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DESIGN AND DEVELOPMENT OF AN AUTONOMOUS UAV USING IMAGE PROCESSING ALGORITHM FOR PRECISION AGRICULTURE

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Abstract – In this paper, we are implementing advanced technological improvisation to perform a precise Agriculture. The major objective of this UAV system is Autonomous Winging for precision Agriculture. Precision Agriculture guides farmers to collect precise data about their field and use that knowledge to customize how they cultivate each square foot. A path following flight control is developed to be implemented in an UAV system. The control scheme is intended to be able to steer the UAV flight close to a pre-defined path and control its heading angle accordingly. The balanced oscillation is handled by Gyro-Sensor also Accelerometer Sensor is implied. The controller principally works by driving the cross-track and course angle errors of the UAV flight, relative to the desired path, to zero through performing back to turn maneuvers. The control is designed in such a way that it appropriately works in roll dynamics of the UAV. The LQR (Linear Quadratic Regulator) is an algorithm used for controlling the movements of the drone. The other few algorithms like SLAM are used for locating and maintaining the stability. GISCT is an algorithm used for processing the image captured by the drone. The Agriculture field surveillance is done by the Camcorder, further the captured images are manipulated in the Ground Station using Image processing Technique to identify the affected plantation area.

I. INTRODUCTION

Precision agriculture is one of the most advanced Farming methods that use UAV which fly at controlled autonomous path and produces high resolution images. Image processing has now also been applied to remote areas to make decisions in agricultural applications. The off board processing of the data is performed after collecting the scaling latitude of UAV. This mainly assists the farmers to assess the plant health.

Autonomous detection and action will target the specific location easily and the application of herbicide is made tranquil. This paper may give the detailed explanation about the internal Architecture of the Unmanned Aerial Vehicle and its wide range of application in the field of Agriculture in accurate form. Linear Quadratic Regulator and SLAM algorithms are chiefly used for the purpose of Stability and balanced oscillation. The observation is based on usage of gyro as well as accelerometer sensors and a camcorder. The ground station receives messages from the off-board to check the status of the mission while the UAV is flying.

1.1 Path Planning

It maximizes the coverage path and minimizes the path length. Moore's function is used to represent critical points. It works with several obstacles in the environment. The major two problems faced by this method are **Travelling Salesman and Genetic algorithm.** The Agricultural robots are implied in UAV to increase mobility and to reduce cost. The proposed shortest path algorithm is mainly used to maximise the coverage GA and TSP. The UAV is automatically commanded to fly over the target by sending the location of the source in X, Y, Z direction.

Fig 1 : UAV in Precision Agriculture

1.2 UAV platform

It is equipped with the camcorder mounted on a gimbals. StabiliserIt is mainly used for the rotating the fan in UAV and give a stabilised motion to the drone. The spectral camera takes images of the whole farming field. This gives a detailed description of the health and pest of the plants in the captured field. This camera is projected in L and H directions with the small spatial angles of dL and dH directions to project in a rectangular path.

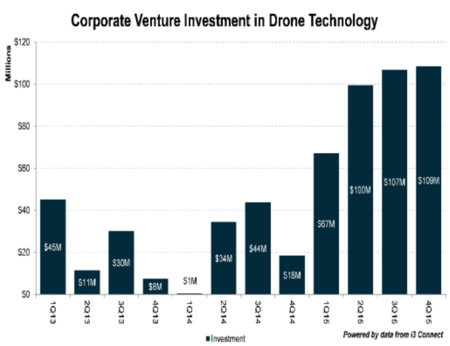
1.3 Detection and Correction

The UAV flies over the planned surface Area and it unceasingly sends the captured photo-shoots through image processing and those are checked for any discrepancy. If the images are overlapped then the corrective measures are taken to rectify it. The algorithm such as SLAM and LQR are used in order to avoid any muddle of the drone.

*Fig 2 : **Drone DJI over farm field***

1.4 Survey

A large number of methods have been proposed for the above mentioned model. Off-board is one of the best ways to enhance the performance of the drone. The main benefit is that there is no need for any remote accessories. The drone itself identifies the pathway and captures the images and senses if the images are mismatched with the condition.



1.5 Hardware Narration

The main Components of our proposed prototype are as follows:

- Standard prop
- Pusher Prop
- Brushless motors
- Motor mount
- Landing Gear
- Boom
- Main Drone body
- Electronic Speed controller(ESC)
- GPS
- Battery
- Sensors
  a) Gyro sensors
  b) Accelerometer sensor

Fig 3 : Autonomous Flying Machine

II. IMAGE PROCESSING TECHNIQUE

2.1 Normalized Difference Vegetation Index*(NDVI)* quantifies vegetation by measuring the difference between near-infrared (which vegetation strongly reflects) and red light (which vegetation absorbs).

NDVI always ranges from -1 to +1. But there isn't a distinct boundary for each type of land cover.

Basic Formula:

$$NDVI = \frac{(NIR - Red)}{(NIR + Red)}$$

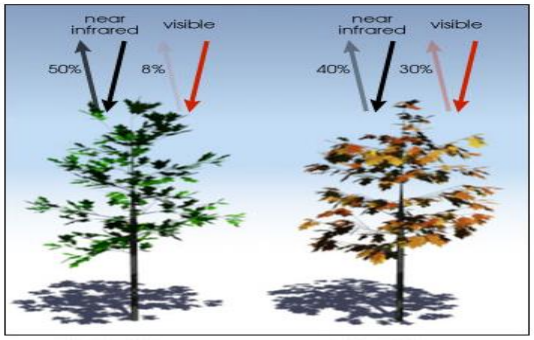
Healthy vegetation (chlorophyll) reflects moe Near Infra Red (NIR) and green light compared to other wavelengths. But it absorbs more red and blue light.

This is why our eyes see the vegetation as the colour – **green.** Satellite sensors **Landsat** and **Sentinel-2** both have the necessary bands with NIR and Red.

Worldview- 2 Band configuration:

1) Coastal as Band 1
2) Blue as Band 2
3) Green as Band 3

4) Yellow as Band 4
5) Red as Band 5
6) Red edge as Band 6
7) Near Infrared 1 (NIR-1) as Band 7
8) Near Infrared 2 (NIR-2) as Band 8



The captured images are loaded to produce best possible result with point-cloud Generation. The basic formula which is used in this process is given as follows:

$$T_{(K)} = \frac{B}{\ln\left(\frac{R}{S-O}+F\right)}$$

Where,
S - 14 bit pixels
B,F,O,R- Series Register

Crop Water Stress Index Ratio:

$$CWSI = \frac{T_{canopy} - T_{wet}}{T_{dry} - T_{wet}}$$

Where.
T_{canopy} – Recorded Temperature
T_{wet} – Artificial Reference

The drier is used for computing the later.
T_{air} is measured with local values and time.

In addition to CWSI, difference in Register index is obtained from 3 channel false colour ortho images. The CWSI ranges from 0.4 to 0.9, 0.29 to 0.74. The overall decrease in CWSI value is 20-30%. The NDVI value is always less than 0.75. Special Filters were installed to overcome Stress.

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