**ECS PROJECT REPORT-3 (REVIEW 3)**

# EC ID: 241107

**Title: VICHAKSHANA -a vision in action**

**Team: (5 scope)**



#### Sub -Teams and Parts:

**Hardware Team:**

**22BCE9899 - PALLA SREE SAKETH REDDY – CSE (sub-part lead)**

**Algorithm Team:**

**SLAM and Mission Planner:**

**22BCE20076 - MOHAMMAD SAIFFUDDIN – AI/ML (sub-team lead)**

**22BCE9556 - DONTU KOWSHIK – CSE (Project Lead)**

**Deep learning:**

**22BCE9979 - DURGAM MOKSHA SREE – CSE (sub-part Lead)**

**Communication Team:**

**22BCE7451 - T S ADITYA – CSE (sub-part lead)**

**Guide: Prof. Bolem Sai Chandana**

**Objectives Added (Guide suggestion):**

* Drone passing through window or door
* Ultrasonic sensor over servo motor for safety validation before taking any move by drone
* Integrate AI in website for interaction that respond using a long file that is updating in backend by raspberry pi

**Current Status:**

A quadcopter drone equipped with a SpeedyBee F405 V4 Flight Controller, finely tuned and tested with an RC, along with Gazebo 7 RO2 HUMBLE simulation and a WebSocket-enabled website for communication. Following a modular RAD process model, the drone now aims to navigate through openings like windows or doors and uses an ultrasonic sensor mounted on a servo motor for safety checks before movements. Additionally, we are integrating AI on the website to provide responses from a dynamically updated file maintained by a Raspberry Pi backend. The AI-enabled interface will enhance real-time interactions and improve control accuracy, making the drone safer and more autonomous in complex environments.

**Tasks Accomplished:**

**Our AI-driven drone project progressed through the RAD (Rapid Application Development) process, focusing on agile and iterative development stages**

**Hardware part:**

* **Work done:**

1. A servo motor has been integrated with an ultrasonic sensor, allowing for rotational adjustments that enhance obstacle detection. This setup enables the drone to dynamically assess its surroundings before movement, adding a layer of safety to its operations, particularly when navigating through tight spaces like windows or doorways.

**Algorithm Part:**

**Mission Planner:**

1. The drone, equipped with a **PiCamera2,** leverages the **YOLOv8n model** to detect doors and windows in real time. As the drone identifies these features during flight, it marks them on a 2D map, creating a detailed layout of detected structures. This mapping capability is crucial for autonomous navigation in indoor environments, allowing the drone to recognize points of entry and exits accurately and adjust its course as needed.
2. To visualize the path followed by the drone, we utilized **the Google Maps API** to trace its GPS coordinates throughout the mission. The API allowed us to dynamically display waypoints, path segments, and **real-time drone location on a map** interface. This integration provides an intuitive overview of the drone's route, assisting in analyzing flight paths, waypoint accuracy, and mission planning adjustments.
3. An ultrasonic validation logic, allowing the drone to assess distances from obstacles and ensure safe passage through openings like doors. By applying positional and rotational vector calculations, the drone can align itself accurately to navigate tight spaces autonomously. Additionally, Chat Bison 100 was integrated for generative AI capabilities, enabling real-time interactions based on a continually updated log file. This AI-driven system enhances autonomous decision-making and facilitates responsive feedback during missions.
4. We have written a code using the position estimates from the ArUco markers, the code enables the drone to follow the person by continuously calculating the marker's position and adjusting the drone's movement to maintain a consistent distance and orientation. The drone uses these real-time position updates to steer towards or away from the person, ensuring it keeps them in the desired location within the camera's view while maintaining the set distance.

**Deep learning:**

1. We developed a PnP solver pipeline using advanced image processing techniques to enhance pose estimation accuracy. Starting with RGB to HSV color space conversion, we applied edge filtering, followed by Gaussian blur and convex hull processing with max contour extraction, to identify precise 2D points. These 2D points are then fed into the PnP solver to estimate the drone's pose relative to detected structures, improving spatial awareness and enabling accurate navigation adjustments in complex environments.
2. By placing a ArUco marker on the person's back, the drone can estimate the distance to the person based on the marker's size and pose, which is calculated through the camera's calibration parameters. YOLO detects the person, and once identified, the drone can switch to marker-based tracking for accurate distance estimation. This allows the drone to adjust its position to maintain a constant 5-meter distance.

**Communication part:**

1. We enhanced the website with generative AI capabilities that generate descriptive text based on the drone’s activity log file, providing a text summary from the drone's perspective. This text is then converted to speech using a text-to-speech feature, enabling the drone to “speak” updates, making the interaction more immersive and informative. This feature aids users in understanding the drone’s actions and status through a conversational interface.
2. We integrated Chat Bison 100 for advanced generative AI responses, leveraging the log data to create real-time, context-aware interactions. Chat Bison 100 enables the website to provide insightful feedback, generate mission-specific recommendations, and answer questions, making the system more interactive and user-friendly. This integration supports smoother mission planning and drone operations by providing continuous updates and user assistance.

## Hardware Components Used:

**LED indicators:** Red and Green LEDs \*2

**Sensor :** Ultrasonic Sensor\*1

**Servo Motor \*1**

# Software Components Used:

#### Deep Learning:

#### YOLOV8n

**Language Model:**

* Chat Bison 100

## Budget:

## Speedy Bee F405 V4 with 4 in 1 ESC Stack: ₹ 5,900 /- \*1 = ₹ 5,900/-

## 920 KV MOTORS : ₹ 525/- \* 4 = ₹ 2,100/-

## LANDING GARE : ₹ 160/- \*1 = ₹ 160/-

## Propellers : ₹ 150/- \*2 = ₹ 300/-

## Frame : ₹ 780/- \*1 = ₹ 780/-

## 16 American Gauge Wire : ₹ 65/- \*4m = ₹ 260/-

## Flux : ₹ 15/-\*1 = ₹ 15/-

## Wick : ₹ 20/- \*1 = ₹ 20/-

## 4s Li – po Battery : ₹2,650/- \*1 = ₹ 2,650/-

## RushFpv M10 GPS with Compass : ₹ 1,600/- \*1 = ₹ 1,600/-

## ExpressElrs : ₹ 1,200/- \*1 = ₹ 1,200/-

## HMC5883L 3 axis Compass : ₹ 180/- \*1 = ₹ 180/-

## Servo motor : ₹ 110/-\*1 = ₹ 110/-

## Raspberry PI 4 : ₹ 5900 /- \*1 = ₹ 5,900/-

## 5mp Noir Camera : ₹ 1,200/- \*1 = ₹ 1,200/-

## Ultrasonic sensor : Lent from ECS lab

## ---------------------------------------------------------------------------------------------------------

## Total ₹ 22,375/-

## 

## 

A total Budget of 22,375/- is spent on Hardware. (no Increment in budget)

---------------x-----------------

The end