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Advanced Drone Technologies and Image Processing for Increasing Crop Yield

Shakti Patel* and Janaki Patel

International Agribusiness Management Institute, Anand Agricultural University, Anand

*Corresponding author: shaktipatel96819@gmail.com

INTRODCUTION

With the pace of time, technologies have developed from traditional means to precision techniques to logical methods (e.g. Aeroponics, Hydroponics) and now to usage of artificial humans(Robots, Drones). The drones or robots so called artificial human has shown a great sign of influence in agriculture with respect to Crop identification, increasing the productivity of agricultural outputs etc. After all, it was only around 100 years ago that farming transitioned from animal power to combustion engines. Over the past 20 years the global positioning system (GPS), electronic sensors and other new tools have moved farming even further into a technological wonderland.

What is Drone?

A drone is land, sea, or air vehicle that is remotely or automatically controlled. Something which make a continuous low humming sound. Drones are more formally known as unmanned aerial vehicles (UAV). Essentially, a drone is a flying robot. The aircraft may be remotely controlled or can fly autonomously through software-controlled flight plans in their embedded systems working in conjunction with GPS. UAVs have most often been associated with the military but they are also used for search and rescue, surveillance, traffic monitoring, weather monitoring and firefighting, in agriculture etc.

Recap of Technologies being used so far

1) Traditional method- we all might be aware of various traditional methods like manual weeding, manual fertilizer application, manual fruit picking etc.

2) Precision Agriculture- It tries to use Information Technology into agriculture leading to an era to tremendous change and scope, it includes techniques like Yield monitoring and mapping with the use of GPS, variable rate fertilizer, weed mapping, salinity mapping etc.

3) Drone technology

a. Heavy robots – e.g. manned aircraft and satellites, automated fruit picker etc.

b. Robust UAV (unmanned Aerial Vehicles) - the use of small UAVs goes far beyond data collection; the technology is changing sensing devices, data processing and data analysis. In the past, these functions were frequently separated. Data were often collected by one company and then handed over to another organization for processing and analyzing, using expensive and complicated GIS software from a relatively small number of established vendors. Now low-cost data acquisition is not only driving down the cost of these functions, it is also simplifying the process.

Basic Parts Used in a typical drone

a) Unmanned Aerial Vehicle
b) Laser Scanner
c) Barometer
d) IMU (Inertial Measurement Unit)
e) GPS receiver
f) Onboard filter
g) Micro-controller

Drone and Image Processing

When we talk about drone technologies being used in agriculture, so explicitly or indirectly Image Processing get indulge into overall scenario. These two are complementary to each other. When a drone takes an image of your field that image is useless until there is something who can analyze that image into a meaningful way (e.g. - comparison of taken image with the standard would provide us with some the current condition of your fields). This task is accompanied using Image Processing.

What is Image Processing?

The analysis and manipulation of a digitized image, especially in order to improve its quality.

a) Digitizing: Digitizing or digitization is the representation of an object, image, sound, document or a signal (usually an analog signal) by a discrete set of its points or samples. Or simply entering the spatial data.

b) Digital Image: A digital image is a numeric representation (normally binary) of a two-dimensional image. Depending on whether the image resolution is fixed, it may be of vector or raster type.

c) Digital image processing: can be defined as the computer manipulation of digital values contained in an image for the purposes of image correction, image enhancement and feature extraction.

Process of Image Processing consists of following phases:

a. Image Rectification **b.** Image Enhancement **c.** Image Classification

Need for the Drone Technology

- To increase crop yield.
- To reduce labor intake.
- Save Time and Money
- Monitoring and accomplishment of Weeding, Harvesting and related agricultural activities.

Scope

Drone technology has already occupied market in various several countries over the world. With the current interest jointly shown by the farmers and the government it can be concluded that the day is not far when the Indian Farming will be accomplished by Drone Technology. Looking various running projects for drones with good success points gives us the look for a great scope in further future. E.g. - By 2017 the economic impact of integrating unmanned aerial systems into the U.S. economy will exceed $13.6 billion and add 70,000 new jobs, according to forecasts by the Association of Unmanned Vehicle Systems International. By 2025, this will increase to 100,000 jobs with an impact of $82 billion. The use of small unmanned aerial vehicles, or drones, to collect data is a major part of AUVSI's forecast.

Application of drone technologies

1. **Precise Crop-Management with Micro-Drones:** In times of a growing global population and progressing climate change, farmers are more and more concerned about the sustainable management of the farmland: On the one hand how to protect the environment and on the other hand how to supply the people of tomorrow enough food without unnecessarily straining the earth
2. **Agricultural automation: Pest Control** - One third of the annual harvest worldwide is lost due to pests and fungal infestation. Today, thanks to the latest technology the farmer can take early countermeasures and actively work against the threat of crop loss. On the field UAVs equipped with multispectral cameras determine the pest infestation of plants – even before the leaves wilt.
3. **UAV-Supported Study of soil:** Studies already report on the devastating consequences of the massive use of pesticides. While in 1960 the use of fertilizer per hectare was below 50 kilograms, in 2020 it already will be around 200 kilograms per hectare. The massive use of fertilizers has disastrous consequences for the ecosystem and thus for the food supply of the future. Using micro drones, the massive use of fertilizers can be reduced: They collect important and multifaceted data of the state of the fields and help the farmers to work targeted, ecological and profitable. The possibilities are extremely various and meet the most diverse requirements. The main method in this context is remote sensing, providing meaningful data of the state of the soil.
    - Providing aerial images of the fields, micro drones give important information of the condition and the degree of maturity based on the color saturation of the plants. In advance of planting, the data of micro drones give an insight into the location productivity, for example by elevation models or by analysis of local weather data. On base of the aerial photos of the soil surface, water erosions are visible at a glance. Color and brightness of the earth allow the farmer to draw conclusions about the humus content, the irrigation condition or stone and weed content at the surface.
    - In the non-visible range, UAVs equipped with NIR cameras supply information about the leaf structure or the water content of the plants. Examining the reflected wavelengths of the plants, the data provide statements about the need for fertilizer, nutritional status and the population density of the plants. The farmer is able to act targeted and locally differentiated without having to extensively use fertilizer and polluting the environment.

There are countless examples of the use of UAVs for examination, monitoring and cartography of cropland. Other application scenarios include:

1. Monitoring and assessment of crop yield
2. Monitoring and testing the fertilizer requirements
3. Planning and mapping of water-drainages
4. Rescue Wild life Animal

Example of various artificial humans (robots, drones)

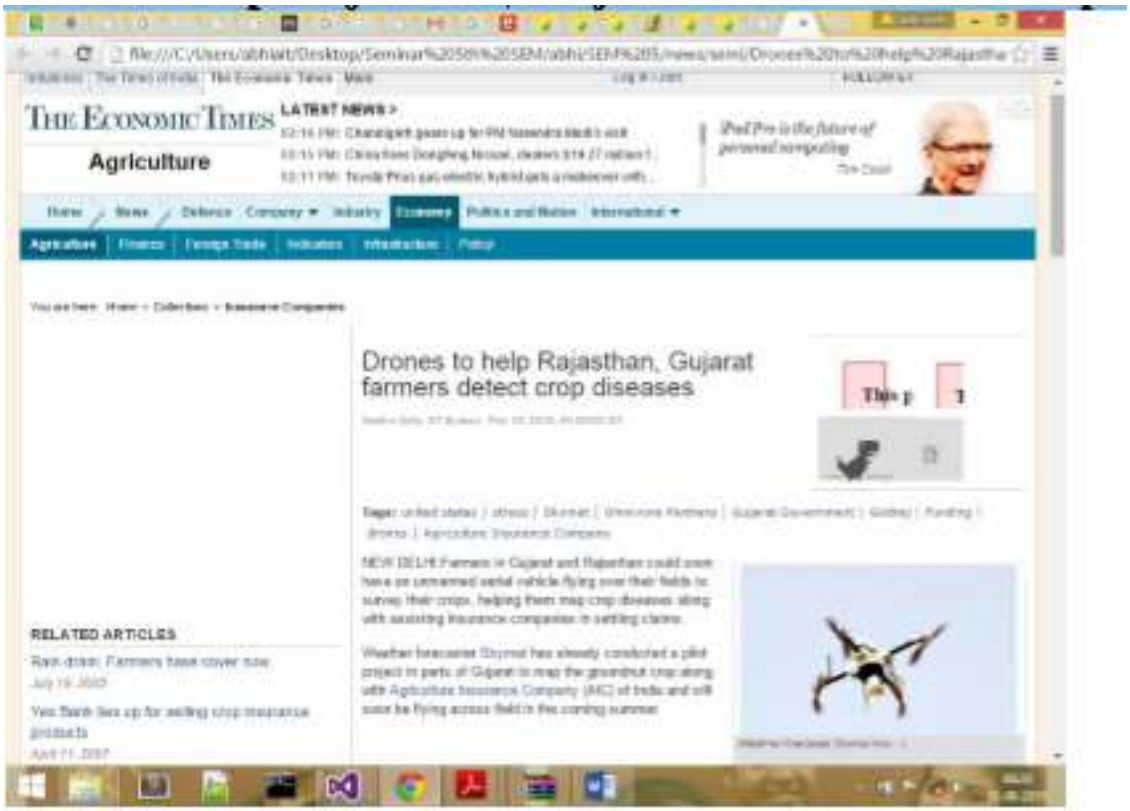
1. **Heavy Drones:** This automatic fruit picker sense the presence of fruit have its multispectral image, analyze it, compare it, conclude and finally through a blower shape arm pic the fruit.
2. **Artificial Bee:** A swarm based meta-heuristic that simulates foraging behavior of honey bees. They help in the most important process of generating offspring i.e. Pollination. This articial bee act as agent for pollination. Based on sensor, metadata and image processing these perform their operations.
   Contains three types of bees considering the division of labour.
   1) The employee bees try to find food source and advertise them.
   2) The out looker bees follow their interesting employer.
   3) The scout bees fly spontaneously to find/explore new food sources.
3. **Unmanned Aerial Vehicle (UAV):**

Case Study:
Drone to help Rajasthan, Gujarat farmer detect crop diseases

Farmers in Gujarat and Rajasthan could soon have an unmanned aerial vehicle flying over their fields to survey their crops, helping them map crop diseases along with assisting insurance companies in settling claims. Weather forecaster Skymet has already conducted a pilot project in parts of Gujarat to map the groundnut crop along with Agriculture Insurance Company (AIC) of India and will soon be flying across field in the coming summer. "Remote sensing through unmanned aerial vehicles allows nondestructive sampling to observe agronomic indicators every square meter. We did a pilot project last year and will increase its coverage across Rajasthan and Gujarat this year," said Jatin Singh, CEO of Skymet.

The technology has been in use in the United States and other developed countries to map crop position, control farm subsidies, detect pests, monitor nutritional and water stress on crops, and even spray fertilizer and pesticides on crops. Skymet, along with the AIC and Gujarat

government, used satellite remote sensing technologies and drones across 10 villages in Morbi district of Gujarat last year. "We covered the groundnut crop, clicking images a few centimeters away, which is not possible via satellite," said Singh.



Satellite's resolutions are less and if a cloud cover comes, then you can't use the images, he said, adding, "At a time when land holdings are less and there is multicropping we were able to help Gujarat government in monitoring of the agriculture area and crop yield. The data could help AIC in giving farmers claims." The automatic and remote controlled UAVs cover 5 sq. km in a single flight, with generally two flights (missions) per day. UAVs send images every five seconds and provide geo referenced images. "It's a beneficial technology for states that have digitized land records or are in the process of digitizing. Pictures clicked by the unmanned aerial vehicles can be superimposed on digital maps of states and we can identify farms and crops sown," said PJ Joseph, chairman and managing director of AIC.

CONCLUSION

Drone technology and Image Processing techniques have been proved as effective machine vision system for agriculture domain. Drone are now become almost compatible respect to size, cost and availability with the novice ease of use. Imaging techniques with different spectrum such as Infrared, hyper spectral imaging, X-ray were useful in determining the vegetation indices, canopy measurement, irrigated land mapping etc. with greater accuracies. The study shows the various Application of Drone technologies with Image Processing, various types of Drone in market with their basics required configuration. The study also shows two case study which state the success and popularity of drone among a common progressive farmer as well as

government. Thus we can conclude the coming era will be the Drone driven farming with the automation in farming and agricultural activities with improved outputs.

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