SYNOPSIS

A) Title of the project: Design of Low Flying Drone for Electrical Insulator Inspection-Jatayu

B) Name of the college & department: Sri Sairam College of Engineering, Electrical and Electrical Engineering.

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D) Keywords:

Unmanned Ariel Vehicle (UAV), Convolutional Neural Network, YOLO algorithm, Intersection over Union (IOU), Insulators.

E) Introduction/ Background:

Quadcopters provide an affordable, safe, and efficient method for inspecting power lines. They The images taken by the quadcopters can be used to detect cracks and other defects in the transmission line components. The quadcopters can also be used to detect the presence of birds or other animals near the transmission lines. This can help to reduce the number of blackouts due to bird strikes. Quadcopters can also be used for aerial mapping of transmission lines. This can be used to create 3D models of power lines for further analysis. The 3D models can be used to detect any changes or deformations in the transmission lines, which can help to determine the cause of any transmission line failure. In addition, quadcopters can be used for thermal imaging of transmission lines. This can be used to detect any hotspots in the power lines which can indicate potential problems. Thermal imaging can also be used to detect any changes in the temperature of the transmission lines which can indicate electrical faults. Overall, quadcopters provide an efficient and cost-effective method for inspecting transmission lines. They can be used to detect

potential problems before they cause any major damage. The proposed algorithm was tested on a dataset of transmission line images. The experimental results show that the proposed YOLOv5 model can improve the detection accuracy of the insulator by up to 10%, while increasing the detection speed by up to 15% compared with the traditional single-stage object detection algorithm. The proposed algorithm can effectively detect the insulator in transmission line images, enabling automated fault detection and reducing the workload of fault detection personnel. The proposed algorithm can provide a powerful tool for automated fault detection, reducing the risk of false alarms and improving the efficiency of fault detection.

F) Objectives:

- Quadcopters enable efficient and safe inspection of electrical insulators without the need for human inspectors to climb up poles or structures.
- Electrical insulators are often located in difficult-to-access or hazardous locations such as transmission towers, power lines, or substations.
- Quadcopters equipped with high-resolution cameras can capture detailed visual information about the condition of electrical insulators. Inspectors can review the footage to identify any signs of damage, corrosion, cracks, or other defects that may affect the insulator's performance.
- Quadcopters can be equipped with thermal imaging cameras to detect anomalies in the thermal profile of electrical insulators.
- Quadcopters can collect data during inspections, including images, videos, and sensor readings. This data can be further analysed using artificial intelligence algorithms or computer vision techniques to automate the detection of faults or irregularities in the insulators.
- By using quadcopters, inspections can be conducted more rapidly compared to traditional manual methods.
- Regular inspection of electrical insulators helps identify potential issues before they lead to failures or outages.
- Quadcopters provide a visual record of inspections, allowing inspectors to document findings accurately and generate detailed reports.

G) Methodology:

We initially focused on insulator inspection on the electric pole with this Drone, but it has since expanded its arms to Drone technology for a variety of applications such as inspection, surveying, mapping, maintaining safety,

and enhancing security. The ability to collect precise data quickly and efficiently is driving the growing demand for Unmanned Aerial Vehicles (UAVs) for insulator inspection operations. YOLO is the onstage object detection algorithm. YOLO uses a Convolutional Neural Network (CNN) for object detection, which is a form of deep learning. In the YOLO algorithm, the CNN is used to predict the bounding box coordinates and the probability of an object in each cell. YOLO is a single-stage detector, meaning that YOLO only needs one pass through the CNN to predict the bounding box coordinates and the class probabilities for all objects in the image. YOLO has a high speed and accuracy and can detect objects in real-time. In summary, YOLO uses a combination of objectless scores, Intersection over Union (IoU) scores, and non-maximum suppression to identify the objects in an image. The model then assigns the correct label to each object in the image.

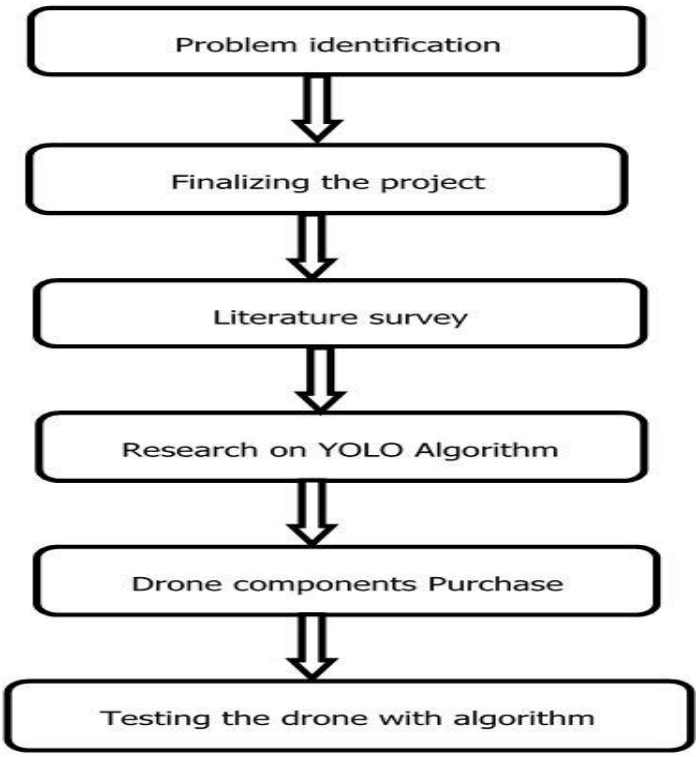

Fig.1: Steps to execute the methodology of Proposed Project using Flowchart

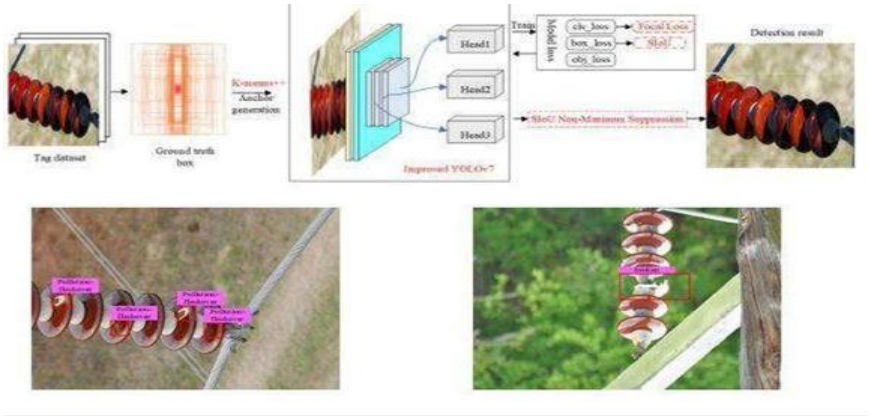

Fig.2: Steps for image processing using YOLO algorithm

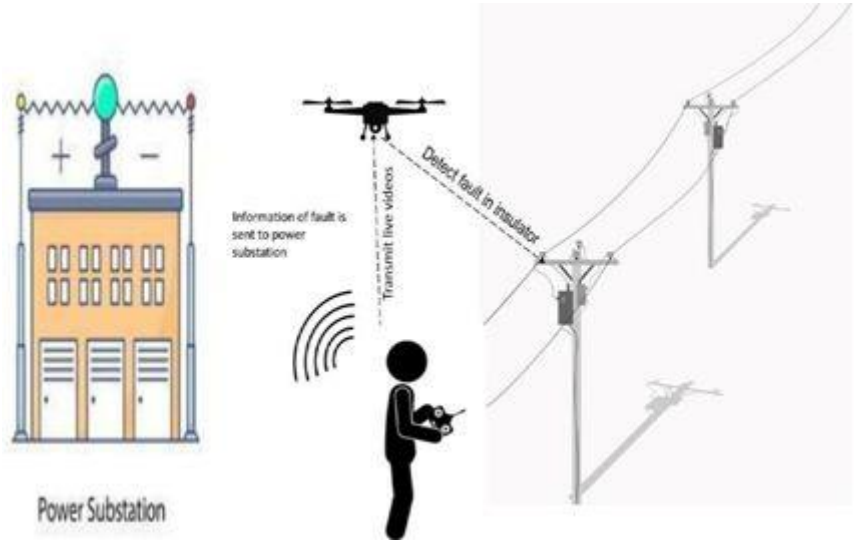

Fig.3: Use case Diagram

The use case diagram shows how the user interacts with the system at different points in the workflow, which helps in evaluating the different circumstances and the output created once the process is complete. A way of condensing details about a system and its users is with a use case diagram. It is frequently shown as a graphical representation of the interactions between different system components.

H)Result & Conclusion:

As a result, we can identify Insulator crack detection, Pollution fragment damage, Power line can be monitored, Live footage can be used for monitoring. The drone can be used for surveillance, Aerial view, Personal uses. This may also increase efficiency allows for more frequent inspections and quicker identification of potential issues. Early fault detection helps prevent

failures, outages, and further damage to the electrical infrastructure. Automated analysis improves the accuracy and speed of inspections, allowing inspectors to focus on critical areas that require attention. Drones provide a safer alternative for conducting inspections in challenging environments. Early detection of faults or abnormalities allows for timely repairs or replacements, preventing potential failures and improving the overall reliability of the electrical system.

In conclusion, the use of drones in electrical insulator inspection offers numerous benefits, including improved safety, enhanced efficiency, detailed visual inspection, thermal anomaly detection, data collection and analysis, cost and time savings, and proactive maintenance. These results highlight the effectiveness of drone technology in improving the overall reliability and performance of electrical systems.

I) Innovation in the Project:

The innovation in the design of a low-flying drone for electrical insulator inspection lies in the application of advanced technologies and features to enhance the efficiency, accuracy, and safety of the inspection process. It also provides the maintenance.

J) Scope for the future Project:

- Advanced Sensor Technologies: Further research and development of advanced sensor technologies, such as hyperspectral imaging or advanced thermal imaging, to enhance the detection capabilities of the drone.
- Artificial Intelligence and Machine Learning: Continued advancements in artificial intelligence and machine learning algorithms can lead to more sophisticated data analysis and anomaly detection.
- Autonomous Swarm Inspection: Investigating the feasibility of using a swarm of autonomous drones for inspecting a network of electrical insulators.
- Robotics and Manipulation: Exploring the integration of robotic arms or manipulation mechanisms on the drones to perform more complex tasks, such as insulator cleaning, tightening of fittings, or minor repairs.
- Augmented Reality (AR) and Virtual Reality (VR): Developing AR or VR solutions that enable inspectors to visualize and interact with the drone-collected data in a more immersive and intuitive way.

- Energy Harvesting and Wireless Charging: Investigating the use of energy harvesting technologies, such as solar or wind power, to extend the drone's flight time and reduce reliance on battery charging.
- Integration with Asset Management Systems: Integrating the drone inspection data with asset management systems or databases to streamline the inspection workflow, track maintenance history, and prioritize maintenance activities based on the severity of insulator conditions.
- Regulatory Framework and Standards: Contributing to the development of industry standards and regulatory frameworks specifically tailored to low-flying drone inspections for electrical insulators.
- Remote Collaboration and Expert Support: Developing remote collaboration tools and platforms that enable experts to remotely assist and guide drone operators during inspections.
- Integration with Internet of Things (IoT): Exploring the integration of drones with IoT devices and sensors placed on insulators to enable continuous monitoring of their condition.