Unmanned Fixed Aircraft System Based Agricultural Drone

Anush K, Kishan Prasad U, Lionel Jeorem Quadres, Pannaga Aithal

Abstract— This paper is to develop unmanned fixed wing aircraft system to spray pesticide and fertilizers over the fields and thereby increase the productivity of the agriculture. These unmanned aircraft system (UAS) will consist of onboard flight controller which is preprogrammed to stabilize the UAS, provide live footage and to control sprayer. The purpose of the on-board controller is to reduce the efforts of the pilot and make it easy for controlling UAS.

Index Terms—Unmanned aerial vehicle, Electronic speed controller, Battery elimination circuit, Brushless DC, Rotation per second.

1 Introduction

Indian agriculture needed production and protection materials to achieve high productivity. Agriculture fertilizer and chemical frequently needed to kill insects and growth of crops. These fertilizers and chemicals are dangerous to human body and might cause disorders in body. The traditional method of spraying is slow process and not efficient. Thus use of UAS in this field will greatly reduce the man hours, reduces wastage and improves efficiency. Agricultural UAS technology has been improving in the last few years, and the benefits of UAS in agriculture are becoming more apparent to farmers [2]. UAS applications in agriculture range from mapping and surveying to crop dusting and spraying. The process of spraying the pesticides using UAS is controlled by means of a remote. Drones are best suitable for large farms compared to the smaller one as they cover larger area [4]. The information is fed through remote which will control the functioning of valve to prevent the loss of pesticides.

The UAS is operated by manual flight plans and the Sprayer is manually triggered by RF controlled Nozzle. This method also speeds up the process of spraying. The body of UAS is mainly made of depron with a pesticide tank underneath with a capacity of 1 litre and a sprayer for spraying the pesticides and fertilizers effectively on an agricultural field. The UAS gets information from the remote.

- *Students, Dept.of ECE,Canara Engineering College,Mangalore*
- *Assistant Professor,Dept. of ECE ,Canara Engineering College,Mangalore*
- *Anushk47@gmail.com,9449533209*

The UAS consist of twin rotor configuration as shown in Fig 1 to lift heavy payloads and is built using lightweight materials which includes depron, carbon tubes to increase efficiency and provide proper strength.

2 Methodology

UAS requires a flight controller that stabilizes the aircraft during flights. The flight controller can be implemented by using STM32F103. Gyro sensor will be used to detect the change in position of aircraft and levels the aircraft again if there is change in position. Stabilization can be achieved by changing the angle of the servo or by changing the RPM of the motors. During the wing-borne flight same servos must change the tilt angle of ailerons. These functions have to be per programmed and tuned before flight. The maneuvering of the aircraft is done manually using a RF transmitter of 2.4GHz. Depending on the receiver inputs the flight controller has to give its output to the servos on the wing.

The spraying module consists tank made up of light weight flexible plastic with capacity of 1 liter. The tank consists of compartments that will prevent the payload from splashes around inside the tank during take-off, landing, rolling and pitching. This compartment thereby increases the stability of the aircraft. The input to the relay is given from controller to either switch ON or OFF the sprayer.

A Raspberry pi 3 processor will be used to stream video live on to a laptop. This is done by uploading the video from raspberry pi to a server and then streaming it in a laptop. When the UAS goes out of sight the video from laptop can be used to control the UAS.

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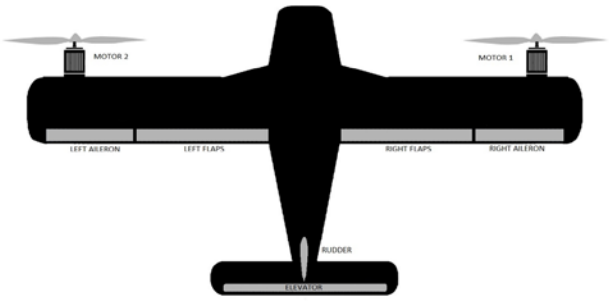

Fig. 1. Twin rotor configuration

Twin rotor configuration consists of a pair of BLDC clockwise and counterclockwise direction motors. This configuration prevents torque roll phenomenon and helps in changing yaw component of the UAS. This configuration increases the payload capacity of the UAS. Stabilizing the UAS using controller as flight controller makes it easy to fly the UAS. Tank with capacity of 1 liter with compartment will be used to store the payload A sprayer module will be attached to the tank to spray the contents of the tank. During flights the center of gravity of the aircraft might get modified. MPU6050 gyro sensors communicate with the controller processor using I2C protocol. The data from MPU6050 will give the change in position of the aircraft in degree/sec for 3 axis. By knowing the change in position of the aircraft, corresponding signal is given to servo motors. Servos motors requires pulse width modulated signal as input. For 0-degree servo angle 1000us pulse is given as input signal, for 90-degree servo angle 1500us pulse is given as input signal and for 180 servo angle 2000us pulse is given as input signal. Depending on the position of the aircraft the servo motors deflects the control surfaces. Single servo motor is used for each of the control surfaces and it is connected using a linkage stopper and push rod. The input given by the pilot in the control stick should operate the same servo but the pilot inputs should have higher priority when compared inputs from controller. The inputs given by the pilot will appear in RF receiver and this signal is a pulse width modulated signal that can directly give to the signal input of servo. The Raspberry Pi camera module [8] is a nifty peripheral that puts the tiny computer to a variety of practical and creative uses. To get the most out of the camera's functionality, at least a basic working knowledge of Python scripting. Can opt for a graphical application like RPICameraGUI.

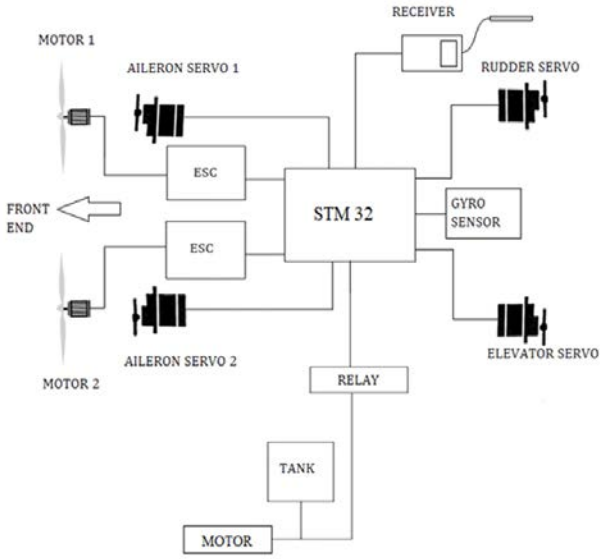

FIG. 2. OVERVIEW OF UAS

Although it's possible to use RPICameraGUI via an SSH connection, the RPi Cam Web Interface (RPCWI) software makes a much better tool for the job. As the name suggests, this web application provides a user-friendly interface that lets you control practically all camera settings with a regular browser. Additionally, RPCWI offers several genuinely useful features that make it an ideal tool for working with the camera module. This includes the ability to preview, manage, and download saved photos and videos, support for time-lapse and scheduled shooting and recording, motion-triggered image capture, and much more.

RPCWI works on all Raspberry Pi models supported by the camera model, and the web application is designed to run on the Raspbian Linux distribution. Before you install RPCWI, it's a good idea to update Raspberry Pi's firmware, distribution, and all installed packages. Next, make sure the Git software is installed on your Raspberry Pi. connect the camera module to the Raspberry Pi, too. If you are new to the camera module. Then grab the latest release of RPCWI by cloning the project's GitHub

If the script detects missing packages, it automatically installs them, then presents a graphical dialog that lets perform several important tasks. True to its name, the script makes it possible to install RPCWI, and it lets choose between two web servers that power the application: Apache and Nginx.

By default, anyone can freely access your RPCWI instance. That means everybody can view the live video feed, take photos, record videos, and perform other supported actions. This might not be a big issue if your Raspberry Pi sits on a local network behind a firewall, but if the machine is accessible from the web, it would be prudent to enable password protection. Before installing any package related to camera, camera

should be connected to raspberry pi. Then go to configuration of raspberry and enable camera. Now download required packages and start working with camera. After enabling need to reboot the raspberry.

3 RESULT

The Automatic flight stabilization system was programmed and the tuned for a mid-wing deep camber aircraft and tested on 14th of May 2017 at bad wind conditions. The plot of degree/ second VS time is show below and there is a significant difference in gyro values with the stabilizers ON. The graph of degree/ second VS time with stabilizers is smoother when compared to graph of degree/ second VS time without stabilizers as show in fig 3

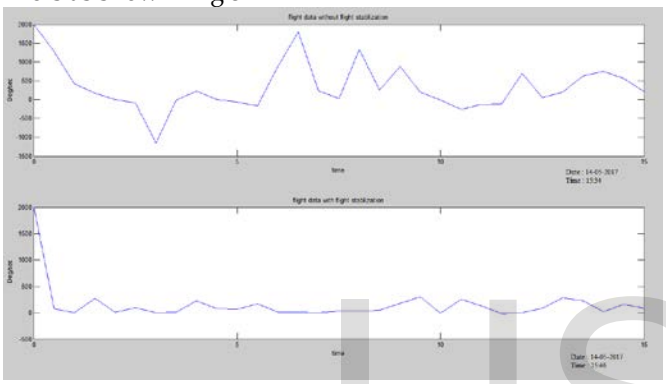

Fig. 3. Plot of Deg/sec vs sec

Now connect any device to the same network that the raspberry is connected. Go to any browser and type an ip address of the network and run. Now a web page of rpi-cam-interface opens where live feeding will appear as shown in Fig.4.

Thanks to the dedicated buttons below the live feed, you can start using RPCWI right away. The record video and record image buttons can be used to record a video or take a photo, whereas the Download Videos and Images button opens a simple file browser that lets you preview saved photos and video files, as well as download them to your computer. The file browser features several creature comforts that can help you manage files. You can specify the desired size for preview images and thumbnails and switch between ascending and descending sorting orders. The File Types drop-down list lets you specify which files to display.

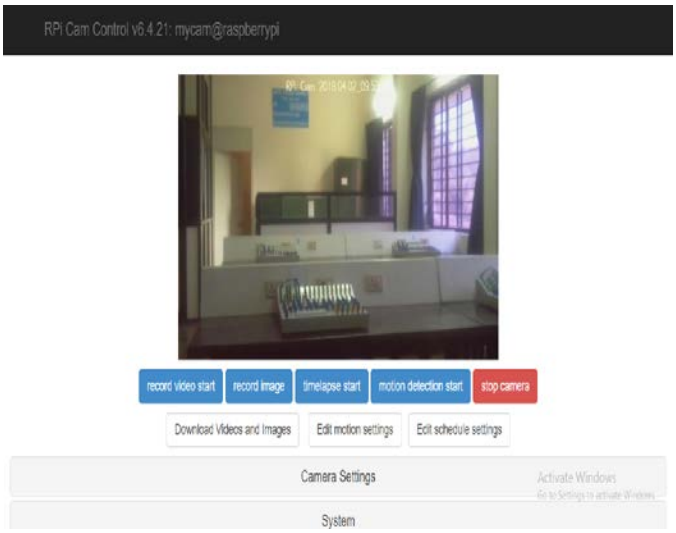

Fig. 4. Example of Live stream window

4 CONCLUSION

The paper provides an outline for design an unmanned fixed wing aircraft to spray pesticides and implementation of CONTROLLER as flight controller and stabilization and to control Sprayer module. The raspberry pi 3 is used for live streaming of video RPCWI is hands down the most versatile and powerful tool that can transform the raspberry pi and camera module combination into a platform for all kinds of creative photo and video projects. Agricultural drone has the potential to improve the crops and helps in providing an insight about the disease management technique through imaging and sensors [5]. It will also provide help in the monitoring of irrigation and water supply by predicting the availability of water through glaciers. Agricultural drone can help the farmers to transform the agriculture industry

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