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DEEP LEARNING AND REAL TIME COMPUTER VISION BASED FEATURE MATCHING IN FLYING ADHOC NETWORKS

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ABSTRACT

Flying Adhoc Networks (FANETs) are getting huge popularity in assorted applications for civilian, corporate and defense applications. FANET is a specialized class of the Mobile Adhoc Networks (MANET) having computer vision, sensor devices and the Global Positioning based System (GPS) for live monitoring and logging the environment under surveillance. From the past few period, FANETs were widely and rapidly used for the monitoring and controlling of scenarios civil wars and local commotions. FANET makes used of assorted Unmanned Aerial Vehicle (UAV) which is useful and because of which the pre-programmed plans running on the flights of such a type of flying and other means of possible related objects were implemented.

UAV describes pre-programmed and structured flying object which can also meats aircraft without the need of any kind of dedicated pilot on boarded. This research paper is focusing on the real time integration of UAV based real-time deep learning methods with real time extraction and feature matching techniques from the camera of relevant flying FANET aircrafts and because of which the definite and accurate target can be easily extracted. The proposed manuscript is presenting the effective way of technique in both civil as well as in military defense and thereby to fully recognize the enhanced activities of many underlying suspicious person which were targeted and also to locate the exact flying objects which were being released exactly by the opponent (or) targeted country.

In the proposed manuscript, the real time extraction and integration of the OpenCV with additional feature descriptors and extractors in the absolute form of camera for the deep learning based real time FANET is being proposed and evident that the method and strategic tactical decisions were made by the explicit use of this proposed methodology in real time occurrences. This proposed empirical research proposal is targeting the effective integration of the high performance and super-computing-based library OpenCV because of which the high dimensional and high efficacy evaluation by the features that actually can be extracted have been analyzed. This feature-based point was found to be projected to be evaluated on the base of corners, edges and inner parameters of the real-time image in FANET.

Keywords: Deep Learning, Flying Adhoc Network, FANET, OpenCV, Real Time Feature and Object Identification

Introduction

The wireless and satellite communication have paid a huge demand and growth in this modern based technology in variety of wireless domains from the beginning of its inception in the year of 1890. That is the effective real time when the patent for photophone by A. Grham Bell and C. S. Trainter were

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initiated. From the advent of wireless based communication technologies, that is being used for personal and official based communications. In the recent times, the wireless based technology was working on fast pace with all the frequencies to be considered that is meeting the variety of applications especially for personal and the corporate usage. It can effectively be used of the defense purpose as well. Thus, we can evident that the wireless based communication which is executing on the radio technologies and there by the assorted and related aspects have been analyzed for the secured and effective way of the data that have been transmitted.

A wide set of assorted perspectives and also assorted parameters which is of wireless based communication technology have to be included in various features consideration of the wireless sensor based networks, adhoc networks, wireless fidelity, wi-max and also to consider many technologies that were grew up. Recent times, the perception of including the Flying Adhoc based Networks were considered to be considered the objects that are prominent in military based applications because of which the flying and modern aircrafts can able to accommodate and communicate with one another during any effective war time or available with the similar set of occurrences. The wireless-based communication which we considered in this FANET will takes place in the effective flying based objects or flying based aircrafts which are most effective and popular and known to be Flying Adhoc based Network (FANET) [1, 2].

FANET is the considered to the very high-performance and high efficient flavoring of drone that can been implemented with the consideration of above ground monitoring techniques in various modern scenarios which includes the disaster recovery of objects, High availability zones, military surveillance, modern aerial based mapping, irrigation and agricultural fields and also many other fields to be considered wirelessly. Variety of Network techniques like Mobile Adhoc based Network (MANET), Flying Adhoc based Network (FANET), Vehicular Adhoc based Network (VANET) were considered to be formed for the protocol based modern communication techniques and also they were really used in military based applications and also for different domain based applications. VANET is considered to the popular implementation and thereby the real-time communication between the frequency based vehicles is quickly maintained and well established for the consideration of the applications which includes high traffic based modern Information Systems and other road based measures.

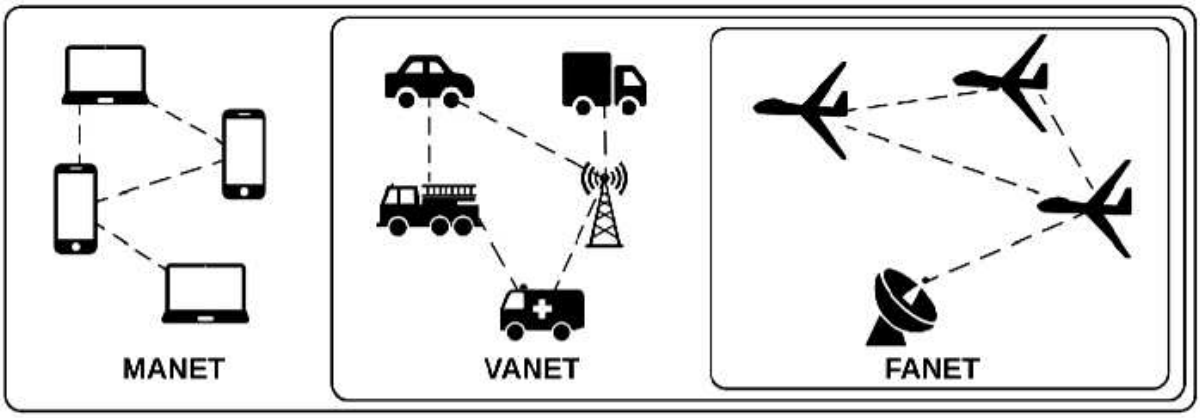

Figure 1. Depiction of MANET, VANET and FANET

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Figure 1 depicts the demarcation line between VANET, MANET and FANET whereby the FANET is having more focus on the flying based objects with satellite-based control and the overall applications for defense and security based domain. Following table 1 is depiction on the perspectives of VANET, MANET and FANET on different parameters and criteria

Table 1: Divergence Factors between FANET, VANET and MANET

Parameter / Network Type	**Flying Adhoc based Network (FANET)**	**Vehicular Adhoc based Network (VANET)**	**Mobile Adhoc based Network (MANET)**
Computational Powers	High	Average	Very Less
Change in Topology	Fast and Speedy	Average	Slow
Node Density	Low	Medium	Low
Localization	DGPS, AGPS, GPS, IMU	DGPS, GPS, AGPS	GPS
Mobility of Nodes	High	Medium	Low
Radio Propagation	Above the Ground Level	Close to Ground Level	Close to Ground Level
Model for Mobility	Predetermined	Steady	Arbitrary

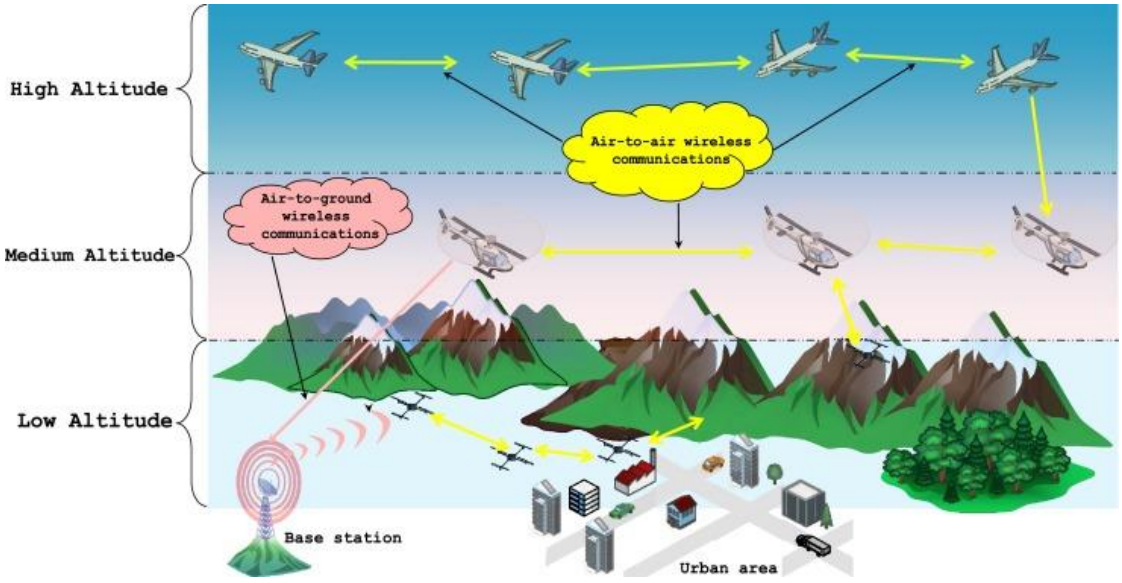

Figure 2. Flying Ad-hoc Networks (FANET)

FANET based aircraft is having number of components and modules. The primary components found in the FANET aircrafts which include the camera, various Sensor, Global Positioning Systems, Actuators, Flight Planner, Barometer, Illumination based Signals and the Radar. The consideration of those secondary modules includes the high processor-based camera, mission processor, digital image-based processing module, web-based services, various internet access protocols and the attenuators. With the effective illustration and thereby the integration of the overall flying scenario, the effective results have been achieved.

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Review of Literature

Several practitioners and researchers were effectively worked based on the real time analysis of similar techniques and domain with the enhanced suggestive remarks on the emerging wireless-based technologies. Numerous sources-based multiple manuscripts, various research papers and technical articles were analyzed from each of the time span to the recent time in actual effort such that the latest possible perspectives of the FANET can be much evaluated.

Bekmezci et al. (2013) [5] presented on the assorted parameters and aspects of energy-based security in Unmanned Air Vehicles (UAV) which were commonly referred to as the Flying Objects that closely communicating in the wireless based environment. The work always presents the primary based differences in Flying based Adhoc Networks, MANET and the VANET and the possible related technologies of various wireless communication techniques with the effectual advantages of real-time monitoring and also thereby using FANET. This manuscript effectively presents the overall performance of the FANET in possible different scenarios and its variety of the usage in the complex and multiple security-based surveillance that helps in its own security-based implementations.

Sahingoz et al. (2014) [6] effectively illustrates that the adhoc network-based models and the overall paradigms of the flying ad-hoc based networks with the effective challenges and key based concepts. This manuscript work always identifies the overall effective architectures and also on the various security-based models which were highly associated in enabling the integrity towards the applicability of the FANET. This enhanced work focuses the real time implementation towards the security storage and thereby integrity as FANETs which were used for any defense in many of the implementation platforms.

Singh K et al. (2015) [7] depicts in his work that the experimental based evaluation of the flying ad-hoc networks on various protocols which includes the OLSR, DSDV, ADSL with the prominent comparative analysis. This work effectively presents the actual usage of Flying based Adhoc Networks for various military applications and also thereby enhancing the performance environment in the possible minimum delay. Also, the routing and effectual overall network communication is important to be considered here in any security and thereby integrity aware network applications. In this paper, the work was more focused on the network protocols of having ad hoc networking that has been used in the FANET.

Temel S et al. (2013) [8] illustrates the effectual and promising technologies of the High Altitude based Platforms with the actual integration of the Flying Adhoc based Networks (FANET) for different military domains including civil nature. This work always projects the ubiquitous and unique protocol that have been titled Location Oriented Directional MAC (LODMAC) based on the implementation of MAC for various network discovery and also the effectual data that have been transmitted.

Rosati S et al. (2016) [9] depicts the dynamic based vector routing in the consideration of the unmanned air based vehicles or the flying adhoc based networks with the experimental evaluation and also thereby results on various small flying robots for the unique testing. This effectual work depicts the real-time comparison of the two routing-based approaches in the ad hoc based networks which includes the OLSR and the effective Predictive OLSR (P-OLSR). The way of approaching on the applicability of P-OLSR is

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developed for the effectual FANET based applications and tested as one of the effectual improved algorithms.

Koucheryavy A et al. (2015) [10] illustrates various research challenges that have been faced in the Unmanned Aerial Vehicle and its assorted aspects of the public flying based adhoc networks in the multiple dimensions of multiple applications. This proposed technique evaluates always the assorted aspects of various Public Flying Ubiquitous based Sensor Networks (FUSN-P) with the effectual presentation of fuzzy and neural based network model and also the effectual network solution for variety of application in military.

Proposed Architecture for Deep Learning based Real Time Computer Vision based Feature Matching

In this enhanced work for the feature matching technique, the deep learning method for the real time identification and enhancing the objects were depicted in terms of the FANET such that the effective and suspicious or enemy's flying based objects can be very well recognized. This technique gives the effective approach that always used the deep learning based algorithm and also the abnormal features has been recorded and till the time of further evaluation on the real time scenario that is using real time feature based points extractor in the implementation of aircraft for the wide variety of applications in FANET.

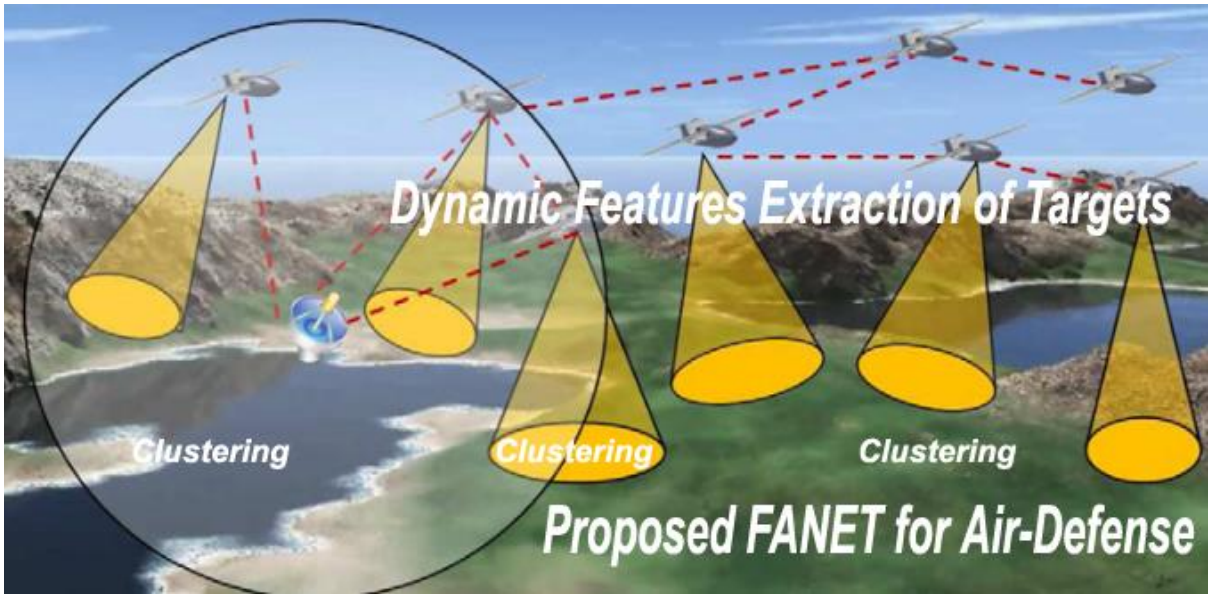

Figure 3. FANET with Applications in Air Defense

The technique that was proposed have been initiated with the effective logging of enhanced Feature Points with various network-based labels. The proposed labels were considered as suspicious or either non-suspicious with the consideration of the Training Dataset for the fuzzy and neural based Deep Learning such that the enhanced and predefined features were logged. In the next implementation, the effective way of integration of the Computer Vision based module which is using the OpenCV for the

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usage of flying based objects of FANET applications and also there by having the real time effective fetching of assorted images and procured objects were considered as the testing data. The next task which includes the feature points extraction by using edge based detection, corner based detection and also the scaleni and scale out invariant features by the effectual implementation of Fuzzy and Convolutional based Neural Network and effective Deep Learning for those identification of real-time objects. In the final reporting phase of the implementation, effectual marking of such objects with the specific usage class of either the suspicious or non-suspicious have been made with the detailed analysis of the traces and logs and illustrates the effectual performance evaluation.

Modules and Steps of Proposed Work

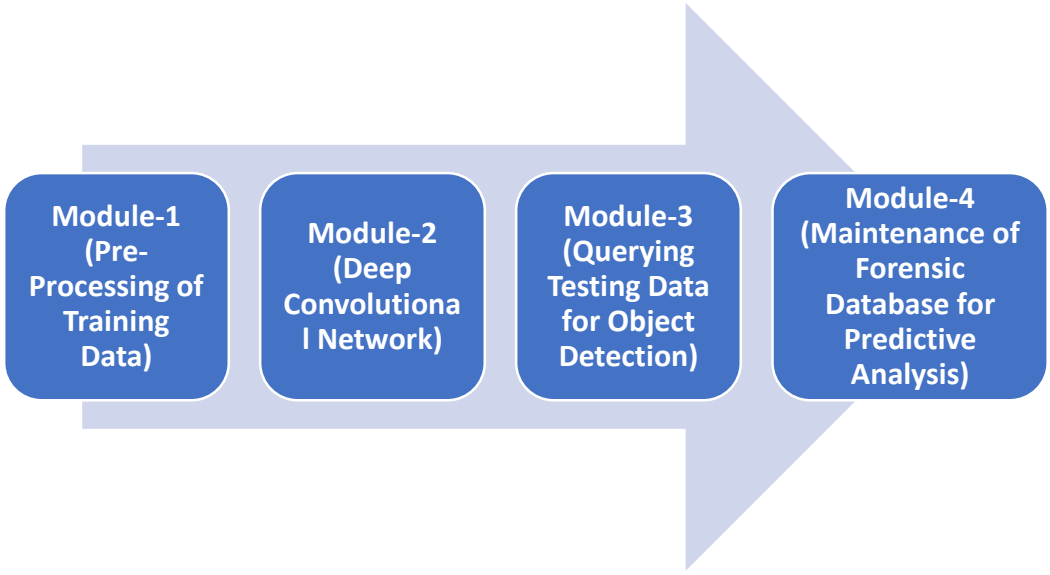

Figure 4. Assorted Modules of Deep Learning based Aircraft

Module-1 (Pre-Processing of Training Data)

1. In first step, the pre-processing of training data is done with the identification of feature points from existing records so that the labeling of object can be done
2. The labeling of objects directs the deep learning approach to present the exact class of the objects under suspicious or non-suspicious category
3. This step includes object feature points in form of the neuron which further can be integrated with the feed-forward back-propagation network
4. It is implemented so that the error factor can be reduced and achieving higher degree of accuracy in training and discovery of patterns.

Module-2 (Deep Convolutional Network)

1. The Deep Convolutional Neural Network (CNN) is prepared such that the feature points obtained from Module-1 are rigorously trained

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2. The training using CNN is done so that the multiple neurons can learn the pattern from the feature points
3. To integrate this feature with live camera, the Raspberry Pi with integration of OpenCV is proposed to be done
4. OpenCV is a high-performance framework for computer vision that integrates enormous soft computing and machine learning approaches

Module-3 (Querying Testing Data for Object Detection)

1. On deployment of the FANET based flying objects or aircraft, all the objects in the nearby location of camera are scanned
2. The scanned objects are automatically fetched based on their different features including edges, corners, scale invariant features and many others.
3. The querying process on testing images present the pixel values which are found analogous to the suspicious or non-suspicious objects as defined in the classes in Module-1

Module-4 (Maintenance of Forensic Database for Predictive Analysis)

1. The forensic database is maintained so that the future predictions and knowledge discovery based on the existing features and historical features can be done
2. The forensic database will be having structured as well as structured records including real time features as well as class definitions of the live images obtained from the aircraft in FANET environment.

Tools and Technologies in Implementation and Simulation

- Anaconda Platform
- Python
- OpenCV
- Notepad++
- Machine Learning Libraries
- Deep Learning Libraries
- Plotting Tools and Frameworks
- Virtual Environment with Windows / Linux

Following picture is the illustration of the aircraft that has been traditionally apply in Flying Adhoc Networks.

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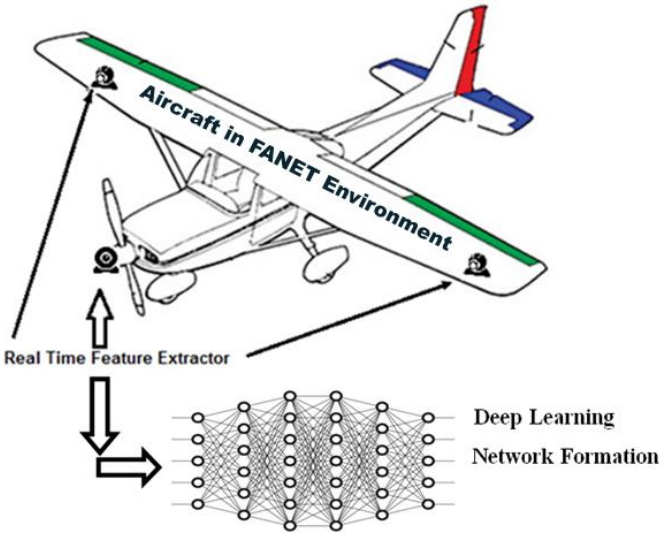

Figure 5. Integration of Feature Extractor with Real Time Deep Learning Module

The components which is having Real Time Deep learning based Feature Extractor that works on OpenCV (A Computer Vision Library for Live Feature Points Matching and Identification), Forensic based Database and also Feature based Descriptor Module for the purpose of recording and saving all the possible feature points that was used in real time. The realtime basd aircraft in the Flying Adhoc networks environment has been detected by the image recording and also thereby by the real time based object with the use of feature points and also feature extraction so thereby actual identification and illustration of the suspicious object can be identified in an effective manner.

Figure 6. Identification of the Suspicious Enemy's Aircraft by using Proposed scheme

In figure 6, the feature-based points which were marked accordingly with all the edges of the corresponding aircraft were considered under the analysis. So, by utilizing this image based feature extraction and the approach which is designed in real-time, the exact behavior of the image and the

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pattern of those flying based Adhoc objects has been well analyzed with the real-time evident and enhanced degree of accuracy by using the deep learning of those feature points extracted.

Conclusion

The proposed technique is proved to have the primary focus on the real time implementation of Flying Adhoc Networks with the effective integration and adoption of feature based technique of the deep learning such that the objects which are in real-time has been trained and well identified and also thereby marked for the surveillance and military based applications. Whenever there is a war at any location or even during the peace, it is considered and desired to always identify the real-time unidentified the and enemy's aircrafts and flying objects.

By the enhanced usage of the proposed technique, the deep learning, and the enhanced evaluation of all the feature points have been realized with the consideration of training set of data and for the appropriate actions which was considered further. The Fuzzy based deep neural networks were used widely in the form of enhanced engineering applications which includes soft computing, biological computations, optimization and even in the pure medical sciences. This proposed technique has been illustrated in the FANET based application and also it is a high-performance based paradigm and effectual to be proven as powerful in the usage of different domains.

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Biography of the Author

Vijaya Karthik S V (corresponding author) was born in India. He received his Bachelor of Engineering in Electronics and Communication Engineering from Anna University in the year of 2009 and Master of Engineering in Embedded and Real Time Systems from Anna University in the year of 2011. He has published more than 10 Papers in various International Journals.