IOT base drones for improvement of crop quality in agriculture field

Mr. Thota rama murthy, Dr. B. Kezia Rani
Research scholar[1], professor[2]
adikavi nannaya university

Abstract— The needs of an expanding agricultural sector and urban population are driving the rising popularity of unmanned aerial vehicles. Precision agriculture will be made easier, faster, and more efficient with the aid of drones outfitted with the right cameras, sensors, and integration modules. We may expand the area of additional development by integrating the provided solutions connected to these drones with other Machine Learning and Internet of Things ideas. This article summarises previous research on the subject and offers solutions that may be implemented into the drone with the help of the Raspberry Pi 3 B module.

Keywords—Internet of Things; Support Vector Machine; Unmanned Aerial Vehicle(UAV); RGB-D sensor; Agriculture.

Introduction

Since its introduction in 1980, the uses for unmanned aerial vehicles (UAVs) have been growing exponentially. The use of drones in agriculture offers a promising alternative to traditional machinery, which has its limitations when it comes to measuring, collecting data in real-time, and managing crops effectively. This could help alleviate the pressure on food production and the growing population. Drones used in agriculture may benefit from the growing number of Internet of Things (IoT) technologies that are finding their way into commercial products. Farmers can use drones to collect precise, real-time data, and they're easy to use and efficient. More effective crop management is achievable with the use of localization, mapping, and analysis of high-resolution photos taken by the drone. This report has outlined previous research on comparable drones and offered suggestions for future improvements. Some methods have been suggested that work well with Raspberry Pi and use the most efficient and compatible technologies to make better agricultural drones. Applications that make use of satellite pictures include detecting sparse shrublands (79% accuracy) and grasslands (66% accuracy) for the purpose of desertification monitoring. However, drones are necessary to meet the need for precision agriculture. Drones, being lower to the ground, give more accurate pictures and exact ground truth information. Among the many uses for drones are the measurement of depth, the adjustment of distance from terrain, the assessment of water stress levels in crops, and the measurement of physiological traits of crops. So, a drone properly equipped with adequate tools and technology can make efficient, precision agriculture possible.

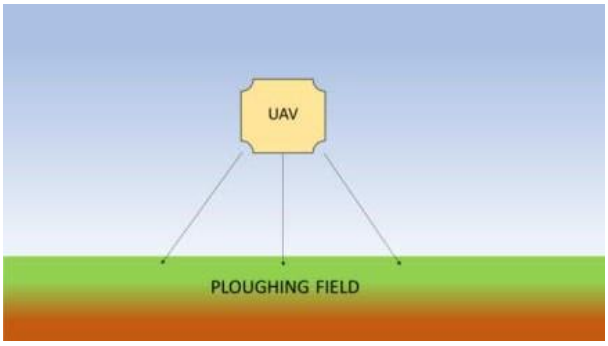

Fig. 1. Schematic of Agriculture Drone

Related Work

Since its introduction in 1980, the uses for unmanned aerial vehicles (UAVs) have been growing exponentially. The use of drones in agriculture offers a promising alternative to traditional machinery, which has its limitations when it comes to measuring, collecting data in real-time, and managing crops effectively. This could help alleviate the pressure on food production and the growing population. Drones used in agriculture may benefit from the growing number of Internet of Things (IoT) technologies that are finding their way into commercial products. Farmers can use drones to collect precise, real-time data, and they're easy to use and efficient. More effective crop management is achievable with the use of localization, mapping, and analysis of high-resolution photos taken by the drone. This report has outlined previous research on comparable drones and offered suggestions for future improvements. Some methods have been suggested that work well with Raspberry Pi and use the most efficient and compatible technologies to make better agricultural drones. Applications that make use of satellite pictures include detecting sparse shrublands (79% accuracy) and grasslands (66% accuracy) for the purpose of desertification monitoring. However, drones are necessary to meet the need for precision agriculture. Drones, being lower to the ground, give more accurate pictures and exact ground truth information. Among the many uses for drones are the measurement of depth, the adjustment of distance from terrain, the assessment of water stress levels in crops, and the measurement of

The use of a simulator well-suited to agricultural settings has been suggested by Floriano De Rango et al. When dangerous insects are present in the crops, this simulator would work in tandem with the UAV to regulate its actions. Energy and the drones' communication range are only two of the many additional factors that would be taken into account. [10] A drone that might be useful for spraying crops with essential chemicals has been suggested by D. Yallappa et al. Application of pesticides becomes less expensive as a result of this. Six BLDC motors are supposedly part of the projected sprayer. The insecticide solution was contained in a conical chamber with a volume of 5 litres. The fluid was pressurised into tiny droplets using four nozzles and a DC motor/pump combination. A transmitter located on the ground allowed for complete control of the process. The live spraying procedure was seen via a webcam.the eleventh

I. Sensors and Module Used

A. *Gas Sensor:*

B. An e-nose, or electronic nose, is a device that mimics the function of a real nose. electrical noses are able to identify individual smell molecules because they use a combination of neural networks (for pattern recognition) and a plethora of electrical sensors. The premature ripening of fruits is another issue that farmers may encounter; to avoid this, they may use sensors to determine the precise moment when a fruit is ready to be picked. Using Taguchi sensors manufactured in China to detect certain gases may do this. A Taguchi sensor reduces resistance by allowing atmospheric oxygen to adsorb onto a tin semiconductor diode's surface. The oxygen is removed from the sensor surface when a flammable gas interacts with it after coming into touch with a heated sensor. Ethylene, propane, and methane are among the gases that it can detect.

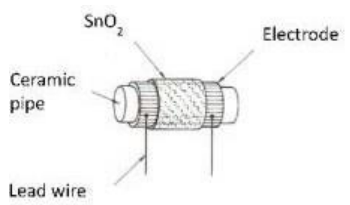

Fig. 2. Taguchi Sensor

C. *RGB-D Sensor*

D. When used in conjunction with an RGB camera, RGB-D depth sensors provide precise readings of the surrounding environment. It provides per-pixel depth information to the standard picture. The RGB camera's calibration and an infrared sensor work together to generate the depth data.

The result is an RGB picture where each pixel has its own depth. By moving the IR projector and sensor side to side, the pattern dots move, indicating a change in the depth of the studied area. The pattern dots are preset by the projector. The point cloud, a collection of points in three-dimensional space, is an aggregated representation of this data. There are convinced that every single point here

additional characteristics, which in the case of the RGB-D sensor refers to the colour. The Asus Xtion PRO and the Kinect from Microsoft are only two examples of the commercially available sensors that leverage this licenced technology.

Fig. 3. RGB-D Sensor

E. Adafruit AMG8833 IR Thermal Camera

Adafruit AMG8833 IR Thermal Camera Breakout is an 8x8 array of thermal sensors which can be integrated with Raspberry Pi. It returns an array of 64 individual temperature readings over 12C when it is integrated with the Raspberry Pi module. This can measure temperatures starting from 0°C to 80°C (32°F to 176°F) with an accuracy of +- 2.5°C (4.5°F). It can detect a human from a distance of up to 7 meters (23) feet.

Fig. 4. Adafruit AMG8833 IR Thermal Camera

F. Raspberry Pi Model 3 B

This is the latest model of the third generation of raspberry pi. It is an ARM-based low cost and tiny SBC (Single Board Computer) which was created by Raspberry Pi Foundation. Through this module, we can send the obtained converted digital equivalents of the parameters over the internet, to any cloud-based storage area. The saved data so obtained finds a use for monitoring purposes as well as in analysing the information. The RGB-D sensor can be embedded in the Raspberry Pi model so as to send data acquired through it to Cloud storage.

Fig. 5. Raspberry Pi Model 3 B

II. Methodology

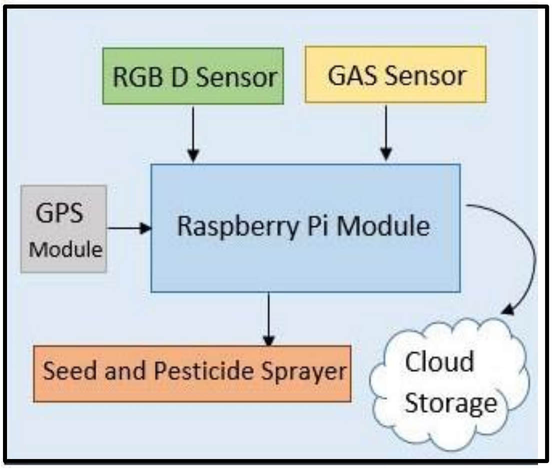

Fig. 6. Block Diagram of Proposed Model

Because it is ten times more powerful, hyperspectral imaging is a superior option for giving accurate data in the UAV than utilising standard multispectral approaches. Although it is more challenging to execute, hyperspectral imaging is the only image format that allows artificial intelligence to be used for agricultural yield predictions, correct fertiliser and pesticide applications, and other inputs like water and manpower. In comparison to previous methods, hyperspectral imaging enables the capture of spatially and spectrally more detailed pictures. The advent of smaller, lighter UAV systems made possible by hyperspectral photography has allowed for their integration into contemporary farming, and hyperspectral sensors can monitor hundreds of bands.

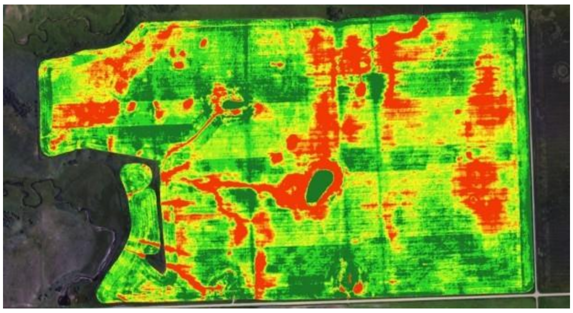

Fig. 7. Hyperspectral Imaging Technique

- • Thermal or heat-seeking cameras may be a huge boon to agricultural management by keeping tabs on plant and crop thermal characteristics and spotting potentially dangerous animals in the fields. In addition, thermal imaging allows us to track many physiological processes, such as plant illnesses and water scarcity. Systems like the Workswell WIRIS system make it possible for consumers to do just that. An additional device that may be connected to Raspberry Pi is the 8x8 array of thermal sensors called the Adafruit AMG8833 IR Thermal Camera Breakout. It offers a

  when coupled with the Raspberry Pi module, it records 64 separate temperature measurements above 12C. A real-time picture capture and processing capability is available with an RGB-D camera, which may be included into the suggested model. Its versatility makes it suitable for use in rotatory wing systems as well as fixed-wing drones. Since it doesn't need specialised acquiring electrical components and can be integrated into several UAVs, this commercial sensor offers the benefit of being more cost-effective than a prototype solution. [8]

• The suggested system's navigation mechanism makes use of the time-tested sensor fusion approach, which incorporates both global positioning systems (GPS) and inertial navigation systems (INS). If you're looking for finite integration error and slow update location information, the GPS module is your best option; if you want unbounded integration error and high update rate, the INS system is your best bet. By integrating the two, accurate location estimate may be accomplished. [6]

Fig. 8. Block Diagram of Inertial Navigation System

Optical data captured from drone are generally affected by cloud. For applications such as agriculture monitoring, which is to be performed in real-time, this poses a problem as the cloud affected data might lead to misleading information due to altered reflectance values. So, there is a need to mask cloud- affected data before proceeding for further analysis. Landsat 8 data are provided with a quality assessment band, which consist of 16 flag bits. High state i.e., ‘1' in the 14th and 15th flag bits indicates the presence of a cloud in the selected pixel, and the mask is thus created using this information. The obtained mask is verified with the mask obtained using cloud detection technique as described.

For the classification and analyzing of data that is uploaded in cloud, support vector machine or SVM is used, which is a supervised learning model, integrated with machine learning algorithm that mainly focuses on regression and classification problems. The main objective of the SVM is to train a model such that it assigns the new objects to a specific category. It starts by modelling the situation which creates a feature space (vector space of finite dimension) wherein each dimension depicts a "feature" of a certain object. SVM selects the most optimal solution. The SVM can also be used in precision agriculture using UAV. The SVM can work on a public dataset of crops and plants and can further predict its results with increased accuracy. The image data and odour data collected from the sensors is put into SVM to accurately predict the condition of the fruit or crop. [12][13][14]

III. Future Work

In this paper, many possible solutions have been highlighted and combined to produce a comprehensive solution for the betterment of agriculture drones. For, future work, a proposed method is the installation of solar panels on the drone itself. By installing solar panels, the need for external charging is eliminated and the drone can charge during the day when it is operating on the field. Another future application may be the use of the Support Vector Machine (SVM) for classification of crops and plants according to yield. The SVM can work on a given database of crops and their respective physiological characteristics and time of yield. Using this, the SVM can predict appropriate yield times of the planted crops, or it could predict the time of ripening of fruits with sufficient accuracy.

IV. Conclusion

Thus, we can conclude that drones or UAVs will be of immense help in the field of agriculture with the increase in population as they are essential at the very beginning of a crop cycle. It will not only reduce time but also yield better cultivation based on analyzed data. Crop management will be more efficient due to systematic monitoring. With the upcoming technologies, the production rate will increase rapidly with lesser consumption of energy. Drones are not just used in the analysis of soil and fields but also in planting seeds and shooting plant nutrients in the soil. Crop monitoring obstacles faced previously can also be done away with the help of drones. The application of drones does not stop here when embedded with hyper spectral, thermal-spectral or multispectral sensors, drones can identify which parts of the land are dry and thereby assessing an irrigation plan becomes easier. Additionally, drones also find use in assessing the crop health by scanning them using near-infrared and visible light. Thus, drones serve as a perfect aerial platform for gathering the data needed in precision agriculture.

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