International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-8, June 2020

Crop Surveillance using Unmanned Aerial Vehicle for Precision Agriculture

S. Ramesh Kumar, Srikanth Vemuru, Srinath.A

Abstract: ***Precision agriculture (PA) is a combination of latest technologies planned to increase the productivity and profitability by retaining the quality of the fertile land and surrounding environment. Crop monitoring in precision agriculture will be achieved by implementing innovative techniques; however the utilization of Wireless Sensor Network (WSNs) results in low power and low cost utilization arrangements thus turning into a predominant alternative. It is likewise outstanding that harvests are additionally influenced adversely by interlopers (human or animals) and by insufficient control of the production process. Crop surveillance through drone is one of the technical approaches to capture and distinguish the crop patterns, which helps in early detection of the crop damage, leads the farmers to take care for crop yield. Drone is also termed as Unmanned Aerial Vehicle (UAV). These vehicles are equipped with required electronic sensors, cameras and a flight control system to simulate the UAV, with small in size and flexible to handle and operate, These Aerial Vehicles can operate within indoor as well as at outdoor. The goal of the research is to contribute to the implementation and deployment of remote sensing technology with UAV. This paper enumerate on the applications of UAVs for crop scouting and analyzing the transmitted images using NDVI to predict the crop growth and yield.***

***Keywords*: Wireless Sensor Network, Drones, Video Surveillance, NDVI.**

I. INTRODUCTION

In India's economic growth agriculture sector plays a major role. Sustainable services are developed in a scalable manner, due to the spread of agriculture. Communication resources and Computing facilities are available with farmers and also the domain experts and awareness programs on latest technologies and its benefits are helping the farmers can differ widely due to their different socio economic backgrounds.
Agriculture is a labored intensive and obsolete. Still in some parts of India, farming is carrying out by implementing old procedures framed long back furthermore, doesn't deal with protection of resources.

Revised Manuscript Received on June 30, 2020.
***** Correspondence Author
S. Ramesh Kumar*, Department of Computer Science and Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, AP, India. Email: cadramesh@kluniversity.in
Dr. Srikanth Vemuru, Department of Computer Science and Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, AP, India. Email: vsrikant@kluniversity.in
Dr. A. Srinath, Department of Mechanical Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, AP, India. Email: srinath@kluniversity.in

The newer scenario like unpredictable environment, Pests, shortage of water resources present an urgent need of latest methods and technologies to simplify the farming techniques and also for proper utilization of available resources.
The application of drones along with wireless sensor network technology in agriculture will bring out the fundamental contribution to precision agriculture by improving the efficiency and quality in production with less impact by unpredictable sudden environmental changes on the crop yield. The precision agriculture is defined as a strategy of applying the right amount of input (water, fertilizer, pesticides, Weather conditions, etc.) at the right location and at an appropriate time to increase in production and also to improve quality, while safeguarding our environment.
UAV's can be used to gather real time data from the fields and the surrounding environment to perform various farming tasks. Its elevated position allows visualizing the farm field with a perspective view, which in turn helps and useful for detecting changes affecting crops, such as crop growth, diseases, pests, significant changes in soil dampness, dry season or floods.

II. CONSTRUCTION AND WORKING PRINCIPLE OF DRONES

Drone, are also called as a quad rotor, it is a multi copter that is lifted and propelled by four rotors. Quad copter is named as rotor craft, instead of fixed-wing plane, on the ground the lift is produced by a revolving a set of airfoils with a narrow-chord. In contrast to most quad copters use uniformly pitched sharp blades, these can be balanced as a group, a property known as collective but not separated based upon the blade's position in the rotor plate, which is called cyclic. Vehicle motion control is achieved by adjusting the pitch and the rotation rate of one or more rotor discs, subsequently adjusting its torque load and thrust/lift characteristics.
The flight controller is the major device in the UAV, embedded with the latest firmware and it plays an important role for the actual flight. The flight controller stabilises the UAV. It is controlled with a micro controller that manages the communication to four brushless motors. These mounted motors are connected with the rotors in directions of the UAV configuration model. These BLDS motors are controlled by The Electronic Speed controllers (ESC). Radio channel transmitter and receiver are used to control the UAV flight as all RC transmitters would have multiple channels to control the UAV and its operations. Smaller size quad copters are fabricated with frames to enclose and protect the rotors,

while flying through any challenging environments, with less damaging to the Drone. They are relatively inexpensive, available in a variety of sizes and amateurs can build and maintain these simple mechanical structure design.

III. CROP SURVEILLANCE USING DRONES

UAVs are capable of scouting the crop with different indices. UAVs can cover a hectare of field in single flight. These types of operations are performed with thermal and multi spectral Cameras to record reflectance of vegetation canopy, which is mounted to bottom frame of the UAV. The camera takes 1 capture per second and stores it into memory and transmits to the ground station through telemetry i.e wireless communication by utilizing the protocols like MAVLINK. The captured images will be in five brands consisting different wave lengths and frequencies for example: (i) Near infrared wavelength 760-850nm, (ii) Red edge wavelength 690-730nm, (iii) Red wavelength 630-685nm, (iv) Green wavelength 520-590nm, (v) Blue wavelength 440-510nm Using Precision Vision Crop Health Imaging system, the farmer can view crop streaming video, displaying the crop health. Observing the true health of field in a color contrast, farmer can estimate how much sunlight is being absorbed by the crop canopy. The data transmitted from the multi-spectral camera via telemetry was analyzed by the Geographic indicator Normalized Difference Vegetation Index (NDVI). Calculations generated output values ranging from -1 to +1; near to 0 (ZERO) which did not specified any vegetation on the crop and near to +1 (0.8 to 0.9) indicates highest density of green leaves on the crop. These analyzed results help farmers to easily identify areas in the field where the pesticides need to be sprayed. The built-in GPS module stores and identifies the GPS coordinates of the images captured. Then The GPS coordinates of the field images are passed to the control system of the UAV, for automatic spraying of pesticides without manual intervention.

Drones provide farmers with three types of detailed views.

First: Crop Surveillance of a particular farmland may reveal patterns that expose many facets ranging from irrigation problems to soil variation and even pest and fungal infestations that are not visible at eye level.

Second: Crop Health Imaging is implemented by providing input capture for multiple spectral images s by airborne cameras. These captured data from the infrared as well as the visual spectrum, can be combined to create a view of the crop that highlights the differences between healthy and distressed plants, which human can't be seen with the naked eye.

Finally: A drone can survey (scout) a crop every week, every day, or even every hour, combined to produce a time-series animation, that imagery can display crop improvements, expose trouble spots or possibilities for better crop management.

IV. CROP SURVEILLANCE AND ANALYSIS USING DRONE DEPLOY SOFTWARE

Recent technology developments in the field of drones not only reduce the delay for taking remedial measure to protect the crop after taking images for analyzing the crop condition. Drone Deploy software which works on its own cloud-based platform and image processing capabilities. This software helps to map the path of the drone, taking the pictures in more accurate way, analyzes the crop health and completes the work in quicker ways. Drone Deploy connects operating drone to the internet, allowing powerful and high end configured cloud servers to plan flight path, carryout safety checks, and crunch vast quantities of visual data.

A. Mapping the Drone with Drone Deploy

The Drone Deploy software opens with a workspace window in GUI environment, where the Google maps appear with various locations. "Plan a map flight" option in the software helps to navigate on the map, for choosing the required field area by changing the limits of the territory expected to do the survey. After selecting the area, the software will be able to demonstrate the aggregate zone we chosen. The logo of flight plan appears on the map which is automatically generated. The flight plan can also be adjusted along with the altitude of the drone. Thus, the mapping of the drone is automated. Now, drone is connected to the system where software automatically detects the drone and it helps to fly in the predetermined way around the field.

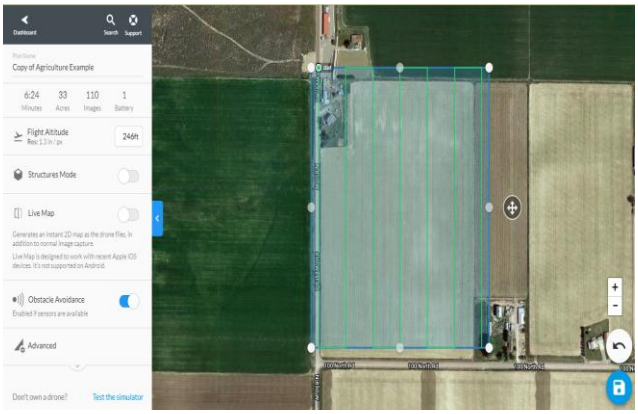

Fig.1. Mapping the area for Surveillance

After interfacing the drone with the selected coordinates of the field, software enable start option, then drone reaches the start position of the plan for operation. It starts taking the pictures in regular intervals of time during its time of flight and the picture accuracy depends on the plan of flight and the altitude of the flight. So, those factors needed to be checked before deploying the drone.

Fig.2. Drone plane of flight at bounded area for surveillance

Fig. 3. Drone during time of flight taking images at specified intervals

B. Advantages & limitations of Drone Deploy Software

Drone Deploy also solved a major problem of digital surveying, i.e. exact co-ordinates of point at which abnormality is detected. When we map in drone deploy software it automatically saves the precise latitude and longitude co-ordinates. When we want to check at the particular point of a crop, we can get the co-ordinates of that point.

Drone Deploy is the pre-customized software. There are few open sources mapping software's which help to embed our own code. In real time analysis there are few problems such as to know the quality, plant height analysis etc. to avoid such problems there is a technology of Augmented Reality. AR helps to embed virtual geometry in real time video. Whenever we draw a virtual line using AR, it fixes in real time there itself in space co-ordinates and we can check that geometry whenever we want. In precision farming, AR helps in many ways. When we send the drone for surveying, the drone completely analyses the plant health and when it finds any abnormality at any point in crop then it takes the co-ordinates and goes to that point. Then using AR, system draws virtual line of plant height, area of plant leaf and greenery of plant is analyzed and stored in system database. System analyses at the same point for few days and analyses few parameters. The system works in machine learning process, using that process and analysis reports the system sends amount of water and chemical treatment needed to particular portion of field/crop.

V. Drones for Agriculture Activities

Drones help in farming activities such as sowing seeds on immense tracts of land. They can also help in spraying pesticides which protect the yield against normal predators. Crop insurance and crop harvest mapping are critical areas where drones can be integrated into the agriculture, expanding the farmers support network program.

Amid India's keen interest in leverage the cloud sowing technology, cost factors are bothering our development. But drones can be further deployed for cloud sowing and for crop monitoring, thus contributing nation's overall food security program.

UAV's are utilized on agricultural field to spray fertilizers. Nevertheless, it is not appropriate to affect the neighboring field, which will belong to another proprietor. In addition the UAV must operate within their specified boundaries. On the off chance that the UAV utilized from spraying comes excessively near to the adjacent area, if there is a sudden shift in the direction of the wind, the fertilizer that fall on the adjacent field and this must be prevented at a strategic distance from, To be able to adjust the operating direction, the arrangement made so that the UAV received information from the WSN deployed in the field. The sensors detect an excessive chemical concentration, and then the UAV spray will be directed away from the borders. The processing of application of the fertilizers is regulated by inputs signals from the WSN deployed on the crop field at ground [2]. It has divided into two modules, i) The Behavioral Module and ii) The Chemical Dispersion Modules, such modules will work simultaneously with the socket-based communication in an integrated way. The behavioral module, along with UAV orientation and velocity gives the present UAV location in (x, y, z) to the Dispersion Module. However, the behavioral module detects the changes in wind direction and velocities with the data sources (signals) from the ground sensors and provides the information to the Dispersion modules so that it can measure the fall and spray position of fertilizers. The UAV periodically sends a broadcast message to ground sensor nodes, requesting the concentration in its location. Therefore, the UAV will call a decision manager instance with these response messages from the deployed nodes to compute its decision and then adjust its path.Before you begin to format your paper, first write and save the content as a separate text file. Complete all content and organizational editing before formatting.

VI. Challenges Facing by Drones

In Precision Agriculture, application of Drones seems to be very useful and attractive, there are a set difficulties and not easy to implement; one of its regulation is, the civil aviation ministry does not permit drones to fly more than 500 meters in the event that they are to be utilized by private companies. The second issue is about the image quality and resolution, which is as yet melancholy from significant distance. Drone manufactures need to redesign, such that payload can be expanded by fixing ling towers to mount incredible cameras, which will raise the size approximately over 10 feet, because of this modification, the existing batteries must be powerful to bear the weight from the present size of 3 feet.

The drone is maintained by batteries in air for an hour and after landing they must be charged for four hours. Added to this the elementary issue; the drone is only as good as recognizing and detecting the GPS signal.

The third issue, one must develop expertise in programming and services to truly become famous in the field of drone management.

The fourth issue is funding; speculators today have no idea but publicity about the benefits of drones. Entrepreneurs need to think about creating IP in algorithms, adding services and include administrations to make an action plan," says Ivaturi Vijay Kumar, co-founder of Indian Innovation Labs and part of the India Angel Network.

VII. RESULT AND DISCUSSION

All types of crops are not greenery, some are obviously light in shading, some are extremely green in shading even in less water supply. This may be an issue for the software to calibrate the plant health for different types of crops. To overcome this problem, software has given the choice to change the shading inclinations for various harvests and simple client assessment.

Another problem that comes in our way is 'visibility defective', which is nothing but some weeds and unwanted plants also grow in the middle of the farms which are also visibly green in color. So, in that situation there might be a possibility that plant health will be showing full plant health in that region. To overcome that situation the software creates a 3D model of a farm in which we can go around the farm virtually and find the unwanted plants. When we select the region we needed to survey, Drone deploy demonstrates the region we chose in sections of land and time taken for the automaton study.

VIII. CONCLUSION

Current agriculture practices incorporate an energizing new area of research that will significantly improve the efficiency of agricultural production and leads to an impressive reduction in operational expense.

The application of precision agriculture techniques gives farmers and agronomists the procedures for implementing new and continually developing technologies that help to manage better growing and harvesting to increase the crop yield at high productivity levels. Many of these technologies include the Vision Crop Health Imaging system, Remote Sensing, GIS, GPS, variable Rate Technology, Farming Machines, Smart Sensor Arrays and WSN technology and UAV's can provide a bird's eye view and thus allow accessing the current situation.

UAV network system can be used to monitor and control precision agriculture parameters such as soil moisture, Photosynthetic photon ux, Leaf wetness, Wind speed, humidity such that early detection of pests/diseases is possible and also to reduce the high levels of drudgery involved in agricultural operations. It is concluded that modern network technology applications have an extraordinary potential for sustainable agriculture and in turn helps our farmers to implement timely decisions to control, protect and improve the crop yield.

IX. FUTURE SCOPE

UAVs in precision agriculture are needed to further develop both the technology and various types of agriculture applications. Providentially, it is expended that with the development of UAV'S technology, with image processing techniques, lower costs, flight time, batteries, new camera designs, low volume sprayers, and types of nozzles. The application of Drone Deployed software helps to carry out experimental studies on different types of crops with changes in environmental condition during the crop cycle, which helps to estimate crop yield and also protect the crop by taking timely decision by observing the analyzed results from the captured crop images.

REFERENCES

1. Everaerts, J. (2008) "The use of unmanned aerial vehicles (UAVs) for remote sensing and mapping." The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, 37(2008), pp.1187-1192.
2. Bendig, J., Bolten, A., & Bareth, G. (2012) "Introducing a low-cost mini-UAV for thermal-and multispectral-imaging." Int. Arch. Photogramm. Remote Sens. Spat. Inf. Sci, 39, pp.345-349.
3. Zhang, C., & Kovacs, J. M. (2012). The application of small unmanned aerial systems for precision agriculture: a review. Precision agriculture, Springer, 13(6), 693-712
4. Primicerio, J., Di Gennaro, S. F., Fiorillo, E., Genesio, L., Lugato, E., Matese, A., & Vaccari, F. P. (2012) "A flexible unmanned aerial vehicle for precision agriculture." Precision Agriculture, 13(4), 517-523.
5. Pankaj Sharma, "Socio-Economic Implications of WSN with Special Reference to its Application in Agriculture".IEEE Afr J Cpmp & ICT-Vol6. No.2, June 2013.
6. Gopichand Allaka., "Modelling and Analysus of Multicopter Frame and Propeller", International journal of Research in Engineering and Technology, 2013
7. Colomina, I., & Molina, P. (2014) "Unmanned aerial systems for photogrammetry and remote sensing: A review." ISPRS Journal of Photogrammetry and Remote Sensing, 92, pp.79-97.
8. Faiçal, B.S., Costa, F.G., Pessin, G., Ueyama, J., Freitas, H., Colombo, A., et al. (2014) "The use of unmanned aerial vehicles and wireless sensor networks For spraying pesticides" Journal of Systems Architecture, 60(4), 393-404.
9. Bruno S. Faical, Fausto G. Costa, Gustavo pessin, Jo ueyame etal. "The use of unmanned aerial vehicles and wireless sensor network for spraying pesticides", Journal of System Architecture, 2014.
10. Pederi, Y. A., & Cheporniuk, H. S. (2015) "Unmanned Aerial Vehicles and new technological methods of monitoring and crop protection in precision agriculture." In Actual Problems of Unmanned Aerial Vehicles Developments (APUAVD), 2015 IEEE International Conference (pp. 298-301). IEEE.
11. Giles, D. K., & Billing, R. C. (2015) "Deployment and Performance of a UAV for Crop Spraying." Chemical Engineering Transactions, 44, pp.307-322.
12. Maurya, P. (2015) "Hardware implementation of a flight control system for an unmanned aerial vehicle." Retrieved 06 01, 2015, from Computer science and engineering: http://www.cse.iitk.ac.in/users/moona/students/Y2258.pdf.
13. Simelli, Ioanna., & Tsagaris, A. (2015) "The Use of Unmanned Aerial Systems (UAS) in Agriculture." In HAICTA, pp. 730-736
14. Kale, S. D., Khandagale, S. V., Gaikwad, S. S., Narve, S. S., & Gangal, P. V. (2015). "Agriculture Drone for Spraying Fertilizer and Pesticides." Published in International journal of Advanced Research in Computer science and Software engineering, 5(12): 804-807.
15. Aditya S. Natu., Kulkarni, S., C. (2016) "Adoption and Utilization of Drones for Advanced Precision Farming: A Review." published in International Journal on Recent and Innovation Trends in Computing and Communication, ISSN: 2321-8169, Volume: 4 Issue: 5 PP.563 - 565.
16. Kedari, S., Lohagaonkar, P., Nimbokar, M., Palve, G., & Yevale, P. (2016) "Quadcopter-A Smarter Way of Pesticide Spraying." Imperial Journal of Interdisciplinary Research, 2(6)
17. Yallappa, D., Veerangouda, M., Maski, D., Palled, V., & Bheemanna, M. (2017, October) "Development and evaluation of drone mounted sprayer for pesticide applications to crops." IEEE Global Humanitarian Technology Conference (GHTC) 2017 IEEE (pp. 1-7).
18. Sohail, S., Nasim, S., & Khan, N. H. (2017) "Modeling, controlling and stability of UAV Quad Copter." IEEE International Conference in Innovations in Electrical Engineering and Computational Technologies (ICIEECT-2017), pp. 1-8.
19. UM Rao Mogili, B B V L Deepak. "Review on Application of Drone Systems in Precision Agriculture", Procedia Computer Science, 2018.
20. Mauro Tropea, Amilcare Francesco Santamaria, Floriano De Rango, Giuseppa Potrino. "Ractive Flooding Versus Link State Routing for FANET in Precision Agriculture", 2019 16th IEEE Annual Consumer Communications & Networking Conference (CCNC), 2019.

AUTHORS PROFILE

S. Ramesh Kumar, Completed his M.Tech degree in Computer Science & Engineering from Acharya Nagarjuna University (ANU), Guntur, Andhra Pradesh, India, He is a Research Scholar, pursuing his (Ph.D) from Koneru Lakshmaiah Education Foundation, Guntur A.P. His research Interest Wireless Sensor Networks, UAV technology. He is author for 6 Scopus publications.

Srikanth Vemuru received the Ph.D degree in Computer Science & Engineering, specializing in Wireless Sensor Networks from Acharya Nagarjuna University (ANU), Guntur, Andhra Pradesh, India, in 2011. He is currently professor with the department of Computer Science & Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Andhra Pradesh, India. His research interests include wireless networks, mobile communications, cognitive radios, manet's, ad-hoc and sensor networks. At present he is guiding 8 Ph.D scholars. He is author and co-author of over 72 Scopus publications.

Srinath . A received the Ph.D. from Pt.Ravi Shankar Shukla University- Raipur under Govt. Engg. College, Raipur as Research Center; (Now NIT Raipur) in 2009. He is currently professor and HEAD, department of Mechanical Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Andhra Pradesh, India. His research interests include Design of Machine Elements, Robotics, Mechanisms and Machine Theory. He had received Former UGC-Research Awardee 2012-14 ,Research Excellence Award 2018, Institute for Exploring Advances in Engineering, 45th Young Engineer Award 2012, IN-India, NK Iyengar Memorial Gold Medal-2006, IE-India . Indira Gandhi Memorial Gold Medal and Award 2017- GEPRA-New Delhi. He had published over 95 research papers in SCOPUS and SCI Indexed journals with high impact factor and SJR rankings, and supervising 9 Ph.D scholars .