International Conference on Recent Trends in Data Science and its Applications
DOI: rp-9788770040723.211

Prediction and Recognition of drone Magnetometer System with Multi Sensor Data Through Magnetic Interference of Signal using Artificial Intelligence with Edge Computing

R.Thamizhamuthu,
Assistant Professor, Department of Computing Technologies,
SRM Institute of science and Technology,
Kattankulathur,Chengalpattu District-603 203, Tamil Nadu,India,
thamizhr@srmist.edu.in

S Parameswari,
Assistant Professor, Department of ECE,
Sri Sairam Institute of Technology,
West Tambaram Chennai-600044,Tamilnadu,India,
parameswari.ece@sairamit.edu.in

Suhana Nafais A,
Assistant Professor, Department of MCA,Sona College of Technology,
Salem-636005,Tamilnadu,India,
suhana.nafais@sonatech.ac.in

Pankaj Negi,
Assistant Professor, ME, Graphic Era Hill University, Dehradun, R/S,
Graphic Era Deemed To Be University,
Dehradun, 248002,
pnegi@gehu.ac.in

A.Prakash,
Professor, Department of CSE, Faculty of Engineering and Technology,
Jain Deemed to be University,
Jakkasandra Post, Kanagapura Taluk,Ramanagara District, Bengaluru, Karnataka 562112, India,
prakash.a@jainuniversity.ac.in

Badugu Suresh,
Associate Professor,ECE,Koneru Lakshmaiah Educational
Foundation,Vaddeswaram, Guntur,Andhra
sureshbadugu@kluniversity.in

***Abstract*—The evolution of advanced technology play a vital role in diverse arena. This helps in the introduction of drone magnetometer system. The drone is an electronic system with sensors to monitor and detect the targeted system thus they are created to visualize the near environmental surfaces and objects. This is accomplished through the magnetometers, radar, GPS and various sensors. These technology are integrated with IoT, artificial intelligence techniques and edge computing techniques. The numerous data are processed through the image processing and recognition techniques. The security and privacy are enhanced to adopt a safer operation in various sectors. The important challenges includes the monitoring of the transmission lines in which heavier electromagnetic waves occur. To avoid these consequences, the drones are manufactured and adopted with advanced technologies. The drones are integrated with the internet of drones to provide various navigation services accompanied with the internet of things. Thus the overall process is implemented through artificial intelligence through deep learning and k-means algorithm and edge computing techniques.**

Keywords—Drone, GPS, sensor, image processing, electromagnetic waves, machine control, artificial intelligence, deep learning techniques, k-means algorithm, edge computing

I. INTRODUCTION

The evolution and advancement in technology leads to various development in versatile fields. This leads to the human lives much sophisticated with enthusiasm. The artificial intelligence play a driving factor for the upliftment of numerous automations. They are helpful in various fields such as industry, manufacturing, healthcare and agriculture. It helps to perform with higher efficiency [1]. The artificial intelligence is defined as the process of training and testing the machines to function as similar to that of the human intelligence. This includes language processing, speech recognition and improving vision through machines. These are done through computational algorithms which helps to control and monitor the overall functioning in the system. This includes deep learning, machine learning and artificial neural network [2]–[4].

Thus the artificial intelligence are used in wide range of applications. They make the everyday lives much easier. The various algorithms helps to control and monitor the system. The artificial intelligence provides various sophistications. They forecast the weather conditions, provide route maps, adopting smart speakers such as Alexa. They also used in entertainment through games and fun. This creates a digital platform to access everyone based upon the interest. This helps to function automatically without the aid of humans. They can control, monitor and function automatically [5]–[7].

After important factor is denoted as internet of things and edge computing techniques. Thus they process the huge amount of data and provide the exact solutions. The edge computing techniques are growing rapidly in diverse field adopting data computation. The edge computing is defined as the developing technology that are uses variety of networks to enhance computational parameters [8]–[10].

This includes processing the data when the user is near or away. This helps to process the information at a higher speed to achieve reliability in the network. The various examples of edge computing involves smart grid monitoring

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and controlling system, industrial automation system , refiners industries and drone management and control system . Here the data are collected and then processed to improve the efficiency in the various sectors. This helps the user not only dependent upon the cloud systems. The classification of edge computing include access edge and network edge. This helps to process the data at remote edge without nay constraints in the networking system. This is the combination of artificial intelligence. The important advantages of edge computing involves improved data management system and lower connectivity price [11]–[13].

Thus it helps to progress higher security and confidentiality of information. These techniques are largely used in military, army and navy applications. The integration of sensors, chips, hardware and software systems with communication technology tend to develop the UAV (Unmanned Arial Vehicle) or drone magnetometer system. The drone is defined as the aircraft or the submarine vehicle that operates without the aid of human. They are represented as an atmosphere ground equipment. This functions automatically through the program initiated through artificial intelligence [14]–[16].

They are implemented through various sensors that are useful to detect the external physical parameters in the environment. They are designed to operate largely in military system for safety and security purposes in the border regions. This helps to capture and sense images across the prescribed geographical conditions. The production of drone and its applications are created during the Second World War. They are manufactured by the US army for military and monitoring purposes. The drones are integrated with Global Positioning System (GPS) and sensor to access the particular locations. This is used to identify and detect the landscapes through the data processing techniques. They are used in various sectors. They are increasing rapidly through the wireless communication systems. They are further developed with the internet of drones. The communication system between the drones and the internet of drones are highly insecure which means the data collected can easily hacked. The drone can able to attack physically using the military powers. This leads to various loss [17], [18].

Fig 1: Drone magnetometer system

The figure 1 represents the drone magnetometer system. Thus various security measures are adopted to enhance the privacy and security concerns of the drones. This leads to provide secure drone of things network. Local attacks of drones may affects the positioning and its control system. The security and privacy are the important modalities to be considered in the drones. The UAV or drones are used as a research technology used for monitoring as directed.

The major challenge in the usage of drones is the prevention and proper functioning in the environment without causing damage to the transmission cable and overhead lines. Thus the safety of the drone and the transmission lines are the most peculiar challenge that are need to be addressed properly. Thus the drone are tend to analyze the capacity with which it protect themselves from electromagnetic waves and electric field. Thus adopting proper safety measures for the power system with transmission line cables are mandatory. The inspection of the overhead transmission line must be verified periodically. Due to the enormous power transmission, the manual way of checking the transmission line are highly dangerous. Thus the drones are helpful in analyzing and determining the functioning of the power system through checking the transmission line systems [19], [20].

Thus due to enormous power supply, there create a strong electromagnetic field with higher corona effects, the drones must with stand without any fault in the drone management system. These electromagnetic field cause disruptions to electronic components that leads to failure of the drone system. Thus the UAV are tend to work in various conditions to adapt itself and protect from strong electromagnetic waves. This leads to advance the safety and consistency of the structure. This can be accomplished through monitoring the transmission line at a particular distance without affecting the quality of service. They are done through the k-means clustering algorithm. Most of the drones are non-magnetic in nature that are prone to the magnetic effects [21]–[23].

The application of the UAV includes in agricultural, industrial and traffic management system through adopting smarter techniques. The internet of drone is decentralized infrastructure. This refers as the system with absence of any infrastructure. This helps to obtain the inter-locational triangulation provision. This in turn integrates with the internet of things. This states that if any threat occurs to the internet of things platform, it directly replicates to the internet of drone network. Thus the security and privacy are the major constraints in the internet of drone technology.

II. PROPOSED SYSTEM

The development of drone are enhanced through the sensors, magnetometer and artificial intelligence. The structure of the drone magnetometer is described as follows. The total weight of the drone system remains 5 kg in which the magnetometer is fixed at the centre of the drone system. There is a small distance of 0.7m from the remoteness of the drone to the magnetometer surface. The altitude of the drone must be maintained through 1 m to have stability in the operation. Increasing the altitude of the system leads to collision between the landing poles which enhances the signal to noise ratio.

The UAV or the drone management system is defined as the magnetic measurement technology integrated with the

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magnetometers, global positioning system and sensors. Two magnetometers are fixed at the center of the vehicle. The mean distance between the two sensors rae 0.3m that are mounted on the drone. The height of the drone is measured using the radar.

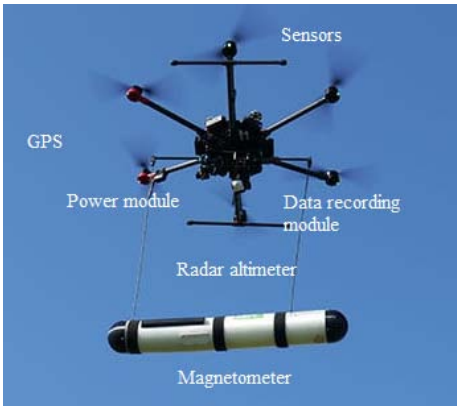

Fig 2: Drone management system

The figure 2 represents the drone management system. It includes GPS, power supply module, data sensing and recording module, sensors and magnetometer. The magnetometer is used to measure the magnetic fields around the surface in which the orthogonal axis in the magnetometer contains minute errors [24].

III. Structure of Drone Magnetometer System

The drone system is an unmanned electrical vehicles used to capture the images through sensors. The drone with magnetometer helps to detect the magnetic components on the earth's surface through geographical maps with higher accuracy. This helps to measure both the direction and strength of the magnetic components. They are introduced to replace the conventional methods [6].

The structure of the drone system is based upon the following parameters such as size and rotor classification, range of detection, landing of drone system and aerodynamic mechanism. The size of the drone varies from micro drone, mini drone, medium sized drone and large drone. The rotors and aerodynamics determine the structure and functioning of the drone system. The landling of drone system is classified based upon the horizontal and vertical takeoff and landing. The aerodynamic systems is classified into four categories. The controlled devices helps to collect the data at remote places through the internet of drones platform. The communication network are classied as ad hoc network and UAV aided communication network.

They are collected and the data are stored in the cloud platform. The data are collected through the aid of sensors assisted on the drone surface. To improve the communication system in rural and denser environments, they are improved through the internet of flying things. It enhances the performance of internet of things. The rotors are differentiated into tricopter rotor, quadcopter rotor, hexacopter rotor and octacopter rotor. The material used for the drone structures are carbon fiber composite materials. They are integrated with the aluminium and titanium alloys.

IV. Functioning of Drone Magnetometer System

The performance and functioning of the drone management system is done through three stages. This includes collection of information, handling of data and interpretation of data. They are done through the image processing techniques with deep learning. The control parameters are done through the optimization algorithm namely k-mean optimization.

(i) Collection of data

The collection of data forms the fundamental step in functioning of the magnetometer system. This includes the preparation of the test path with the flight area. This is the preliminary task in the magnetic investigation. The external parameters such as climatic conditions, environmental factors and surface height with vegetation are monitored and analyzed keenly. The direction of the drone, height and distance are the driving factors for the data collection. Thus the analysis of magnetic survey is an important factor for the drone magnetometer system. This helps to observe the functioning of the drone in normal conditions. The collection of data is performed through four stages.

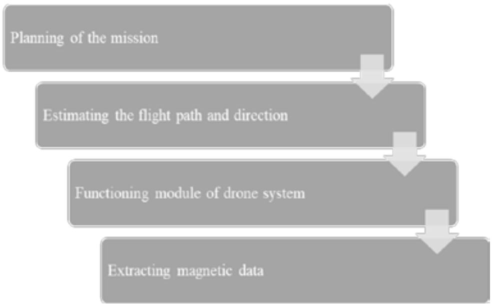

Fig 3: Collection of data

The figure 3 represents the collection of data. This is the first stage involved in the functioning of drone magnetometer system.

(ii) Processing of data

The second stage involved is denoted as processing of data. The processing of the data leads to the reduction of noise signal. This helps to enhance the signal to noise ratio. They perform three functions such as backgroud field elimination process, UAV with removal of inference field and gridding the data.

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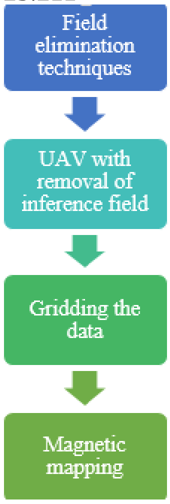

Fig 4: Data processing stage

The figure 4 represents the data processing stage. The first step includes the field elimination techniques. This refers to the elimination of geomagnetic and magnetic fields across the surface. They are generated by the power transmission cables. Increased traffic and in industrial buildings. Thus the external background field must be eliminated.

The earth is defined as the natural magnetic field which produces magnetic effects. It is the process of magnetic stimulus on the movable electric charges. It experiences the force that acts perpendicular to the velocity and the magnetic field. They are classified as external source and internal source. The stable dipolar field is obtained through the internal surface of the earth's crust.

The second stage includes the UAV inference field removal technique. This is the inherent noise signal generated inside the system. There is no other external disturbances takes place. Thus the removal of inteference field is much important in functioning of the drones . The complete field signal are eliminated through the calibration process. The calibration process is defined as the signal correlation method to defferentiate the magnetic signal from the total field signal. The calibration process includes initialization, execution of operation and functioing to extract the output.

The another stage includes the gridding of data. The gridding of data is accomplished through the process of interpolation. This refers as the computation of the magnetic field to that of the irregularly distributed systems. The abnormal conditions are denoted by the 2D contour map representation [21]. This helps to identify the abnormal conditions of the assessment circumstances.

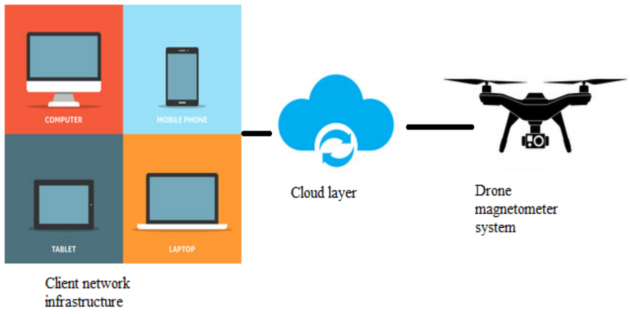

Fig 5 : IoD network structure

The figure 5 represents the IoD structure that uses the edge computing techniques. This helps to improve faster communication speed through higher accuracy in the network. The application of the client network infrastructure includes the cloud system inteface with the UAV interface. The information are collected and stored in the cloud layer with big data analytics with collection of data and processing system. They are forwarded to the drone management system [22]. This is the combination of hardware and software system accompanied with commmunication system. This sd done through the integration with internet of things.

V. Drone Magenetometer System using Deep Learning

The deep learning is a subsection of artificial intelligence. The deep neural network helps in the remote sensing field in diverse fields. This includes data processing with obtaining the finalised output. The information are processed in the hidden layers to produce the output. As the name suggest, the deep learning incorporates numerous layers to process the output involving the activation function. The layers are tend to involve in the problem solving through the feature maps. This is implemented through the training and testing the data. The UAV or drone performs based upon the deep learning techniques with optimization techniques.

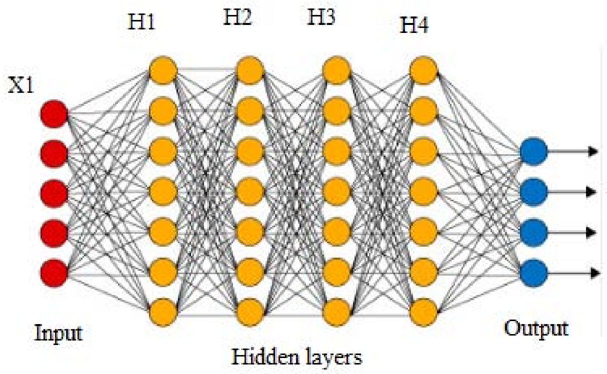

Fig 6: DNN model

The figure 6 represents the deep neural network prototype. The information are attracted to the hidden layer are performed through the back propagation techniques. They are accomplished through the generative adversarial networks algorithm. This is used to obtain the new data that are relevant to the training data. The two components of the

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GANs include generator and discriminator. The generator is used to obtain the false information. The discriminator adapts themselves to the false information and training and testing phase occurs. They are largely used in obtaining astronomical images and gravitational matters.

This helps in the creation of video games to provide increased resolution through two dimensional structure. This helps in the processing of real data and the false data. The discrimination determines the false information and proceeds results through them. This includes increasing the probability of the true and false images. The one cycle of the training data and processing to obtain the system is referred as epoch. They are formulated with mini batches to obtain the outcome. Then they are proceeded to obtain various training iterations.

```
# gan training algorithm
def train_gan(generator, discriminator, dataset, latent_dim,
 # calculate the number of batches per epoch
 batches_per_epoch = int(len(dataset) / n_batch)
 # calculate the number of training iterations
 n_steps = batches_per_epoch * n_epochs
 # gan training algorithm
 for i in range(n_steps):
 # generate points in the latent space
 z = randn(latent_dim * n_batch)
 # reshape into a batch of inputs for the network
 z = z.reshape(n_batch, latent_dim)
 # generate fake images
 fake = generator.predict(z)
 # select a batch of random real images
 ix = randint(0, len(dataset), n_batch)
 # retrieve real images
 real = dataset[ix]
 # update weights of the discriminator model
 # ...

 # update the generator model
 # ...
```

Fig 7: GAN training algorithm

The figure 7 represents the GAN training algorithm. Here the discriminated model is trained to obtain the true value probability.

The training data determines the training iterations. The discriminator model is obtained through the extraction of input from the generator and provides to the discriminator. This is obtained as fake samples. The discriminator teld to obtain the expected probability when the error signal is propagated backwards towards the generator. The keras model is used in the generator and discriminator model. The target is determined through the zeros and ones. The keras is implemented through the complete model integrated with the generator and the discriminator. Thus the trueness of the input image can be identified. The differentiation of the true and false value are obtained through the discriminator. The complete functioning of GANs is obtained with the solid foundation obtained from the keras. The keras function provide influences to the training functions. Thus they provide exact output in the drone magnetometer system.

```
# generate points in the latent space
z = randn(latent_dim * n_batch)
# reshape into a batch of inputs for the network
z = z.reshape(n_batch, latent_dim)
# define target labels for real images
y_real = ones((n_batch, 1))
# update generator model
gan_model.train_on_batch(z, y_real)
```

Fig 8: The composite model

The figure 8 represents the composite model integration of generator and discriminator. This shows the complete GAN algorithm with weights and functions for the estimation and detection of the discriminator and generator models.

VI. Performance Analysis and Outcome

The detection of drone magnetometer through artificial intelligence is designed and implemented in MATLB simulink. This helps to detect the performance of the drone before the execution in the real environment. This includes the observation of various parameters of the drone system ranging from phyical analysis and functioning of the system.

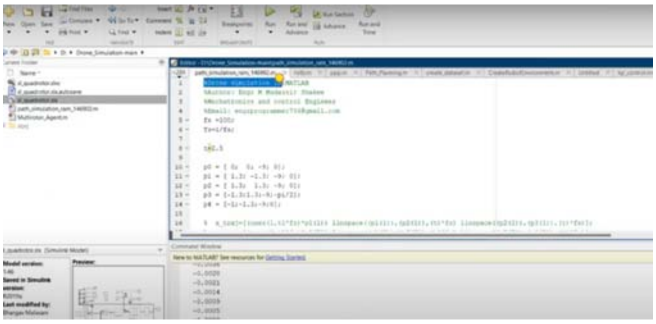

Fig 9: Implementation in MATLAB

The figure 9 represents the programming code for the implementation in MATLAB.

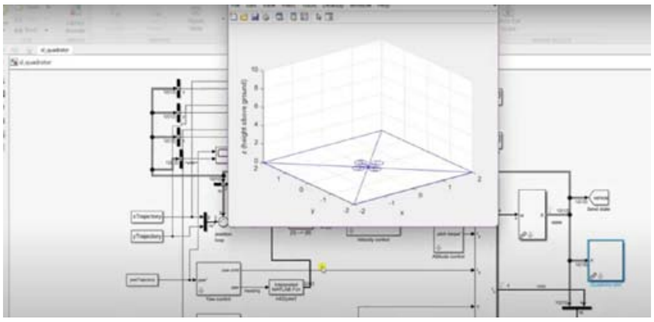

Fig 10: Calibration process

The figure 10 demonstrates the calibration process. They are done through the accelerometer. This helps the drone to fly without any oscillation in functioning.

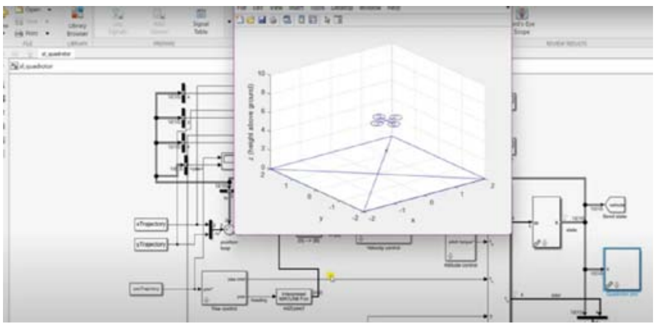

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Fig 11: Drone functioning with altitude 1 m

The figure 11 represents the functioning of drone at an altitude of 1 m. This must be stable to improve and maintain the performance of the drone system. It is attached with a magnetometer in pendulam structure. This detect the occurrence of magnetic components on the surface. The evaluation of the substances are recorded and captured as images.

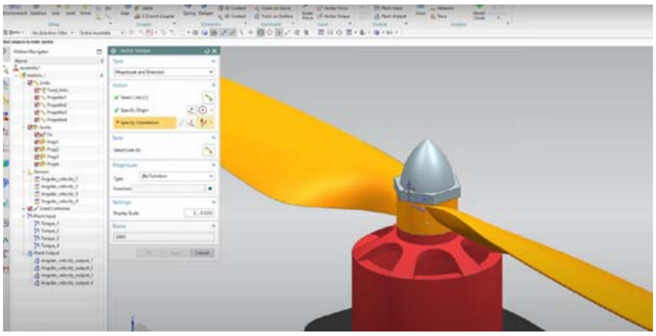

Fig 12: Rotor with controllable devices

The figure 12 represents the rotor with controllable devices and sensors.

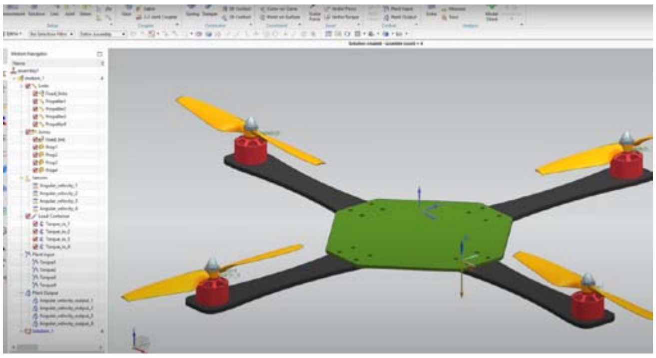

Fig 13: Performance analysis

The figure 13 represents the performance analysis of drone magnetometer system. The overall performance are sensed and recorded in cloud system.

VII. Conclusion

The drone magnetometer system are largely used in the mine detection and military areas. The remoteness between the bottom surface and the magnetometer are reduced through installing it in a pendulum method. This includes the capturing and visualizing the objects, detection of magnetic components on the surface through artificial intelligence and image processing techniques with optimization techniques. The internet of things paved a platform for the development of internet of drones. They are functioned with innovative automation techniques. Thus it overcomes the problems faced by the conventional methods and enhances the detection of metallic components in remote areas through reduced computation time and increased efficiency.

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