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Yield Monitoring using UAV

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Abstract - *Yield Estimation of the plant is an important aspect for planning many tasks such as storing, packaging, and exporting. It is quite difficult and time consuming to measure the quantity of the fruit on the tree manually. The Image Processing based Automated System is an influential technical competent to measure the number of fruits. Our project describes the method for Counting the fruits and plays a critical role in the Yield Estimation. Efficient locating of fruits on the tree is one of the major requirements for the fruit harvesting system. Fruit detection using an improved multiple feature-based Algorithm is used. In our project firstly, using UAV Image is captured and then Pre-Processing is done on the input fruit Image, then it is converted from RGB to HSV Color Space to detect the fruit region from its background. To detect the fruits, an Image Processing Algorithm is used for efficient feature extraction.*

Key Words: **Unmanned Arial Vehicle (UAV), Agriculture, Fruits, Monitoring**

1.INTRODUCTION

Unmanned Aerial Vehicles (UAVs) have been in use since 1980 and their applications are expanding rapidly [3]. Yield Prediction of fruit through Automatic Counting in a practical environment is one of the hardest and significant tasks to obtain better results in Crop Management System to achieve more productivity regarding moderate cost. Yield Estimates can provide valuable information for forecasting Yields and generating prescription maps for tree specific application [1]. In the present project Yield Estimation of fruits is a process to find the total number of fruits in a tree automatically. For the successful application of effective control methods, the Yield information about the Individual tree is a prerequisite in real-time. The Fruit Counting system is primarily developed for Yield Estimation. However, this technology can be easily used for other applications such as Tree Yield Monitoring, Disease Detection, and Crop health monitoring [3]. For the fruit Counting system, it is necessary to detect fruits on the tree efficiently. The fruit Counting system depends on the contribution of different features in the Image. The basic features required are Intensity, Color, Edge, and Orientation [2]. This project proposes an efficient method for the Counting of fruits on the tree. The methodology presented can recognize and count the fruit in natural conditions facing a difficult situation. The proposed method can Process, Analyze, Recognize, and Count the fruits based on Color and Texture features.

2. LITERATURE SURVEY

Our project deals with the Framework, Requirement, and Uploading in the Cloud server [4]. This paper had done Multi-Spectral Image Processing for the determination of crops and on which corresponding actions are taken. However, computational resources are high and implementation costs are more [5]. So, for low implementation cost and reduced labor, this system can be used [6]. In our proposed project, we have used the concept of Counting fruits on the tree using Image Processing. Thus, in our project part of Processing is done on Raspberry Pi which is a part of Image Processing unit mounted on Quad-copter and result are sent to the Cloud and it can be accessed by the user. The Image Processing applications developed instead of manpower succeed in recognition and counting of fruits from the input Image [6]. It starts with the recognition of fruits with different color. To improve the functionality and flexibility of the recognition Shape and Size features can be combined with Color textures features. Texture property, Contrast property, and the Color property is primary analysis [4]. For Implementation of the proposed project Autonomous Quad-copter should be able to carry a payload of around 1.5 kg [5]. This will help to mount the Image Processing unit which comprises of the Raspberry Pi, Camera, GSM module, Battery. The Quad-copter reaches over the tree on the field and captures the Image of the fruits on the tree. This Image is processed by the Raspberry Pi connected to the Camera. The proposed project needs Image Processing [1]. Color Composition is the basis of an Image, equally important for the identification of fruits. Color-based models are used to Analyze fruit color information [2]. First, segmentation of the fruits by Color and Shape Analysis is performed, then Color Analysis is done by using color thresholding, and finally, Shape Analysis is done by finding contour and connected components [1]. The input image is captured and then Pre-Processed. The next step is the color

conversion from RGB to HSV Color Space. To extract the HSV value Image is taken. RGB color space into the HSV Color Space changes the Saturation and Hue Value of the Image. HSV Color Spaced Image the fruit region must extract by using color thresholding [2]. This is done by identifying the range for detection of fruits depending on the Color of fruit taken into consideration. The output of the final thresholding gives the optimal Edges. Hence, Edge detection Algorithm is applied. Then by region labeling, the region correlated to the Image is observed. Then automatic Counting of fruit is implemented using Circular Fitting Algorithm where identified Edges are fitted in the Circle. Finally, the number of fruits is calculated using Circles fitted on the input Image [1]. Computation of the number of fruits is done on the Raspberry Pi. We proposed to use Cloud services for the storing of results and providing them to the system [7]. The Images captured by the Quad-copter are processed on the Raspberry Pi, after which the result is uploaded to the Cloud for Historic Data Log [5]. The user accesses the result in the System.

2.1 Problem Identified

Yield Estimation has importance in packing material, resources and, market need India ranks 2nd world wide in agricultural produce [3]. In India, the total production of fruits during last year was 3.5 million tons [11]. So, to perform Counting of fruit from a tree manually by the hired employees requires a large amount of investment and manpower. Manual Counting has several issues with the accuracy of manual counts higher due to the higher number of fruits and the exhaustion from the continuous and repeated work. So, due to the large scale of production even if (5-10) % of error in estimation will lead to the loss in the agriculture harvesting industry [7]. If the counts are Overestimated, then the money on pre-ordering and packing will be lost and if it is Underestimated, then the bulk requirement of packing and transportation will cost much. Moreover, the bulk sale of products cost will be lowered.

3. METHODOLOGY

UAV is used to capture the Image of the fruit on the tree with the help of an Image Processing unit mounted on it.

Image Processing Unit: The Image Processing Unit comprises of Camera, Raspberry Pi, GSM module, and Battery. The Camera is used to capture the Image, Raspberry Pi is used to analyze the Image, GSM module is used to provide Communication between Raspberry Pi and Cloud, Battery is used to Power the GSM module and Raspberry Pi.

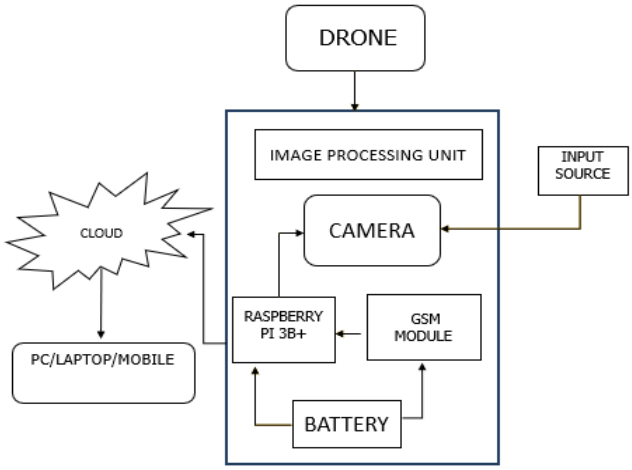

Fig 3.1: Block Diagram

1. **Autonomous Quad-copter:** The Quad-copter can carry a payload of around 1.5 kg. This enables us to mount the Raspberry Pi, Camera, GSM module, and Battery on our UAV. This will lead to efficient utilization of the resources.
2. **Image processing:** The Quad-copter will be mounted with an on-board camera. Once the Quad-copter reaches over a tree with the fruits it will capture an image of it. This Image is processed by the Raspberry Pi connected to the Camera.
3. **Camera:** The purpose of using the Camera is to record and capture the Images of the fruits on the tree.
4. **Raspberry Pi 3b+:** The purpose of using Raspberry Pi is to capture the Image of fruits on the tree and perform local basics Image Processing.
5. **GSM module:** It is used to send and receive data between Raspberry Pi and Cloud.
6. **Cloud:** Since computational and storage resources are limited for the Raspberry Pi, we used Cloud services. The Image captured by the Quad-copter will be processed on Raspberry Pi itself and after which it will be compressed and uploaded to the Cloud.
7. **PC/System:** The result is processed and transferred via Cloud to the system where the user can access the result.

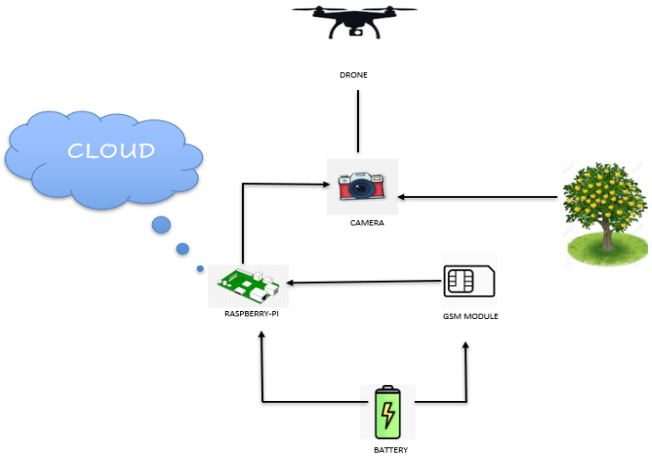

Fig3.2: Functional Diagram

Figure 2 shows the working of the proposed system

The first step is to click the Image of fruit from the tree by using the Image Processing Unit mounted on the UAV. The Image Processing Unit helps in analysing the fruits, where the Image processing unit consists of a Raspberry Pi, Camera, and a Battery. The next step is to count the number of fruits present in the tree by using the code which is dumped on the Raspberry Pi with the help of the Raspbian Pi Operating System. Raspbian OS is an Operating system for Raspberry Pi. The Raspberry Pi controls the Counting of fruits part. As the Image is taken by the Camera, the Raspberry Pi samples the Image of the fruits taken by the Camera with the already stored Images in the database. If the Image of the fruit matches with any of the Images stored in the database, then the counter values increase. Then the final counter value is sent to the cloud and the final output is displayed on the system.

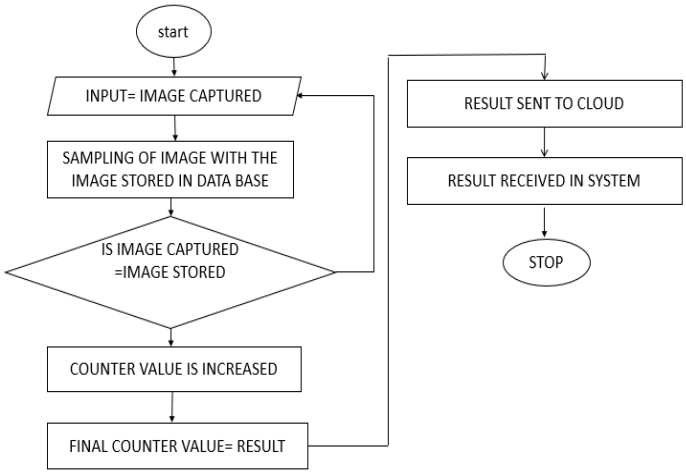

Fig3.3: Flowchart of Image Processing Unit

Fig3.4: Prototype model

3.1 Expected Results

The expected results are the number of fruits detected rather we can say the count of number of fruits. The Image below shows the expected results

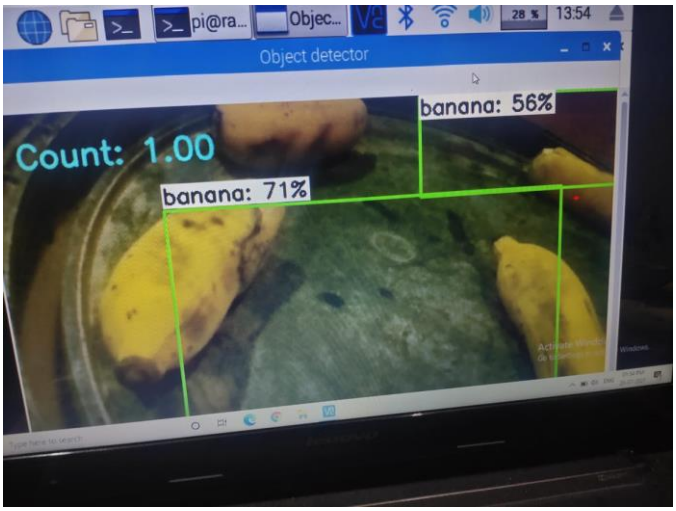

Fig3.5: Model detects the images of the Banana

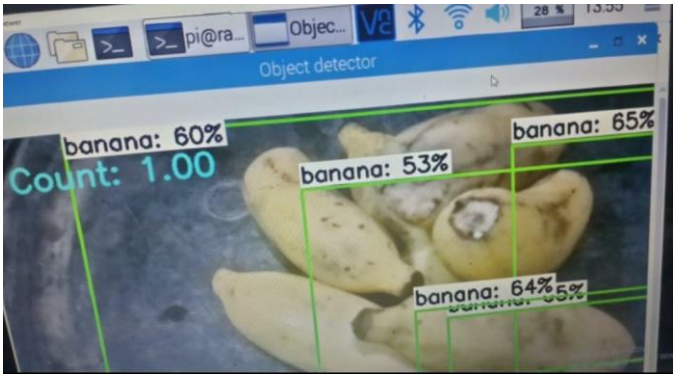

Fig3.6: Model detects the overlapped images of bananas

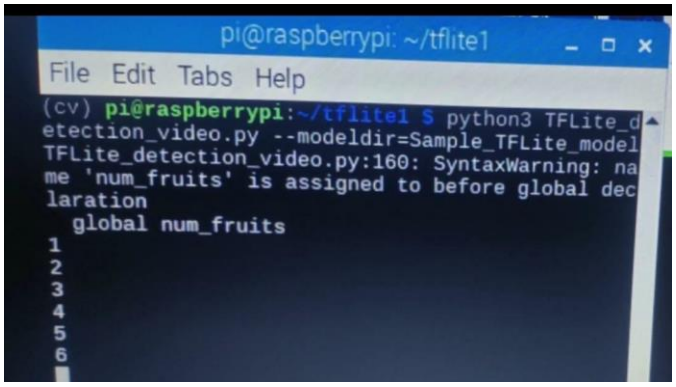

Fig3.7: The count of banana is shown in the terminal

4. CONCLUSIONS

This paper concludes the proposed automated system for the counting of fruits on the tree with the ability to detect the type of fruit. Hence with this proposed system the job of farmer will reduce and the cost of labor will be decreased. The proposed method consists of image processing unit which detects and count the fruit. The process is comprised of the graph cut method; color conversion; coarse detection; then Gaussian filter to remove the noise, then canny edge detection and then smoothening of the edges is done after smoothening the pixels are labeled and then on then connected component the circular fitting algorithm is applied and the final count is processed. In the past decade latest technologies are included into the precision Agriculture to improve the productivity of the crop. These technologies are useful where human interventions are not possible for counting the fruits on tree and scarcity of the labor. It also helps the counting of fruits job easy and faster. The proposed system describes the detection of number of fruits on the tree through the multispectral camera which is mounted on the UAV.

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