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PROJECT PHASE-II (MVJ21ECP81)

QUADCOPTER WITH LONG RANGE AERIAL SURVEILLANCE AND OBJECT DETECTION SYSTEM

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
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CONTENTS

- Introduction
- Importance of Project
- Common Drawbacks
- Focus of our project
- Problem Statement
- Novelty of the project
- Methodology
- Components list with its specifications
- Block diagram & Circuit diagram
- Result & Analysis
- Conclusion

INTRODUCTION

A quadcopter with a camera is a four-rotor aerial vehicle equipped with a camera module that allows for real-time video streaming, image capture, and surveillance capabilities.

1. Four-Rotor Design
2. Camera Module
3. Real-Time Streaming
4. Remote or Autonomous Control
5. Wi-Fi/Radio Connectivity

IMPORTANCE OF THE PROJECT

- Growing Demand for Surveillance Solutions
- Advancements in Drone Technology
- Integration of IoT in Surveillance
- Importance of Long-Range Object Detection
- Benefits of Hardware-Software Integration

COMMON DRAWBACKS

After going through all the research papers we have listed the drawbacks & problems that need to be addressed.

- Limited Battery Life
- Real-time Processing and Data Transmission
- Security Risks
- Privacy Concerns
- Vulnerability to Weather
- Long-Range Connectivity
- Cost Efficiency

FOCUS OF THE PROJECT

Th main focus of our project is show bellow:

- Limited Battery Life
- Real-time Processing and Data Transmission
- Security Risks
- Privacy Concerns
- Vulnerability to Weather
- Long Range Connectivity
- Cost Efficiency

PROBLEM STATEMENT

The problem statement that we are addressing is to implement esp32-cam for long range aerial surveillance and object detection in drone.

NOVELTY OF THE PROJECT

- IoT integration in the drone for the Realtime information accessibility which can be done through the live surveillance camara and changes can be made based on our needs and further improvements can also be made.
- This project is aimed to build a system with surveillance and object detection which is don by the computer by processing the image taken by the esp32 cam and due to this Integration of IoT with the drone setup is effective as well as efficient for the project.

METHODOLOGY

The proposed system integrates various hardware and software components to achieve long-range aerial surveillance and the real-time object detection. Below is the breakdown of the system and its components:

Working Principle:

The working principle of the Quadcopter with Long Range Aerial Surveillance and Object Detection System is as follows:

1.Flight Mechanism: The quadcopter is built using a DIY Drone Combo Kit, which includes a F450 Frame, BLDC motors, ESCs (Electronic Speed Controllers), and a APM 2.8 Flight Controller. The transmitter and receiver system (Fly Sky FS-CT6B) allows remote control of the quadcopter. A 2200mAh LiPo battery powers the system.

2.Surveillance and Object detection System: The ESP32-CAM WiFi Module with OV2640 Camera is integrated into the quadcopter. The camera captures real-time video and images, which are transmitted via WiFi to the ground station for monitoring. Object Detection:The ESP32 microcontroller is programmed for object detection using computer vision techniques.It processes the captured images and performs object recognition in real-time. the real-time object detection is done by the laptop using the well known python openCV and yolov3 processing.

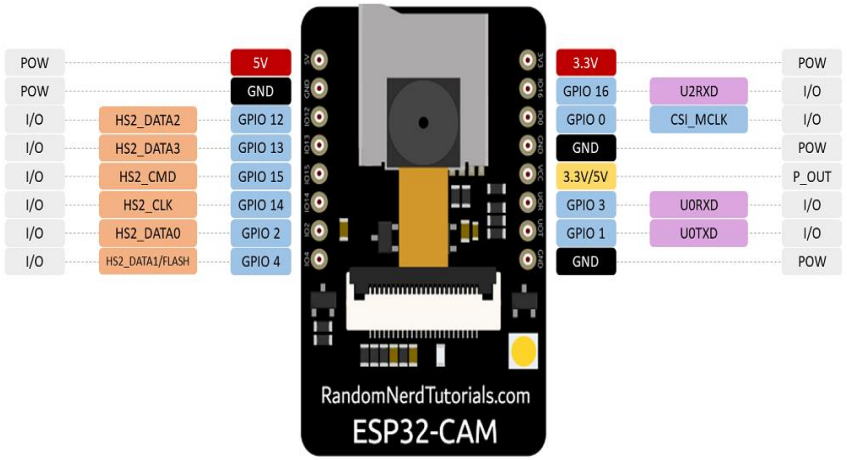
3.Communication: A 6dBi 2.4GHz Dual-Band WiFi SMA Antenna extends the range for better communication from the esp32 cam and the computer.

4.Autonomous & Remote Control: The drone can be operated remotely or programmed for autonomous navigation. Integration of IoT technology enables real-time surveillance and control via an online.

COMPONENTS LIST WITH ITS SPECIFICATIONS

1. ESP32-CAM WiFi Module with OV2640 Camera Module

- 1 x ESP32 CAM WiFi Module.
- 1 x OV2640 Camera Module 2MP



Input Voltage (Volt)	5V
Operating Temperature (°C)	-20 ~ 85
SPI Flash	Default 32Mbit
Bluetooth	Bluetooth 4.2 BR/EDR and BLE standards
RAM	520KB SRAM + 4MB PSRAM
Wi-Fi	802.11 b/g/n/
Package Dimensions	11 x 9 x 5cms
Weight	50 grams

2. Quadcopter DIY Drone Combo Kit for Beginners

- 1 x F450 Frame
- 4 x 1000kv BLDC Motor
- 4 x ESC Motor
- 1 x 2-3 Cell Battery Charger
- 1 x 2200 mAh Lipo Battery
- 1 x Fly Sky FS-CT6B 6ch 2.4GHz Transmitter & Receiver
- 1 x APM 2.8 Flight Controller
- 1 x XT60 Male Connector
- 4 x Propeller (2CW, 2CCW)

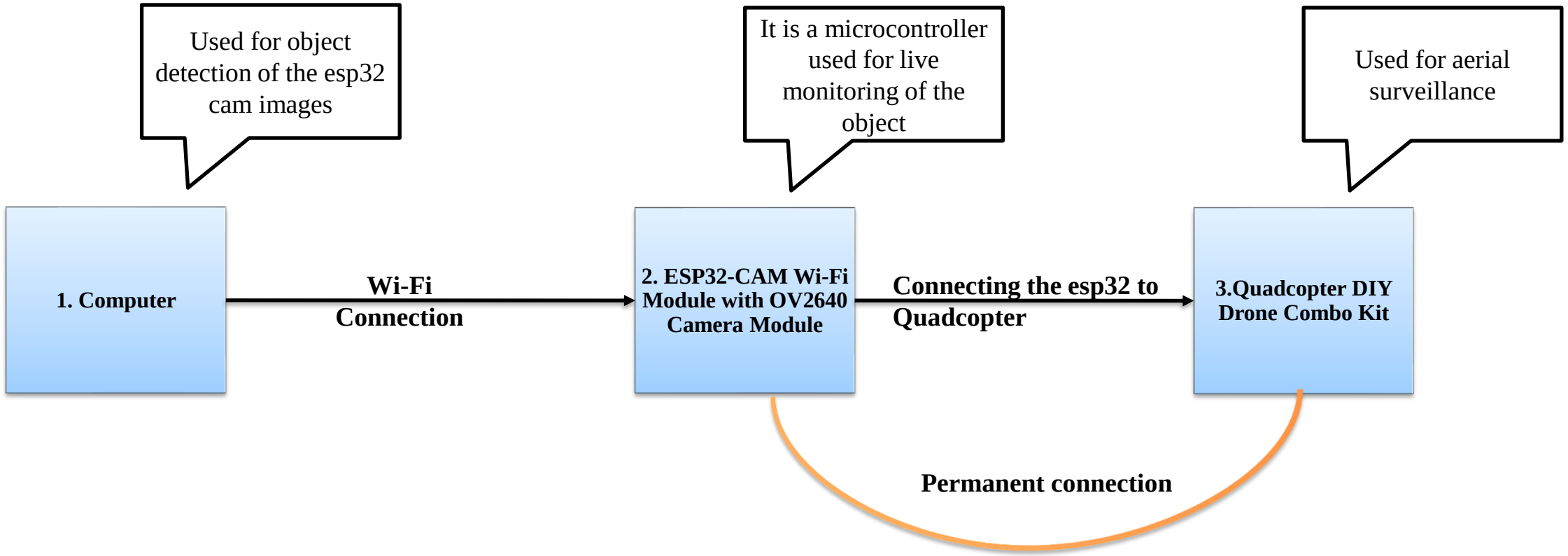
Motor	1000Kv BLDC Motor
Frame Model	F450 (Red-Black)
Flight Controller	APM 2.8 Flight Controller
Battery	2200 mAh Lipo Battery
Transmitter	Fly Sky FS-CT6B 6ch 2.4GHz Transmitter & Receiver

3. 6dBi 2.4GHz Dual-Band WiFi SMA Antenna

- 1 x 6dBi 2.4GHz 5GHz Dual Band WiFi SMA Antenna
- 1 x 165mm U.fl-IPEX Cable

Connector Type	Male Antenna and Female IPX connector (SMA type)
Frequency(Hz)	900/1800
Gain	<3 dB
VSWR	<1.5

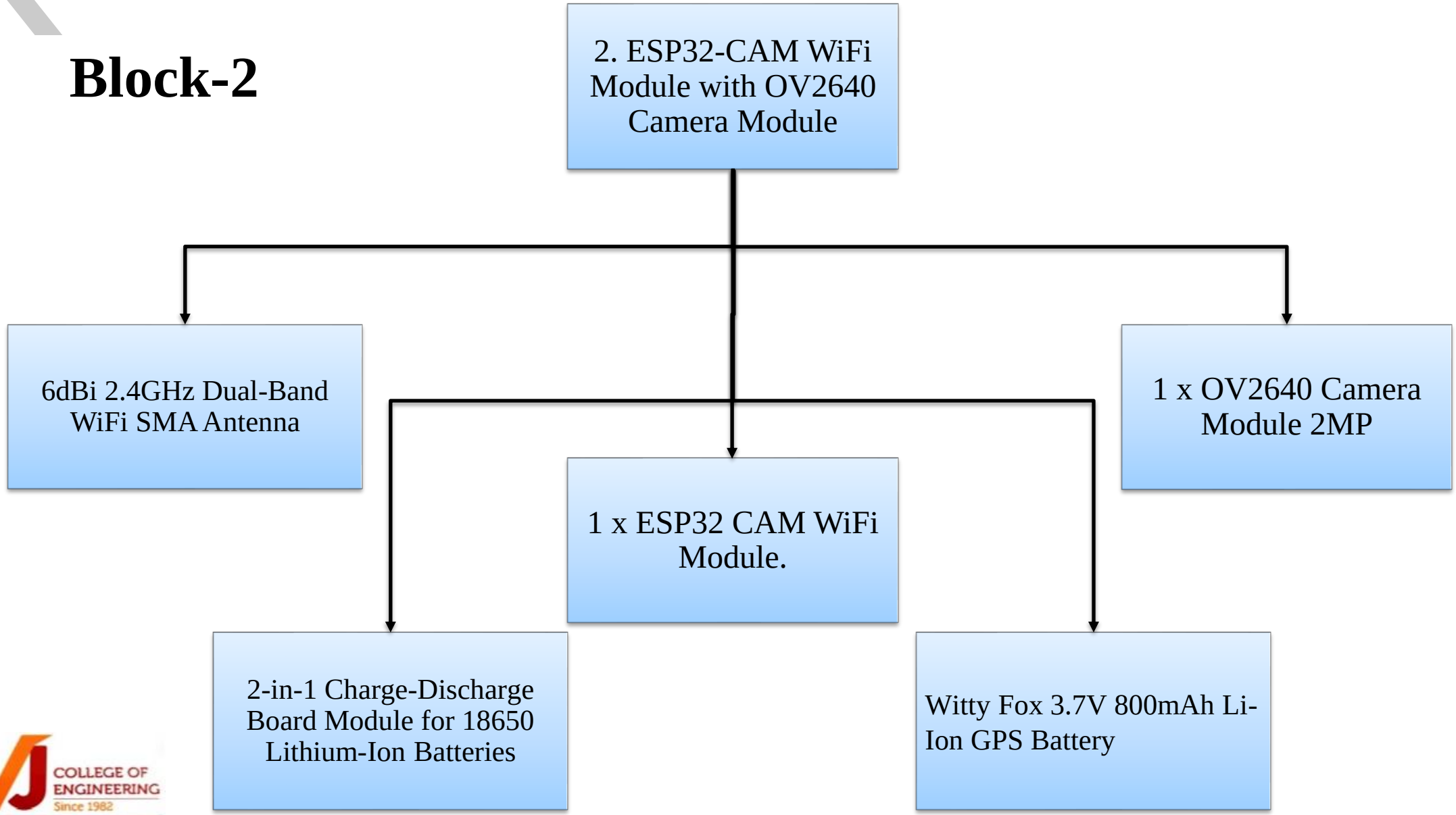
BLOCK DIAGRAM



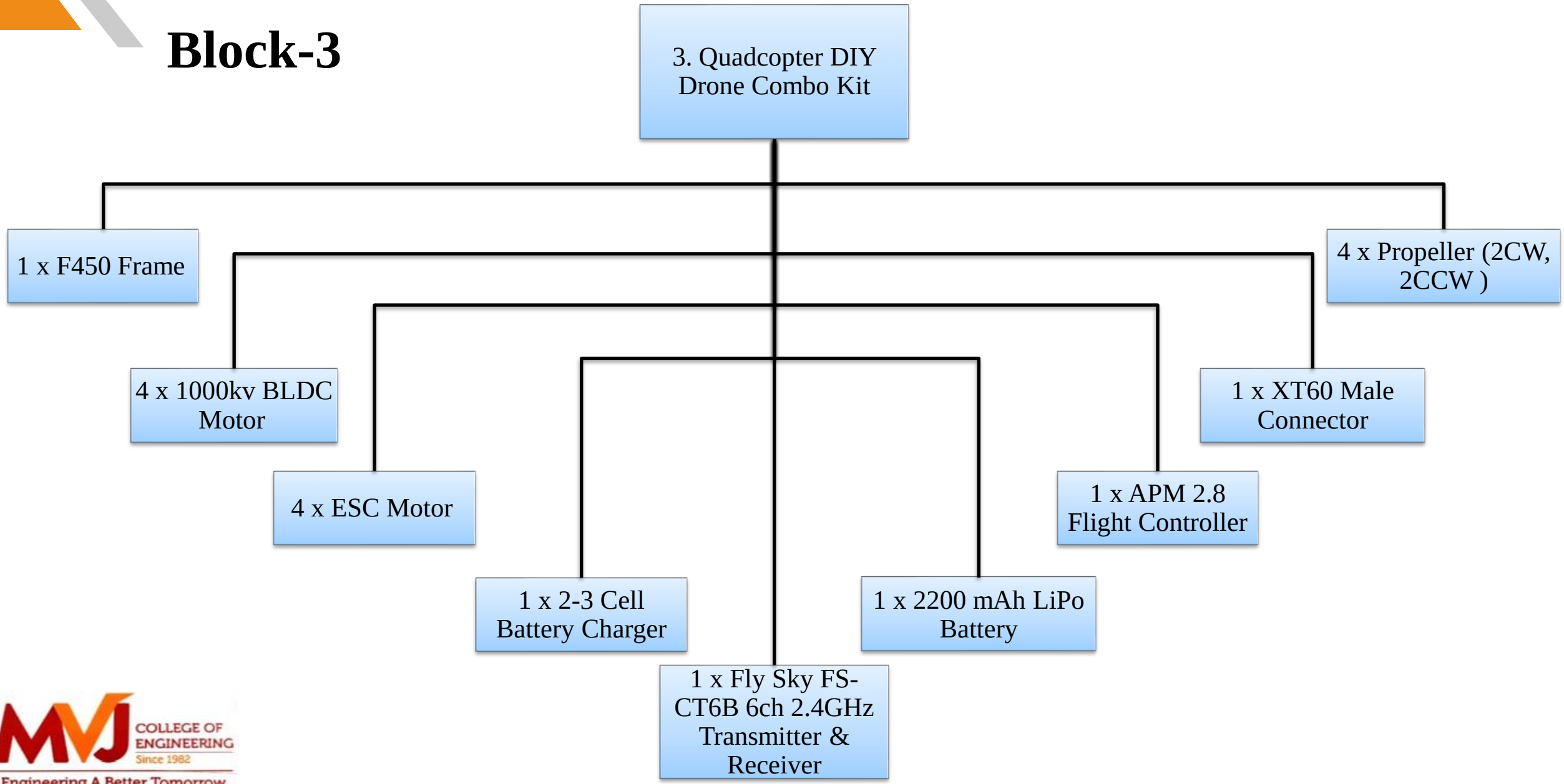
Block-1

COMPUTER	PYTHON	ARDUINO
• Software used (python & Arduino). • It is used for live monitoring and object detection from the esp32 cam images	• We will use openCV and yolov3 for the object detection. • Python will be the main processor used for the object detection.	• Used to generate the IP address of the esp32 cam for live surveillance.

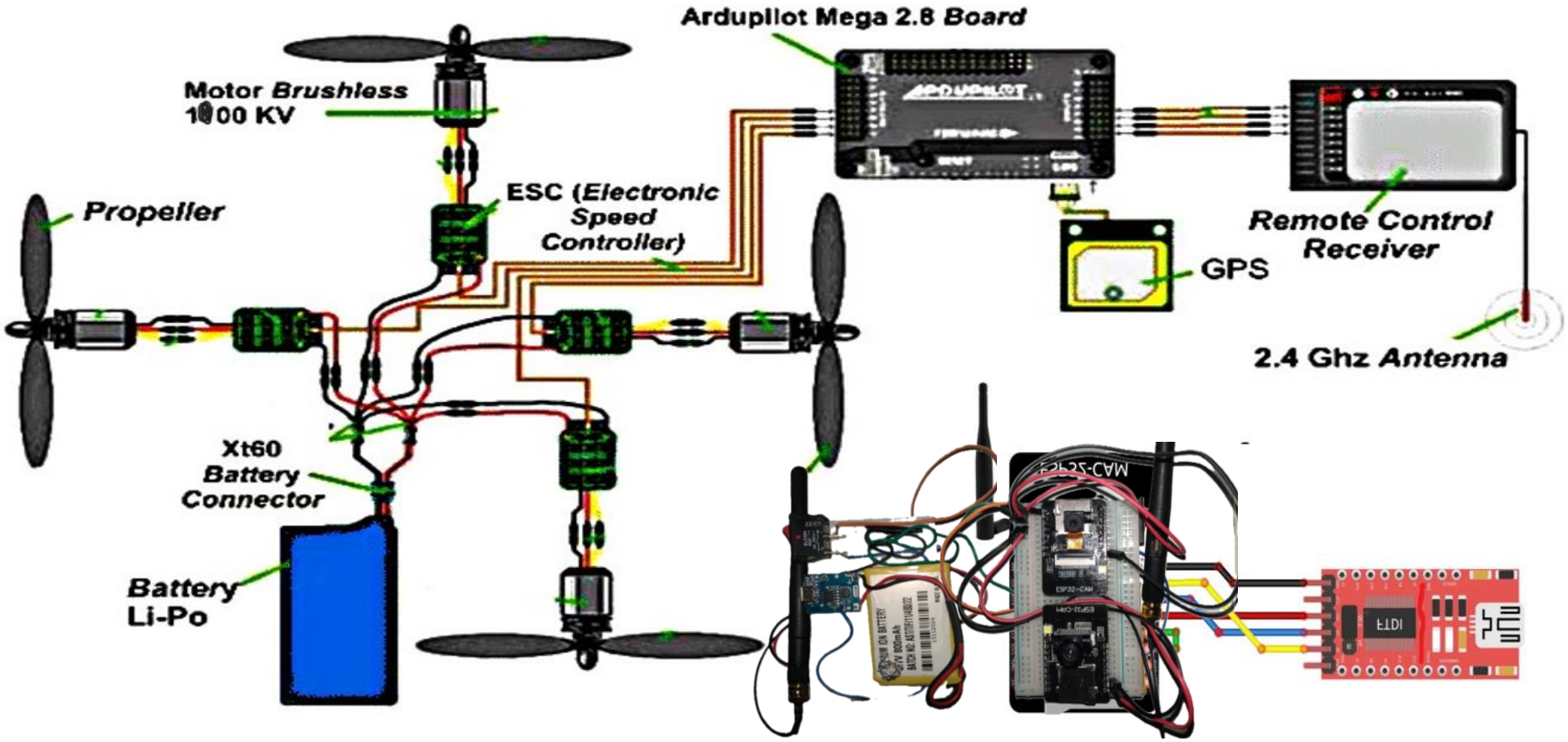
Block-2


2. ESP32-CAM WiFi Module with OV2640 Camera Module
6dBi 2.4GHz Dual-Band WiFi SMA Antenna
1 x OV2640 Camera Module 2MP
1 x ESP32 CAM WiFi Module.
2-in-1 Charge-Discharge Board Module for 18650 Lithium-Ion Batteries
Witty Fox 3.7V 800mAh Li-Ion GPS Battery

Block-3


3. Quadcopter DIY Drone Combo Kit
1 x F450 Frame
4 x Propeller (2CW, 2CCW)
4 x 1000kv BLDC Motor
1 x XT60 Male Connector
4 x ESC Motor
1 x APM 2.8 Flight Controller
1 x 2-3 Cell Battery Charger
1 x 2200 mAh LiPo Battery
1 x Fly Sky FS-CT6B 6ch 2.4GHz Transmitter & Receiver

CIRCUIT DIAGRAM



RESULTS

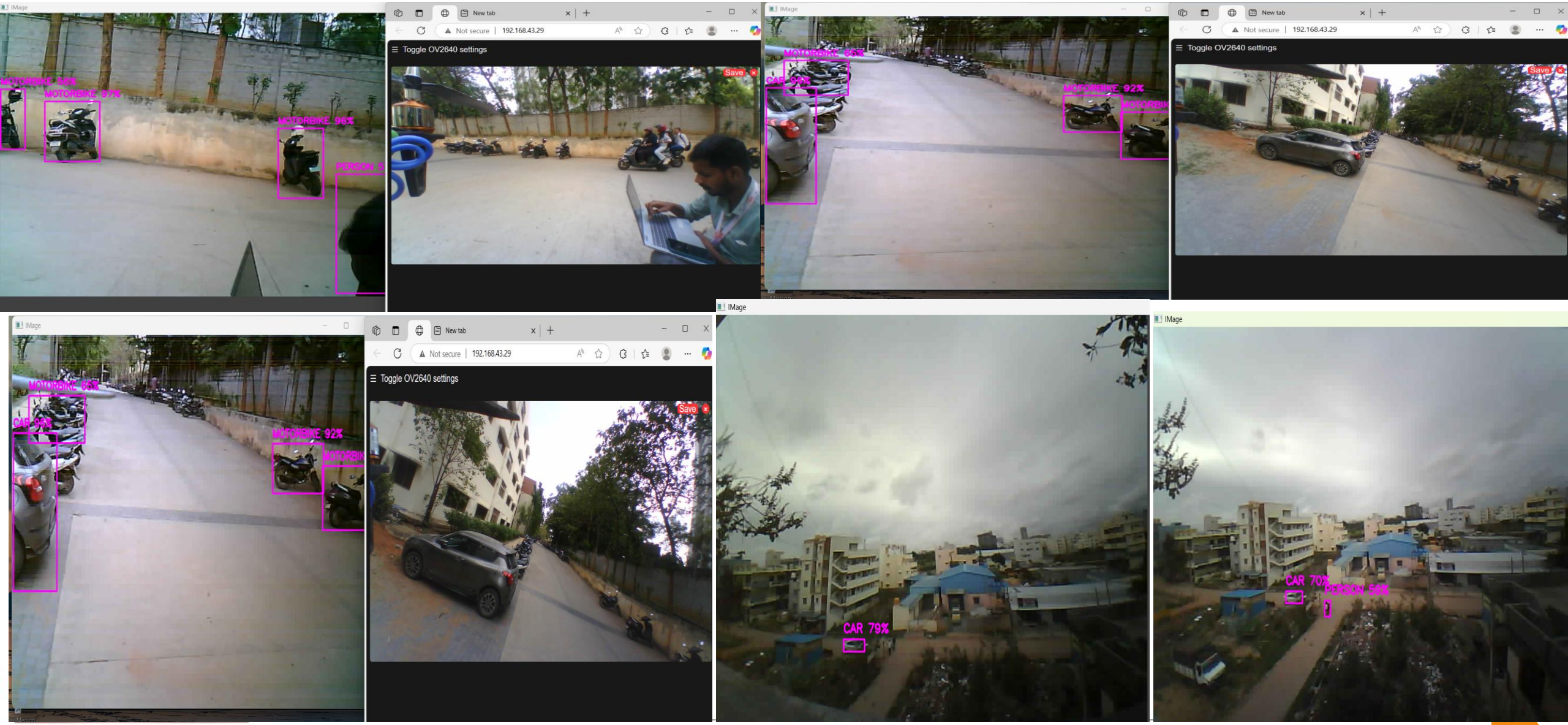


IMage
MOTORBIKE 97%
MOTORBIKE 96%
New tab
Not secure | 192.168.43.29
Toggle OV2640 settings
Save
MOTORBIKE 92%
CAR 79%
CAR 70%
PERSON 58%


IMage
CAR 78%
CAR 93%


IMage
CAR 68%
CAR 63%


CAR 72%


IMage
CAR 61%

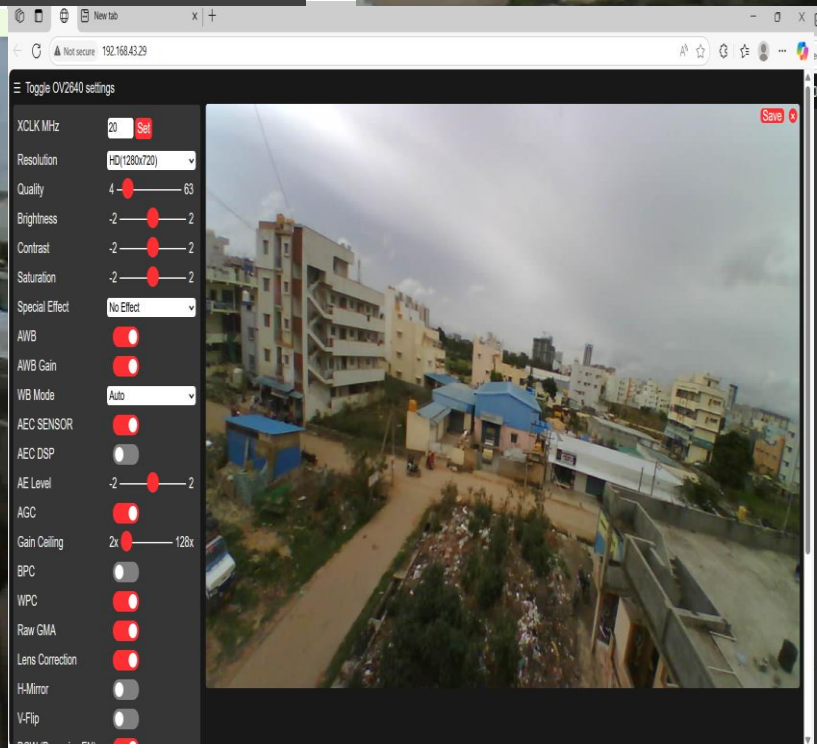

IMage
CAR 75%
CAR 96%

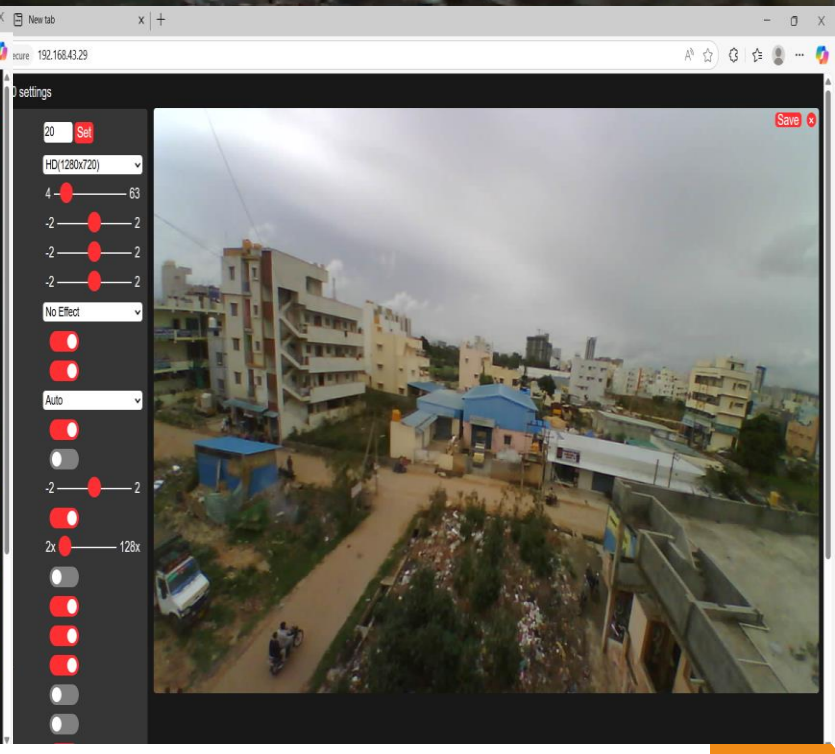

IMage
CAR 86%
CAR 54%


IMage
TRUCK 58%
CAR 91%

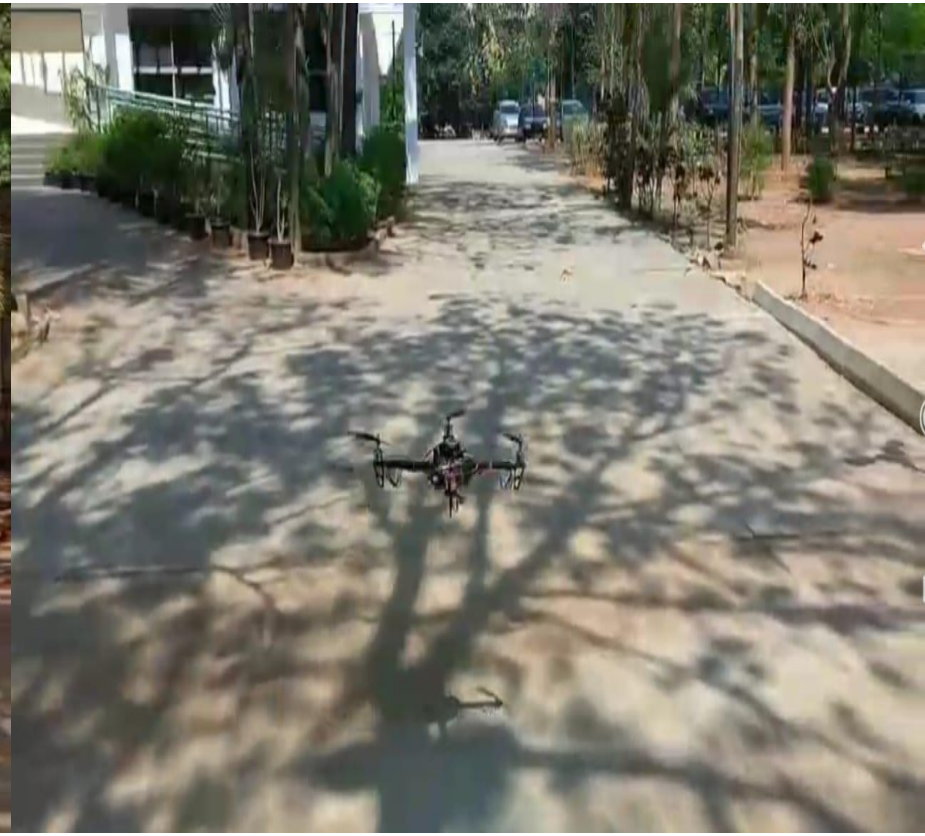

TRUCK 51%
CAR 74%


IMage
TRUCK 62%
MOTORBIKE 58%


Toggle OV2640 settings
XCLK MHz
Resolution
Quality
Brightness
Contrast
Saturation
Special Effect
AWB
AWB Gain
WB Mode
AEC SENSOR
AEC DSP
AE Level
AGC
Gain Ceiling
BPC
WPC
Raw GMA
Lens Correction
H-Mirror
V-Flip
Save


Save







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ANALYSIS

While testing the output of our project we have come across several flaws that need to be addressed for the this project to give even better results and improve its capabilities. The addressing Matters are as follows:

- After the drone takes flight it is hard for the person controlling the drone to identify the direction at which the drone is flying and then to control it.
- The frame rate of the object detection and surveillance will show delay if we don’t use a high processing laptop and a high quality Wi-Fi network.
- The vibration of the drone will affect the performance of esp32 camera setup which can be seen in the monitor while live streaming.

- After inserting the external antenna the camera range has extended to 150-200meters and its range variation is shown below.

Environment	**Estimated Range (Line-of-Sight)**
Indoors (walls present)	20–40 meters (~65–130 feet)
Outdoors (clear view)	80–150 meters (~260–490 feet)

- Our drone is also responsive which is a very important aspect for the aerial surveillance and object detection.

CONCLUSION

- This project successfully combines advanced hardware and IoT technologies to develop a efficient drone system capable of aerial surveillance and object detection.
- The integration of real-time image processing, stable flight mechanisms, and robust communication systems ensures reliable functionality.

THANK YOU