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An AI Based Electric Field Detection using UAV

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***Abstract*- The Idea of detecting the Electric Field which is sustained in the space universe will get detected in this system. The implementation of Unmanned Aerial Vehicle with autonomous control can specifically determine the system of its intensity, levels of deficiency, benefits and circuitry difficulties in the field when synchronizing with Artificial Intelligence. The traditional aircraft systems have a manual pilot operator to maintain security and safety, the charge existed in the medium can proportionally detect the quantum of charge, intensity, waveform of representation. This proposed framework consists of a decentralized control in architecture which simultaneously controls the monitors and the swarms of resource-constraint in UAV for their real-time requirements. The outcomes of UAVs can be mitigated significantly in space medium and their efficiency can be increased in realizing their diverse range of missions.**

Keyword-UAV, RPAS, Artificial Intelligence, Quantum, Electric Field

I. INTRODUCTION

Recently, the interest in drone are sustaining it maximum demand in the field of AI as much more than ever. With this popular demand, a new systemised of drone machines are designed and manufactured, Unmanned Aerial Vehicles (UAVs) are one of the most significant disciplines in recent technology which is used in the detection of various electric field, with autonomous drones. Self-piloting, refers to a drone’s aerial capacity which conduct visual movements without the assistance of a pilot or a person to function. UAV’s operated manually to face many functional and operational challenges. Such as the weathering condition and climatic disaster which even can proximate the system to malfunction it. Some specific sensors in the system like proximity sensor and UV Sensor are used to operate for avoiding accidents. Due to its outstanding usage and suitability on commercial the E-Commerce companies like Flipkart and Amazon are designing the drone device to deliver their products to the consumer.

Initially the image processing criteria are equipped in the scanning of the environment by disruptive calculation which simultaneously suspects the system to get involved in the detection of Electric Field which surrounds the nearby environment by radar. The radar based obstacle detection is initially implemented in Water Navigation and Air Navigation for detecting unnatural circumstances in the surrounding [3]-[4]. As same here the deep learning and image processing criteria are used in the detection of the Electric Field.

In this paper, an AI drone detection system based on machine learning is used for detection of Electric Field. This proposed system consists of object detection algorithm to pertain the unknown fields into suggestion of detection of it as wave in the system, this system is directed to flew in the environment as surveillance drones. Such that during its aerial motion, the surveillance drone records its surrounding field on camera and sensor attached with it. If there is any wave developed in the system they may get crippled by the camera installed over it, it will be specified on the frame sustained in by applying object detection algorithm, and the system will make its mark on the frame. The marks obtained in the frame is then get further processed as data which is specifying it peak, final proportions and send those detection field into the system, which has learned various waveforms model through various algorithm such as ANN (Artificial Neural Network) and CNN (Convolutional Neural Network).

The integrated experience video frames generated by the GPU with CUDA computing for image processing. Another algorithm for object detection is used on each frame as the wave's point. For the purpose of object detection, cascade classification is specifically enhanced [4] - [5]. The system stimulates how to accurately identify the fields from frames using machine learning techniques based on a variety of waves photos that are provided and analyzed beforehand. Frames that have a wave recognized are then analyzed one more to determine the type of waves.

II. RELATED WORK

In this part, we intimate various ideas relevant to our research. The idea of the proposed paper can be summarized as detection of drone and identification of electric field using image processing and machine learning. The Classification of object detection is a related work done by the system. This proposed idea has three key techniques.

One of the technique is by implementing Integral Image and its features used by the detector can be easily computed, making its computation complexity [1] - [2].

Second method is constructing the classifier by selecting a small number and its important feature using a learning algorithm, yielding a very efficient classifier [2].

Third method is combining increasingly more complex classifiers in cascade fashion, making it dramatically fast [3].

III. BLOCK DIAGRAM

The block diagram of proposed system is shown in fig.1 and fig.2. the unmanned vehicle and AI algorithm altogether addresses the field in the wave form representation. The Fig.1 shows the block diagram of universal functions of drone where the RPAS components acts as the control exhibitor and intermediate UAV, GCS, and Communication Data Link acts as an intermediate to mediate the control of drone in specific function. The Avail devices estimates the detection of all the obstacle in the mean of product. Where the mission planning equipment also estimates the function of the different controlling capabilities to the system.

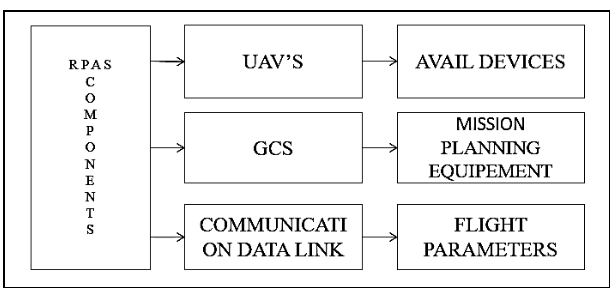

Fig.1 UAV's

The Collection of data are initiated to the system which consist of the specific data set with the various assigned data [6]. Which undertakes the visual feedback towards the system of main controller where the acquiring of data gets equipped with essential function that's get executed according to the controller.

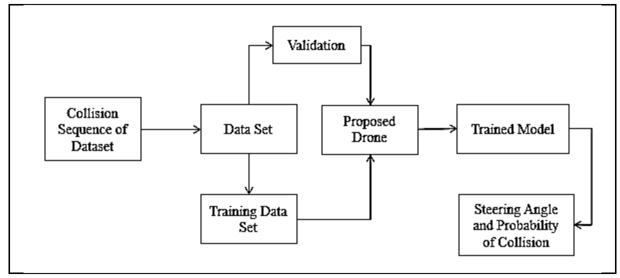

Fig.2 Data Set

The processed data undergoes two phases that's validation and Trained for final data set. After the process of attaining validation, the data are given to the proposed drone, [7] the Trained model collects the data and according to such data they steer the drone for attaining the intensity with the probability of collision.

IV. PERFORMANCE EVALUATION

In this part, we intimate our experimental performance and analysis. Initially, we show how the detection of drone and its module works. Then, we analyse the performance feed of electric field in the surrounding.

Drone Control:

The drone control calculation is used to analyze the systematic behavior (1) which provides the feedback for the controlling system (2) - (3) which systemize the drone to unmanned vehicle which automatically segregates the detection as Electric field. By this drone system the control of the drone captured with respect to it intensity and sustains the aerial motion towards it.

$$V_k = (1-\alpha)V_{k-1} + \alpha(1-P_t)V_{\max} \quad (1)$$

$$S_k \rightarrow [-1,1]$$

$$\theta_k = (1-\alpha)\theta_{k-1} + \alpha(\frac{\Pi}{2})S_k \quad (2)$$

$$\theta_k = \left[-\frac{n\Pi}{2}, \frac{n\Pi}{2}\right]$$

Performance Matrix:

The system already consists of previous data which executes the functional analysis with the present data and future probable data and proceeds the movable drone towards its field and gets processed by the capturing of it. In this case the Eq. (3) is used to detect the accuracy of the intensity of Electric Field by recalling the function of system to procure aspect intention of the fields.

$$Accuracy = \frac{E+E'}{\vec{E}} \quad (3)$$

$$\mathrm{Re}call = \frac{E_1}{E_2 + E'} \quad (4)$$

$$F - score = 2 \times \frac{Accuracy \times \mathrm{Re}call}{Accuracy + \mathrm{Re}call} \quad (5)$$

$$EVA = \frac{V_{ar}[Y_{true} + Y_{predicted}]}{V_{ar}[Y_{true}]} \quad (6)$$

$$Cl = Z + \sqrt{\frac{error(1 - error)}{TotalSamples}} \quad (7)$$

Aerial Determination:

The Aerial map is initialized with the specific analytical function of which the system moves as its aerial direction. The topologies initiated in the system is in the 3-dimension of which it accurately gets systemized with the analytical data toppled over it. This system of direction determination is attained by the Eq. (8) for Aerial Map and Eq. (9) for Ground Map. And at last they simultaneously get mapped with the field intensity in Eq. (10)

$$LF_A U_A V_a.3DAerialMap = A = A + \sum_{n=1}^{k} F_A U_A V_n (X, Y, Z).AerialData \quad (8)$$

$$City_A.3DGroundHDMap = B = B + \sum_{n=1}^{w} LF_A U_A V_n (RH).GroundData \quad (9)$$

$$City_A.3DMap = (8) + (9) \quad (10)$$

Electric Field:

The Electric Field can be defined Mathematically by a vector field that gets associated with every dimension in open space, the force per unit charge with exerted of a positive test charge at rest and at the point. The electric field is generated by the Electric Charge or by time-varying Magnetic Fields. As shown in fig.3 and fig.4

$$E_{eq} = E_1 + E_2 + E_3 + E_4 + \ldots . + E_n \quad (11)$$

$$E = \frac{1}{4\Pi\varepsilon_0} \sum_{i=1}^{n} \frac{q_1}{|r_i|^2} \hat{r}_i \quad (12)$$

$$\oint E.dS = \oint E.\hat{n}dS = \frac{q}{\varepsilon_0} \quad (13)$$

$$E(4\Pi r^2) = \frac{q}{\varepsilon_0} \quad (14)$$

$$E = \frac{q}{4\Pi r^2 \varepsilon_0} \quad (15)$$

V. ALGORITHM

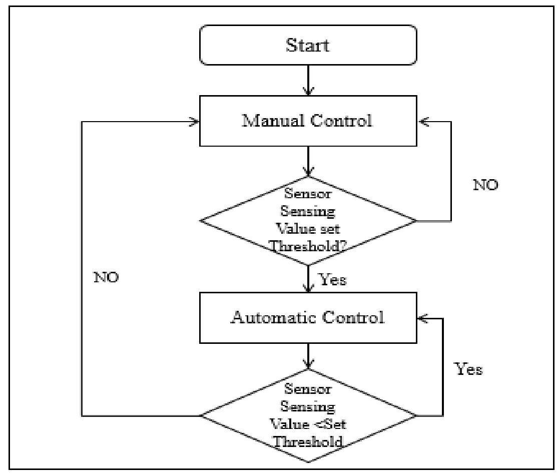

Fig.3 Algorithm for Controlling Drone

Steps involved in algorithm:

Step 1: Start the Program.
Step 2: Initially the Program controls the drone by manual until it acquires the data.
Step 3: Check for the threshold value of the sensor if yes the program gets shifted to automatic control.
Step 4: Else again proceed to the manual control and proceeds the step 2.
Step 5: In the automatic control of drone check for the condition of the threshold.
Step 6: If Yes the drone gets controlled itself and worked as the fully automatic.
Step 7: Else go to Step 3 and proceeds
Step 8: Stop

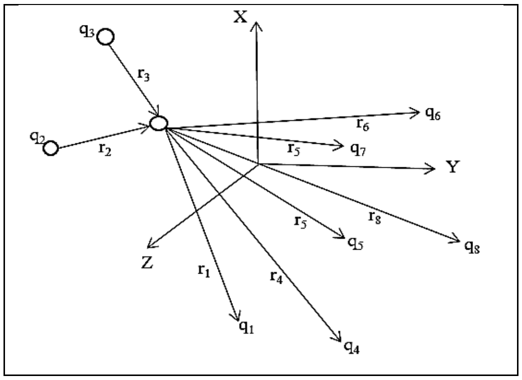

Fig.4 Quantum of Charge

According to the coulomb charge the displacement of charges with respect to the distance is specified in the vector form of representation as F_n (Net Force of the Charges), E_n (Equivalent Electric Field between the charges) Eq. (11) and r_i (The Resultant vector of the Electric Field) Eq. (15).

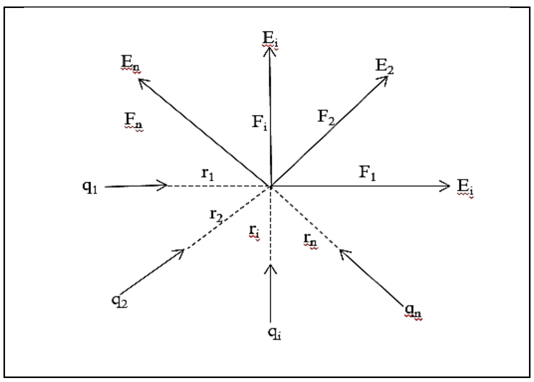

Fig.5 Quantum of Electric Field

Electric Field intensity is inversely proportional to the distance between the source and charges. They are directly proportional to the charge 'Q' on source charge. Not dependent on the charge on the test charge 'Q'. When these conditions are applied to the inverse square law, the relation between the electric field strength at a distance and electric field intensity at distance is given in Eq.16,

$$\frac{E_1}{E_2} = \frac{{d_1}^2}{{d_2}^2} \qquad (16)$$

When the distance is increased by the factor of 2, the electric field intensity will decrease by the factor of 4. Calculate the electric field strength acting on a particle with charge $-16\times10^{-19}C$ when the Electric Force is $5.6\times10^{-15}N$.

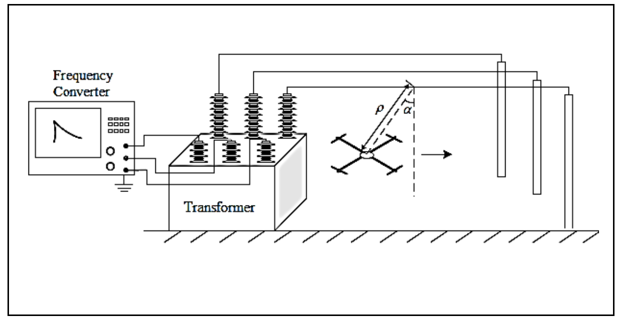

Fig.6 Field Intensity is Identified Between Transformer and Electric Pole

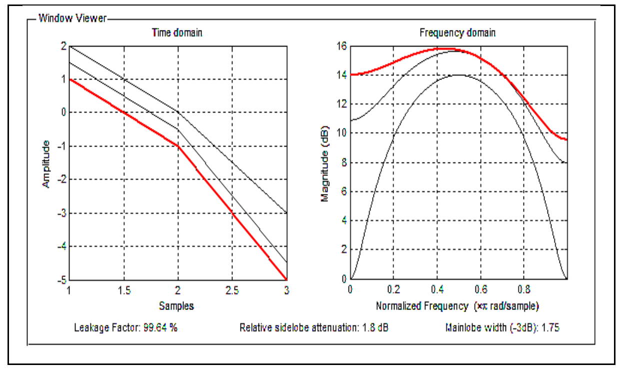

Fig.7 Input Charge Variation in Electric Field Intensity

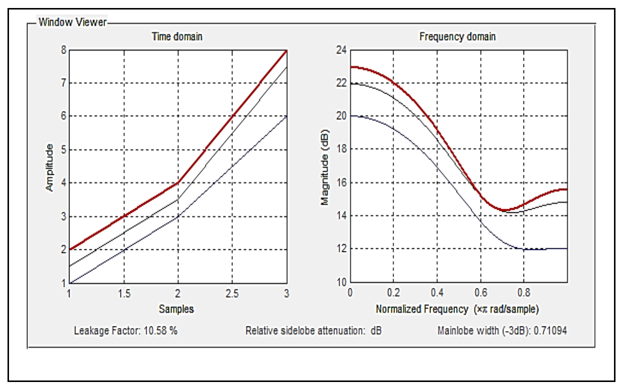

Fig.7 Field Polarization

VI. CONCLUSION

The electric field curve obtained in insulators with good insulation sustainment illustrates a V-shape with intensity of high at both ends and low in the core under the influence of stray capacitance of imaginary lines and fluctuation towers. While the electric potential on both sides unusually increase, the electric field near the damaged insulator drops sharply. The electric field at maximum in the high voltage end is most affected by the degraded insulator, followed by the middle portion, and the electric field at the low voltage end shows the least noticeable reduction.

The flight region of the UAV was found by analysing the electric field distribution under three alternative configurations of 10-kV transmission lines, including horizontal, triangular, and inverted triangular configurations. Further research into the electric field distribution law in the UAV's flight region led to the discovery that it can be compared to that of a single-phase transmission line. This confirmed that the current method can be applied in the case of a three-phase transmission line.

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