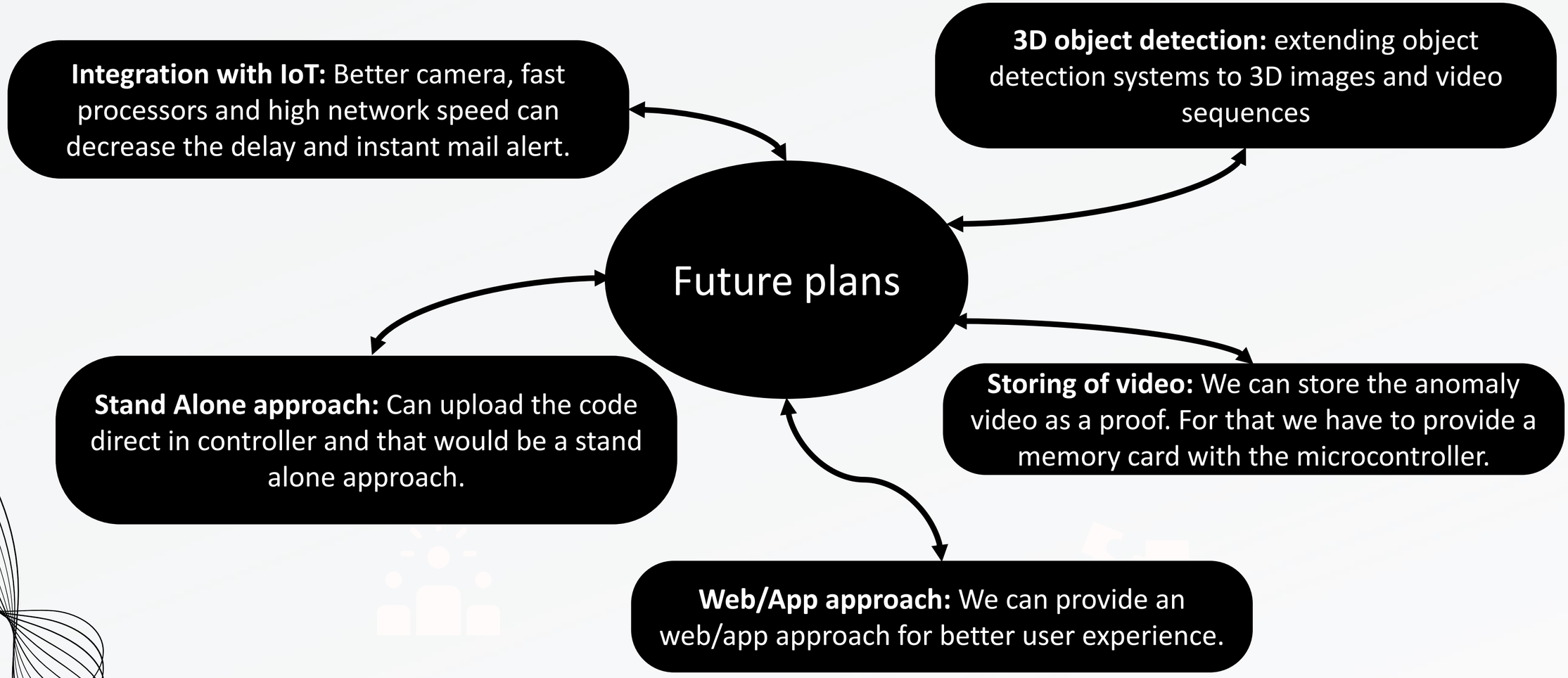
CONCLUSION

We have successfully completed the object identification and motion detection project using deep learning algorithms, Optical Flow (for motion detection) and YOLO (You Only Look Once) v8 (for object identification). It is better than already existing market product as it provides instant mail and also send the object name which is causing the result. The dataset we have used for object identification is a predefined dataset of objects to compare with. So, the result ultimately depends on a parameter called confidence percentage (that is how much an object is similar to a data present in that set). But, that object may be present in data set but for any reason (say distorted image or same object but different type) algorithm may provide wrong answer. In order to fix that problem several present day evolving technologies are there like neural networking, contour mathematics etc. they may increase the accuracy of that project. Also to provide a low price solution we have used ESP32-CAM which has a very less pixel camera (2 Mega Pixel only), but several boards are there like Arduino and other modern day microcontrollers which could have a higher Mega Pixel camera and our project can provide more efficient solutions in challenging environment like low light, changing weathers etc.

REFERENCES

1. https://www.ijraset.com/research-paper/moving-object-detection-using-ml
2. https://issuu.com/ijraset/docs/a_literature_review_of_object_detection_using_yolo/s/21496887
3. https://www.academia.edu/99058470/A_Literature_Review_of_Object_Detection_using_YOLOv4_Detector

FUTURE PLANS



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THANK YOU