https://doi.org/10.46335/IJIES.2022.7.9.4 **e-ISSN: 2456-3463**
Vol. 7, No. 9, 2022, PP. 16-20

International Journal of Innovations in Engineering and Science, www.ijies.net

Integration of Control link, Data link and Mission Planning for RPAS

Sanghamitra Badole[1], Swapna Choudhary[2], Pranav Khergade[3], Abhijit Titarmare[4]

[1]*P G Scholar Department of Electronics & Telecommunication Engineering G.H Raisoni College of Engineering Nagpur,*
[2]*Assistant Professor,Electronics & Telecommunication Engineering Dept., G.H Raisoni College of Engineering Nagpur,*
[3]*Aviation Industry Directore Pashaan Technologies Pvt. Ltd Technology Center Nagpur*
[4]*Professor, Electronics & Telecommunication Engineering Dept., G.H Raisoni College of Engineering Nagpur, India*

sanghamitra.badole.mtechcom@ghrce.raisoni.net

***Received on**: 11 June ,2022* ***Revised on**: 05 August ,2022,* ***Published on**: 09 August,2022*

Abstract-*The Drone Ground Control Station is a system for managing and observing remotely piloted aircraft system and drones from remote locations. With existing non-military drone ground control stations, the software can only display drone telemetry data and manage framework. This does not guarantee the safety of the flying drone from a crash due to bad weather or other facts. From many years, we have been using control link, data link, and video link technology separately as a ground control station and flying drones, to remove the technology we are build portable compact GCS. In this paper we present the RPAS Ground Control Station is a small portable unit that enables the safe operation and control of military drones. Its user-friendly integrated interface is used for mission planning, various operational modes, payload control, and RPAS monitoring.*

Keywords— Payload, Mission, Data link, Control link, Video link, RPAS

I. INTRODUCTION

The uses of remotely piloted aircraft system (RPAS) are becoming in favored nowadays. This circumstance alters the RPAS to involve in numerous applications [1]. The exploration of RPAS obsolete a tropical topic both for military and civilian solicitation at accommodation and overseas. Deck command station is the core of deck control of RPAS and the only way of deck control distinctive to communicate with RPAS. Currently, exploration on ground control station of RPAS is achieving popularity. As the demand for task complication increases, huge amounts of details need to be rapidly recognized and handled by operators. The huge work strength is also growing the mental and physical stipulation of the operator [3]. A drone deck manage station is a unit structure of hardware and software that acts like the cockpit of a real airframe. The hardware could be a joystick or other auto electronics device that receives pilot commands and sends them to the drone via a wireless communication. This software accumulates telemetry data from drones via transmission modules such as 3DR radio [2]. Along with to the user associate so that the drone pilot can know about the present state of the drone. Nevertheless, contrasting the actual compartment, the drone pilot relies entirely on telemetry data to steer the drone appropriately and carefully. Telemetry data typically includes GPS position, elevation, course, mission status, and more. However, there are further main factors such as meteorology, UV indication, wind rate, air standard, and magnetic field interference. Take into account to take into account one to avoid unwanted drone crashes. The remotely piloted aircraft system (RPAS) have become extra broadly utilized within all kinds of packages. Alongside from the army use of RPAS, from focused on and exploration to real guns transportation there are more and more civilian makes use of RPAS. These packages encompass seek and save performance, land and surroundings observing, farming spraying or even a suggestion to use soaring fly RPAS as stand in for communication satellite.

In this paper we present the hand-held ground control station which is based on raspberry pi 3b and raspberry pi display screen, which will be operate on drone, The rest of the paper organized follow: Section II briefly describe the background of ground control station, III Section about existing system of GCS, integrated system of GCS we discussed in section IV. Section V concerns the design and details. Finally, Section VI conclude the paper.

II. BACKGROUND

The first goal was to acknowledge the flight data generated by the RPAS and to investigate the various data causing and transmission convention that might be acceptable for this structure. In the field of RPAS development, there came to be dissimilar approaches to the design of the onboard architecture. We propose a straightforward hardware/ software construction for RPAS. A major contributor to this project is the UnoJoy library, which allows embedded PCs to communicate with multiple microcontrollers running Linux as the operating system.

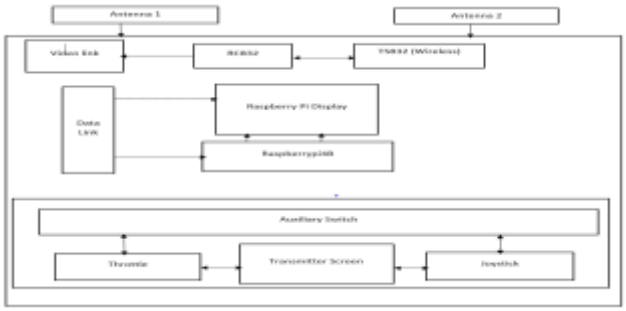

Fig 1-Background of Ground Control Station

Telemetry organization representation for brilliant RPAS observing. This dissemination narrate algorithms to acquire flight data for independent RPAS. Another design proposed to contrivance the deck station software was contemplate. Refers to the evolution of a real-time software system for RPAS Drone. The ground station system provides a flexible graphical interface to monitor the real-time status of RPAS Drone. The system uses a two-tier framework. Data transmission in the background and data visualization in the foreground. Many factors must be correct in order to develop a ground control station for unmanned systems. Considered from the design stage. Such as layouts, information components, display schemes, and human manipulation methods. Considering so many factors, it is very difficult, so we conducted a detailed investigation of the design elements. Major UAV stations around the world. Design features and Uniqueness. This includes screen display information, display methods, and Screen, tactical status information, tactical map equipment operation, and number of mechanic, operator location, layout, and operating surroundings. By doing it here is how to derive ordinary aspects of design features that lead to success design approach.

III. EXISTING SYSTEM OF GCS

Currently drone industry is using a three-way GCS for effective operations of a drone. Which is a very inefficient, time consuming and delicate process. Current GCS uses a 900MHz radio frequency telemetry for data transfers, a 2.4 and 5.8 GHz radio frequency system for video feed transfer and a low separate frequency for remote controller of drone. These are three different equipment we have to connect to GCS for effective operations. However, carrying this equipment onto different fields is a hectic job and equipment can be damaged easily halting on field operations increasing project costs. Below are the images showing GCS with telemetry and remote control.

IV. INTEGRATED SYSTEM OF GCS

The deck regulate station is at the core of the functioning. GCS controls the launch, flight and recuperation of the RPAS. It also procedure data from inner and external sensors in the network. To execute this task, GCS contains the subsequent sub-systems:

- RPAS Status Indicators and Command
- Payload Data Indicators and Command
- Mission Plans, RPAS Locations, Maps for Current Orbit Monitoring
- Data Link System Ground Terminal

Ground Station is a software implementation that runs on a deck-based computer and transmission with the RPAS via cellular telemetry. It acts as a "virtual cockpit" that exhibit real-time RPAS performance and location data, displaying many of the same devices as if you were maneuvering a real aircraft. You can also use GCS to control RPAS in flight, transfer new mission instruction, and lay framework. It is also often used to detector live video runnel from RPAS

cameras. The GCS Smart View associate allows users to allocate channels and attribute to bring buttons, switches, knobs, and joysticks between a fully associated on-screen display surface. This innovative structure creates a fully customizable associate for effectively any platform of interest, allowing pilots to rapidly and easily switch connecting multiple RPAS models to utilize the entire fleet with a single GCS. HOTAS (Hands on Throttle and Stick) arrangement provides an instinctive set-up that furnish a high degree of control and creativity for unmanned systems.

V. DESIGNE AND DETAILS

RPAS means an aircraft that operates remotely or independent without a pilot. The Deck Command Station (DCS) is used to remotely control the RPAS. The RPAS mission and characteristics are generally contrasting from manned aircraft, so the control station design is different. With RPAS remote control, the GCS display should be designed to provide the operator with a sufficient level of situational awareness. Fig. 2 shows the general attributes of GCS. It is preferable that all mission flights can be performed impulsively with minimum human intervention. The human operator only acts as a manager, ensuring that the mission goes according to plan.

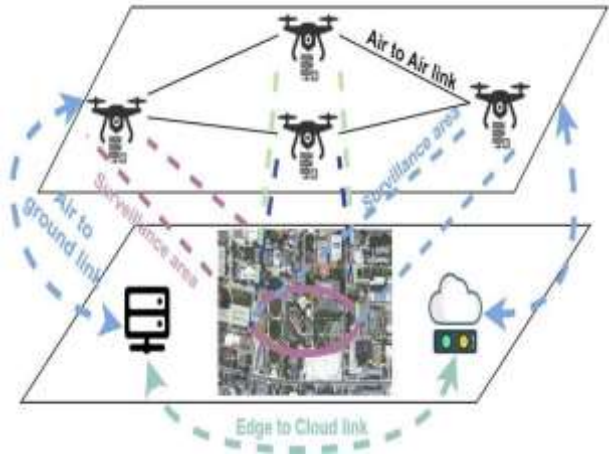

Fig 2-Ground control station overview

To expand a deck command station for unmanned structure, many element from the arrangement stage, such as layouts, details components, presentation schemes, and human interaction. Since it can be very difficult to consider so many factors, we conducted a detailed study of the design factors for large RPAS establishment throughout the world. We examine the attributes and characteristics of the design. These incorporate screen exhibit details, display technique, number of screens, tactical status details, tactical map equipment functioning, number of machinists, machinist position, layout, and operating surroundings. Now we derive design of GCS functions that has been lead to a successful design approach.

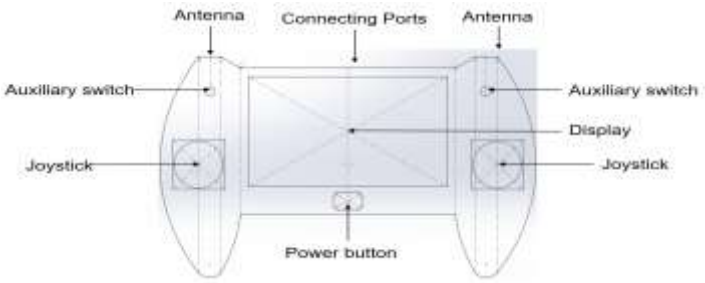

Fig 3-.Structure of GCS

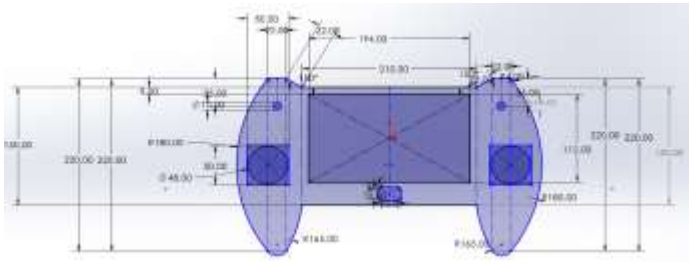

Fig 4- Dimensions of GCS Structure

Above figure, we design with the help of Solid Work and computer-aided engineering (CAE) computer program SolidWorks is a computer-aided design (CAD) for solid illustration published by Dassault Systèmes, primarily running on Microsoft Windows. First we installed Solid Work on a Windows version. It was Solid Work Premium 2021. Then I started Solid Work setup units in mm, inch, m, and so on. Select a plan according to design and then create a sketch. Extrude part 2d in 3d using the sketch tool and finally save it as .sldprt format.

A] DISPLAY UNIT WITH RASPBERRYPI

The 800x480 exhibit is connected via an accessory board that manipulate power and signal transformation. Only two interrelation to the Pi are essential. Powered by a ribbon cable connected to the GPIO port on the Pi and the DSI port on all Raspberry Pis. Touch screen driver that supports 10-finger touch and on-screen keyboard

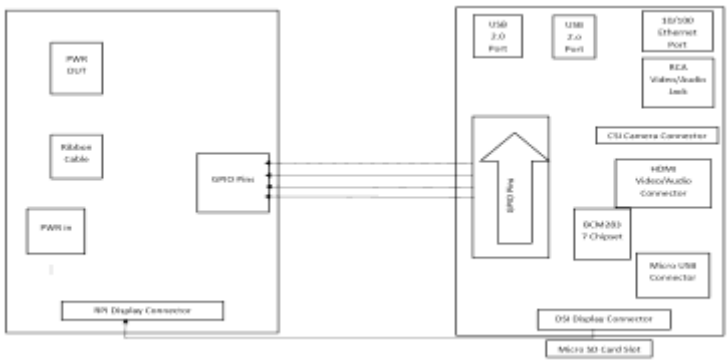

Fig 5-Block Diagram of Display Unit and Raspberry Pi

Figure.4 shows the connection of Raspberry pi and Display unit left hand side raspberry pi pins are showing and right hand side Display unit pins are showing both GPIO pins are connected to each other.

Figure 6. Back Side Raspberry Pi Display

First, connect the sizeable ribbon topping lift from the display to the associated at the bottom of the selector board. The clamp must be carefully loosened previous positioning the cable. Be sure to push in the clamp to secure the ribbon. Then turn the control board over and connect a small ribbon cable from the screen to the board. Using the same principle as above, loosen the clamp, insert the topping lift, and press the clamp to secure the band. Using the white ribbon topping lift supplied, connect one end to the selector board, and then just associate the red and black jumper wires supplied to the control panel. Attach the Raspberry Pi to the four standoffs. Connect the white ribbon to the exhibit port on the Raspberry Pi.

B] INTEGRATED GCS RPAS SYSTEM

Our integrated ground control station for RPAS provide a convenient way to control and view HD low-latency video feeds from UAVs and other unmanned systems. The handheld RPAS ground control stations (GCS) are compatible with a wide range of platforms and payloads. It is extremely lightweight and controls unmanned systems that communicate over MAVLink, such as UAS, quads, multirotor, VTOLs, fixed-wing UAVs, and unmanned ground vehicles (UGVs). It is designed to simplify the management of autonomous flight, live video streaming and data collection. Reliable controllers feature built-in environmental protection for harsh conditions and can support a wide range of professional and mission-critical unmanned system applications in the enterprise, defense, and government sectors.

This GCS uses some following special features:

- Raspberry pi multi-touch Tablet
- Battery
- Power supply & Antennas
- Customized transceiver unit, joysticks, buttons, sliders, toggle switches
- Dual Radio antenna & GPS Antenna for location base services
- Configurable multiple joysticks, buttons, sliders, toggle switches and a fail-safe guard
- User-replaceable battery in field
- I/O interfaces to peripherals
- Light and compact.

VI. EXPERIMENT RESULT

Deck control system functionality is tested to verify the effectiveness of the design. The terrestrial control system assumes a MavLink protocol as a data connection that indicates that the measurement control system receives serial port data after the data communication is first set, indicating that the measurement control system receives serial port data after a successful serial port. Data can be encoded and decoded according to the MavLink protocol. Data display modules can be viewed in real time and can be viewed in a variety of ways. With the help of the flight control module, the measurement control system sends control commands to the RPAS flight control system and receives control commands and decodes appropriately. The report information returned to the ground control system is correct. Therefore, the flight control module is functioning properly. For working smooth joystick, we used IC MCP3008 and we convert that IC analog to digital but it's would not work properly, instead of that we used Arduino Uno. Arduino Uno build serial communication with raspberrypi4b using Arduino IDE and Pythone Software.

This work proposes a hybrid of an infrastructure-based Network, successfully executing the code for joystick cursor and ground control station work.

VII. CONCLUSION

GCS is typically aimed at solving three major issues with traditional offline GCS such as wireless controllers and Mission Planner. Bounded jurisdiction span, limited functionality to reinforce multifold operators, and bounded functionality to jurisdiction numerous drones at the same time. A ground station for RPAS control has been designed and testified with satisfactory performance. RPAS-based ground station system software is analyzed and functionality modularized based on project requirements.

ACKNOWLEDGMENT

I extend my sincere gratitude and affection thanks to my Project guide, staff of Electronics and Telecommunication Engineering, They have stump up to a great estimate in surmounting all the difficulty faced throughout the achievement of the project. I also acknowledge the inventiveness and uplifted provided by Director of Pashaan Technologies, I also take opportunity to acknowledge the contribution of Pashaan Technologies members for their kind encouragement during development of the project.

REFERENCES

[1] *Ting Yang, Chuan Heng Foh and Fabien Heliot 5GIC, Institute of Communication Sytstem , Chee Yen Leow, Wirless Communication Center , Periklis Chatzimisios ,"Self Organization Drone based Unmanned Aerial Vehicles(UAV) Networks" 2019 IEEE.*

[2] *Bo Han, Chaofang Hu, Yimin Zhou, " The Ground Station Design for Swarm Unmanned Aerial Vehicle Control" july 27-30,2019,Guangzhou, China.*

[3] *Yingbo Zhou, Jingyun Hou, Yi Gong, Aviation Industry Chengdu Aircraft Industry Group Co.LTD, "Research and Application of Human Computer Interaction Technology based on Voice Control in Ground Control Station of UAV" 2020 IEEE.*

[4] *MladjannJovanovic, Dusan Starcevic Labortary for Multimedia Communication, Faculty of Organizations, Faculty of Organizational Sciences, University of Belgrade, "Software architecture for Ground Control Station for Unmanned Aerial Vehicle" 2008.*

[5] *G. Natarajan Aeronautical Development Establishment, Bangalore-560 075 "Ground Control Staions for Unmanned Air Vehicles" 2001 IEEE.*

[6] *Himanshu Sharama, Frederick Luthcke, Amay Desai, Dr. Ilteris Demirkiran, Ph DProfessor of Electrical Engineering, "Development of aground station Software for a Vertical Take-Off/Landing Unmanned Aerial Vehicle" 2017 IEEE.*

[7] *Kumoh National Institute of Technology, South Korea "Secure Ground Control Sation based Routing Protocol for UAV Networks" 2019 IEEE.Danielle Jaye Segui Agron, Muhammad Rusyadi Ramil, Jae-Min Lee, and Dong-Seong Kim Department of IT Convergence Engineering .*

[8] *Danielle Jaye Segui Agron, Muhammad Rusyadi Ramli, Jae-Min Lee, and Dong-Seong Kim Department of IT Convergence Engineering Kumoh National Institute of Thechnology, South Korea, "Secure Ground Control Station Based Raouting Protocol for UAV Networks" 2019 IEEE.*

[9] *Adrian Done, Alin-Mihai Cailean, Cezar Eduard Lesanu, Mihai Dimian, Adrian Graur.Integrated Center for research, development and innovation in advanced materias, "Designe and implementation of a satellite communication ground station" 2017 IEEE.*

[10] *Chi Tinh Dang, Hoang The Pham, Thanh Binh Pham and Nguyen Vu Truong " Vision Based Ground Object Tracking Using AR. Drone Quadrotor" ICCAIS 2013.*

[11] *Lyuyang Hu, Omkar Pathak, Zeyu He, Hunkyu Lee, Mina BEdwany, Jace Mica ,Peter J.Burke, Sr.Memebr IEEE. "CloudeStation A Cloude based Ground Control Station For Drones" 2020.*

[12] *Syed Razwanul Haque, Robi Kormokar, Akhlak Uz Zaman, Department of Computer Science and Engineering Metropolitan University, Sylhet, Bangladesh, " Drone Ground Station with Enhanced Safety Features", 2017 IEEE.*

[13] *DJI Official. (2018). Mavic Pro– Specs, FAQ, Tutorials and Downloads. [online] Available at: https://www.dji.com/mavic/info [Accessed 26 Apr. 2018].*

[14] *Espen Skjervold, Oistein T. Hoelsaeter , Nowegian Defence Reasearch Establishment (FFT). "Autonomous, Cooperative UAV operations using COTS Consumer Drones and Custom Ground Control Station" 2018 IEEE.*

[15] *Paul G. Backes, Greg Tharp, Bruce Bon, and Samad Hayati, Jet Propulsion Labortory California Institute of Technology , Linh Phan Sohar Incorportated Beverly Hills California. "Ground Control Station Development for the Dexterous Orbital Servicing System" 1995 IEEE.*