



## Supervising flora and fauna of forest using drones

Datta S Chavan<sup>1</sup>, Swaroopa S. Bhosale<sup>2</sup>, Niyati Patel<sup>3</sup>

<sup>1,2,3</sup> Bharati Vidyapeeth Deemed University College of Engineering, Pune India

**Abstract.** In this research the drone is developed to monitor the flora and fauna of forest. A vision camera is fitted on the drone to record various things in the forest like animals, water bodies, birds, butterflies etc. The microphone is also fitted on the drone to record voices of different animals. The drone is also equipped with data storage and data transmission facility. Also various sensors are fitted on drone to record various atmospheric parameters like humidity, temperature, rain and wind speed etc. The recorded data can be transmitted to the google drive or data center. Due to this the reliability of storage of data is increased. Various abnormal conditions in the forest like fire, unauthorized tree cutting can also be monitored by forest drone. Certain preventing measures can also be taken to reduce the intensity of abnormal conditions like fire. Some drones can be equipped with carbon dioxide powder to extinguish the fire in the forest by spraying the carbon dioxide powder on the fire. Incipient abnormal conditions of fire can also be detected by smoke detectors fitted on the drone.

**Keywords:** drone, forest, sensors

### 1. Introduction

#### I. INTRODUCTION

The research is related to drones [1] as drone is used for monitoring the flora and fauna in the forest. Furthermore the research is related to the forest as drone is utilized for preserving the green corner of forest. Similarly the research is related to aerial vehicle as drone is one of the aerial vehicles. In the same way research is related to sensors as various sensors like rain sensor humidity sensor temperature sensor and smoke sensors are used. Correspondingly the research is related to global warming as these drones [2] [71] monitoring technology can help in reducing the global warming effect by increasing the green corner. Similarly the research is related to fire extinguishing technology for forest fire as drones [3] [72] can be used to extinguish the forest fire by sprinkling CO<sub>2</sub> powder with the help of the drones. Further, the research is related to protection of flora and fauna of forest as this drone surveillance can help to increase the growth of various species. In addition the research pertinent to biodiversity growth as these drones [4] [73] monitoring technology can eliminate forest fire event by detecting the forest fire at an incipient stage. Further, the research is related to theft in forest as drone [5] [74] surveillance technology can prevent the sandalwood and other precious trees cutting and theft. The research is also related to preservation of vanishing species of trees and animals as drone [6] [75] surveillance can detect the presence of rare animals and measure to preserve these animals can be taken. The research is related to forest research as drone technology can be useful in research activities related to forest. The research is also related to tourism these forest drones [7] [76] it can guide tourist in the forest. Research is related to prevention of poaching of wild and rare animals as the drones [8] [77] can detect private hunters doing same unwanted activities. The research is related to growth of trees in forest as the drone [9] [78] can be used to throw the seeds of rare trees in the forest in rainy season so that plants growth of new plants will be started.

Chung Hoon Choi carried some research in charging the battery of drones. [10] Use of drones [11] [79] is increased in various sectors. The battery life in a drone is a major issue now days. Chung put an idea of automatic charging stations. The charging stations proposed by Chung is fully automatic. The charging stations proposed by him is wireless as well. Drone [12] [80] is one kind of unmanned vehicle. The drones [13] [81] are of very small size. There are various types of drone [14] available now days. Most of the times the drone [15] [82] has four rotors. The drone having four rotors is called as quadrotor drone. [16] [83] The drone can be used for disaster management. The drones [17] can also be used for 3D mapping. Likewise the drones [18] [84] can be utilized for aerial [73] photography. In the same way drones [19] can also be used for unmanned cargo system. The drawback of drone [20] [85] is that the battery time of the drone is very less. Most of the time lithium batteries are used in drones. [21] [86] Due to low battery life the battery of the drone is required to charge after half an hour. Due to this fact the drone [22] [87] cannot fly for more time continuously. Chung used a laser beam to charge the battery of drones. [23] [88] Some researchers used solar energy to charge batteries of drones. [24] Some researchers developed wireless drone [25] [89] charging stations. In wireless charging station two induction coils are used. Charge proposed battery charging using magnetic induction.

Charging in Chung's method is done wirelessly. The charging station developed by Chung Hoan consist of a frame made up of aluminum, two stepper motors, two laser sensors and a ultrasonic sensors. The slide of the plate can move in x-axis and y-axis in the horizontal direction. On the aluminum frame PVC panel is fixed. On the PVC panel the drone [26] [90] lands for charging. The role of the ultrasonic sensor is just to detect the landing of the drones. [27] For controlling the stepper motor arduino chip is used. Laser sensors are used to sense the position of the drone. [28] [91] Using some of the softwares and sensors the drone [29] [92] is brought at the centre of the PVC panel. In wireless charging method, magnetic induction technology is used. The two coils are used for transmitting the energy using mutual induction. After receiving the energy it is converted into DC and is used to charge the battery. The technology eliminates the use of wires for charging. The charging method is separated into three sections. In the first section it senses the battery is needed to be charged or not and then the charging is initialized. In the second step scanning is done and the drone [30] [93] is landed on the PVC pipe. In the third section by using laser sensors the drone's base coil is positioned along with the coil on the base plate. He has used a quadcopter drone [31] [94] for his experiment. In his research accuracy of position is done upto 2mm, the charging current in his wireless charging is 300mA. The charging voltage used is 5V. The time for charging in his experiment is 75min. He used a battery of 700mah for his experiment. In his experiment the charging efficiency was 65%. This technology of charging drone [31] [95] battery is useful for remote areas. In this process the sensing process is 5 minutes.

Hironbu Kinjo developed a drone [32] for monitoring the transmission lines. There are various applications of drones. Drones [33] [96] can be used for surveying land. Drones [34] [97] can be used for transport purposes. Drones [35] can be used for spraying pesticides and insecticides. Drones [36] [98] can also be used for monitoring the crop. Smart phones are used for controlling the drones. Autonomous drones [37] [99] utilize self positioning system. Under bridges sometime GPS data is not useful. GPS data also goes wrong in tunnels. GPS data even goes wrong under electrical power lines as to high voltage. He developed drone [38] which is not dependent only on GPS data. The drone [39] [100] developed by Hironobu Kinjo computed the position of drone [40] by image processing. He manufactured a drone to monitor transmission line. Lifespan of transmission line is about 40 years. Frequent interruption is needed for transmission lines. He utilized ground images for deciding the position of the drone. [41] [101] The images taken from the high altitude are not much clear. He used fast and surf algorithms for image processing. He used RANSAC to detect mismatches in the image. He used five point algorithm to correlate position and altitude of the location. He computed the co-ordinate trigonometrically. He also provided a flowchart for image processing. He also used a LUCAS Kannade method for image matching. He eliminated all mismatches using RANSAC.

Jorgen Wallerman developed a monitoring system of forest using drones. He used a drone [42] with four rotors. He used a multispectral camera on a drone [43] [101] to collect the data from forest. The data is used to develop map of forest. The data received by him is useful in studying green house gases. He performed the experiment in Sweden for three sites. His research is useful to study green house gases. In Sweden at four sites towers are erected to monitor the green house gases. The height of the tower is around 150m. The data collected is used to monitor the vegetation in the forest. The emission produced by human beings is also monitored. The data acquired is three dimensional. The height of the tree is also monitored. Laser scanning is also done to acquire the data. For laser scanning time required is more. The above method is not suitable for repeated acquisition of data.

Jong Hwan Beck developed a measurement technique using a vision camera. He used a barcode with two directions in its measurement. Accurate positioning of robot is very important. For precise positioning of robot, GPS system, landmark recognition system and map matching system are used. Sometimes, incremental method is used for positioning of robot. Odometry method is one of the incremental methods of positioning of the robot. Sometimes, landmark identification system based on image is used for positioning of robot. Barcode consists of white and black bars. The thickness of the bar is different. Computer can read the barcode. The barcodes are printed on the cover of the products in malls. In this measuring system, the barcodes are fixed on the objects. The barcode represents a particular object. In measurement system, barcodes are used. The barcodes are of two types. Two dimensional barcodes and one dimensional barcodes. Two Dimensional barcodes can store more information as compared to One Dimensional barcode. He used quick response code, i.e. QR code. Quick response code is a type of two dimensional barcode. In some methods, on board sensors are used. Artificial landmarks are employed for detection. Vision camera is used to detect the landmarks. In the landmark, double layer barcodes are used. The location of the barcode is detected by global positioning system. Sometimes, quick response code is used to measure the distance. Smart phones are used for conducting the experiment. Location of Quick Response codes is detected. Then, by using geomagnetic sensor camera, the direction is found. The arrow on the screen of the smart phone shows the road direction. He had used smart phone camera and gyro sensor. In barcodes, data is represented using different width of bars and spacing between them. These barcodes are treated as one-dimensional bars. Nowadays, two-dimensional quick response codes are used. In quick response codes, various rectangles, hexagons or any other geometric shapes are used. In earlier days, optical scanner was used to read barcodes. Nowadays, smart phones are used to read the image of the quick-response code. In quick-response code, the information is stored in black-and-white patterns. The capacity to contain information is more in case of quick-response code than one-dimensional barcode. In

quick response code, the complete information of the landmark of robot can be stored. The information about the geometrical position can be found. In a quick response code, geometric positional information like latitudes, longitudes, altitudes, normal vectors, scope of size of the object is stored. The data is stored in the barcode itself. The quick response code is not used worldwide. The quick response is printed in a small area. Sometimes, stickers of quick-response codes are used. The finder pattern is placed at the upper and lower left corners, as well as the upper right corner of the entire code. The direction and position of the code is found using Global Positioning System (GPS). In the finder pattern, there are three identical patterns placed at the corners of the complete code.

## 2. Objectives Of developing a drone for forest

1. The objective is to develop drone [44] [102] to monitor flora and fauna of the forest.
2. Further goal is to build a drone for carrying out research in the forest.
3. One more motive is to manufacture a drone [45] [103] to record various environmental parameters in various parts of the forest with suitable sensor.
4. Yet another goal is to monitor the green corner of the forest.
5. Correspondingly the goal is to develop a drone [46] to monitor the presence of rare animals in the forest.
6. Besides the target to develop a drone [47] to detect the natural fire in the forest an incipient stage using a smoke detector attached to the drone. [48]
7. Further motive is to monitor the rainfall at different parts of the forest.
8. In addition, the motive is to develop a drone [49] to throw the seeds of trees in the forest for growing new trees.
9. Additionally the goal is to develop a drone [50] with vision camera to record the presence of various butterflies in the forest.
10. Further the goal is to fabricate a drone [51] to monitor the unauthorized cutting of trees in the forest.
11. In the same way the motive is to build a drone [52] for recording the presence of migrated birds in the forest.
12. Further the goal is to monitor various parameters like rainfall wind speed and humidity etc.
13. Further the motive is to fabricate a drone [53] to monitor unauthorized tree cutting like sandalwood, etc.
14. Likewise, the goal is to monitor the biodiversity in the forest using drones. [54]
15. In the same way the goal is to detect the presence of various birds in the forest.
16. In the same way the motive is to develop a drone [55] to prevent hunting of birds and rare animals by hunters.
17. Further the aim is to develop a drone [56] to guide the tourists in the forest.

## 3. Tasks performed by forest drone

1. To guide the tourism in forest.
2. To monitor biodiversity in the forest.
3. To help in forest research.
4. To monitor flora and fauna of the forest.
5. To monitor rare animals in the forest.
6. To monitor various butterflies.
7. To monitor group of trees in the forest.
8. To monitor green cover in the forest.
9. To throw seeds of trees in the forest.
10. To monitor unauthorized tree cutting in the forest.
11. To prevent the hunting of wild animals in the forest.
12. To monitor rainfall in the various parts of the forest.
13. To monitor various environment parameters like rainfall humidity, moisture, wind speed etc.
14. To detect natural fires in the forest using smoke detector.
15. To extinguish the fire by spraying CO<sub>2</sub> powder on the fire.
16. To monitor presence of various birds in the forest.
17. To keep a watch on migration of various birds from other regions.

#### 4. Various Sensors Used In Forrest Drone

1. Vision Camera- To capture images of the Flora and Fauna.
2. Microphone- To capture voices of animals.
3. Temperature sensor- To record temperature.
4. Humidity Sensor- To record humidity in the forest.
5. 3 D imaging sensor- To get the actual dimension of the animals.
6. Anemometers- To record the wind speed.
7. Smoke Sensor- To detect fire at earlier stage.
8. Pain Sensor- To record the amount of rain fall in the forest.
9. Object Sensor-So that it can travel autonomously without collision to any object present in the forest.
10. Battery status sensor.

#### 5. Advantages Forest Surveillance Using Drone

1. Large area of forest can be monitored in less time.
2. Forest can be monitored in rainy season also when it is very difficult for human beings to reach at a particular place due to mud.
3. Various wild animals can be monitored easily without disturbing them.
4. Various birds and butterflies can also be monitored easily.\
5. The amount of rainfall in the rainforest can be monitored using rain sensors.
6. Growth of various trees and their flowering season can be monitored easily by using drones. [57]
7. Data capture by drone can be transmitted immediately to the control room.
8. Real time monitoring of forest can be with the help of drones. [58]
9. The technology of drone surveillance in the forest can help to prevent unauthorized cutting.
10. The drone [59] surveillance is helpful.

#### 6. Applications of Forest Drone

1. The Appointed drone [60] can be used for survey flora and fauna of forest.
2. Further it can be used for monitoring green cover of the tress.
3. Furthermore it can be utilized to monitor the occurrence of natural fire.
4. Further it can be used to check the presence of rare animals like tiger in the forest.
5. In addition the drone [61] appointed in forest can be used to monitor the rainfall in the forest with some rainfall sensor attached to it.
6. Additionally the drone [62] appointed in the forest can be used monitor butterflies in the forest.
7. In the same way the drone [63] appointed in forest can be used to throw seeds in the forest for growing new trees in the forest.
8. Corresponding the drone [64] appointed in the forest to record the presence of migrated birds.
9. Further the drone [65] appointed can be used the monitor the unauthorized tree cutting in the forest.
10. Further the drone appointed in the forest can be used to prevent tree theft of pressure tree like sandalwood tree from the forest.
11. Further the drone [66] appointed in the forest can monitor various environment parameters in the tree like moisture, temperature, humidity, rainfall, wind speed etc by attaching various on it.
12. Further the drone [67] appointed in the forest can be used to monitor the presence of various birds in the forest.
13. Further the drone [68] appointed in the forest can be used to monitor the biodiversity in the forest.
14. The drone [69] in the forest can be used for carrying research activities in the forest.
15. The drone [70] appointed in the forest can be used for guiding the tourist in the forest to show them path in the forest.
16. The drone in the forest can be used to prevent hunting of wild animals by private hunters.

#### 7. Conclusions

It is concluded that the drone can be used for monitoring the forest. It can monitor the flora and fauna of the forest. The drone can also be used for throwing g the seeds in the forest for growing new trees. Even it can be used to sprinkle the Carbon dioxide powder to extinguish the fire in the forest.



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## 9. Biographies



Dr. Prof. Datta. S. Chavan is Ph.D. in Electrical Engineering. He received BE and ME (Electrical) (Power systems) with rank certificate from Pune University, India. He is presently an Associate Professor, Co-ordinator (R&D cell), Co-ordinator (Ph.D. Program Management) in Bharati Vidyapeeth Deemed University College of Engineering Pune, India. He has total 26 years of industrial and teaching experience. He guided 20 Bachelor’s and 15 Master’s projects. He visited total 70 industries and R and D institutions. He has 135 publications, 37 papers at conferences in India, Malaysia, Canada and Taiwan and 40 international journal papers. He was invited as a session chairman for IEEE conference in Malaysia. He filed 28 Indian patents. He has 24 book chapters with ISBN number published by IEEE USA. He worked as a technical program committee member and designated reviewer for 20 IEEE and international conferences at Bali, Bandung of Indonesia, Kuala Lumpur, Langkawi, Kuching Sarawak, Melaka, Johor Bahru, Penang of Malaysia, Calicut Kozikode, Kochi, Kerala, and Jaypur Rajasthan. He has research collaboration with researchers of India, Spain, Italy, Denmark, Netherland, Switzerland, Austria, New Zealand, Australia, France, USA, UK, Ukraine, Greece, Germany, Poland, Chile, Singapore, China, Romania, Belgium, Taiwan, Norway, South Africa, Turkey, Canada, Argentina, Algeria North Africa, Portugal, Brazil, Mexico, Sweden, Malaysia, Uruguay, Ireland, Iran, and UAE. He is a member of IEEE USA, IEEE PES USA, Institution of Engineers, Institution of Electronics and Telecommunication Engineering, Indian Society for Technical Education, Indian Society of Lighting Engineers, Mahratta Chamber of Commerce Industries & Agriculture, Bombay Natural History Society, world wide fund for nature, rose society of Pune, Exotic Pets and Animal Welfare Society, and friends of empress Garden, Pune India. His research area is wind energy, renewable energy, electric vehicles, robotics, drones and internet of things. email- greeneearth1234@yahoo.com.



Swaroopa S. Bhosale is M Tech Electrical power systems. She is a Ph.D. research scholar of Bharati Vidyapeeth deemed university college of Engineering, Pune India. She has published few papers in IEEE conferences. She has worked as an assistant professor in Bharati Vidyapeeth deemed university college of Engineering, Pune India. Currently she is working as an assistant professor in Navsahyadri Education Societys Group Of Institutions Faculty Of Engineering, Naigaon, Pune-Satara Rd, Bhor, Pune, Maharashtra 412213 Her area of interest is electrical vehicles and power quality. **Email Id:** er.swaroopa@gmail.com



Niyati Patel is from Bharati Vidyapeeth deemed to be university College of Engineering. She is from Electrical Engineering. Her areas of interest are Electric vehicles, drones. Robots, and internet of things.