Drone Applications

Report by: Fahid Choudhry

Electronics Engineering Technology

Table of Contents

Introduction

Drones have a significant role in today's society and have been a rapidly growing technology in the past decade. Many people consider flying drones as hobbyist type of technology, but their applications have a much larger scope than that. They have become significant to the functions of businesses and governmental organizations, including areas where industries were not making substantial progress. Their real world applications include surveying areas that are difficult to navigate on land and transporting items from one location to another.

We chose to do a project on drone applications for the reason being our mutual interest in the field of drones and the innovative approach to real world scenarios. This report documents our finalized model for our capstone project on drone applications. Based on our drone applications project, our Parrot AR drone can be manipulated to be controlled wirelessly and streamed through LabVIEW. Furthermore, we can apply image recognition to an external camera to be then mounted onto the drone to enhance its applications to the real world. The future development of this project includes a possibility to apply image recognition to control the drone autonomously and react to the external environment.

Project Description

Our project as a group was based on making improved and more appropriate applications on an AR Parrot Drone. Therefore, we decided to utilize machine vision via LabVIEW applications on a drone equipped with a high definition camera on it. Drones initially were strictly recognized with Army or Air Force applications and it ought to have a negative image to it where it was restricted to spying or dropping bombs on areas. As the time and research on these devices progressed, analysts tend to achieve broader sense and utilities for a drone.

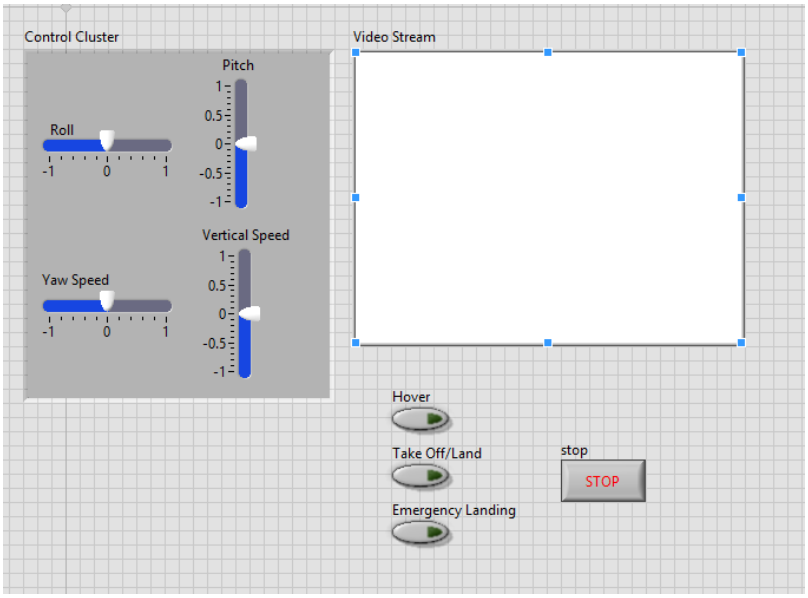
Keeping that notion in our initial capstone research and also having the opportunity to acquire a real-world skill while working with drones conspired us to move forward with this project. AR Parrot Drone is wildly popular among the developers and there has been immense amount of research and projects completed on it because of Linux based operating system and also its compatibility with several design software.

LabVIEW was one of the courses we finished before last semester and that provided us an easy path to decide what software to pick in order to make the project work. Parrot AR drone has its mobile app but in order to bring in machine vision and image recognition in specific, our challenge was to process the images or a live stream on a software where we can further analyze the image patterns. Hence we decided to use LabVIEW software, an AR Parrot Drone and Machine Vision Applications to deliver our project.

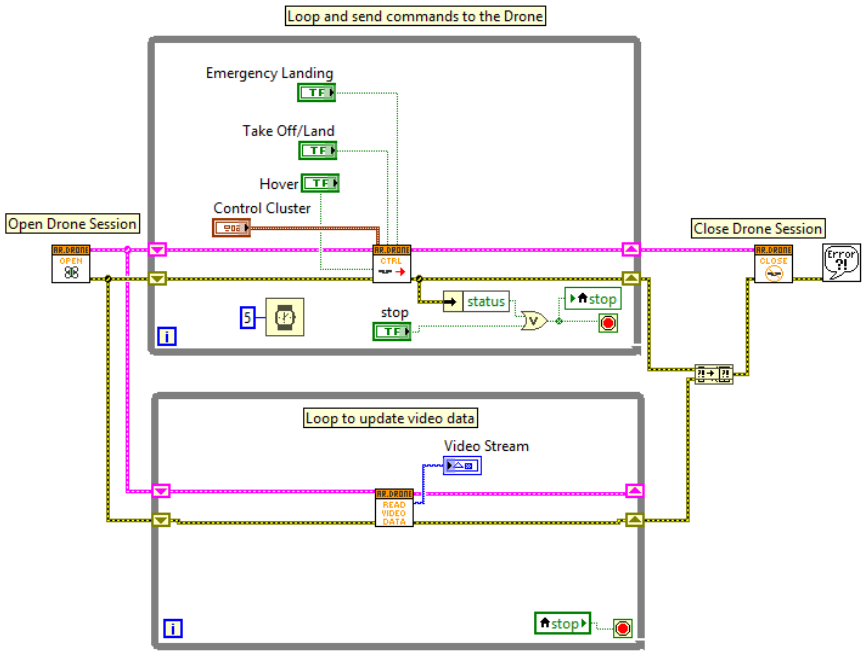
Technical Documents – LabVIEW VI's

Drone Control using LabVIEW and Video Stream Output

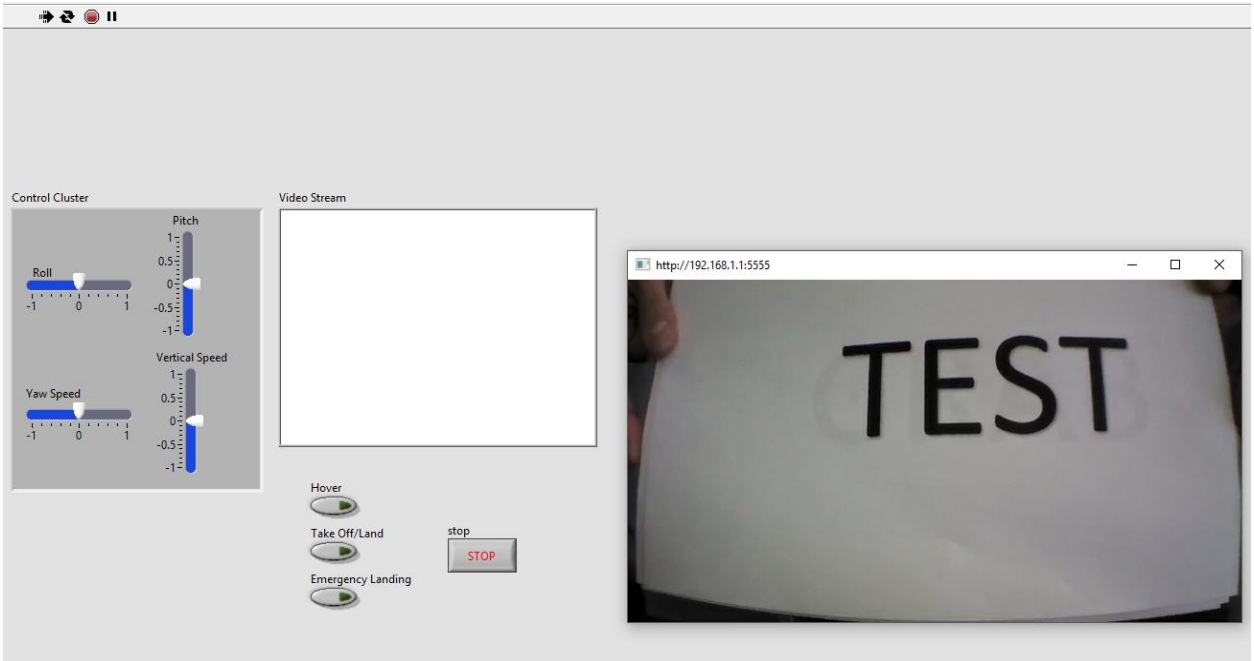
Front Panel – Before Running



Block Diagram



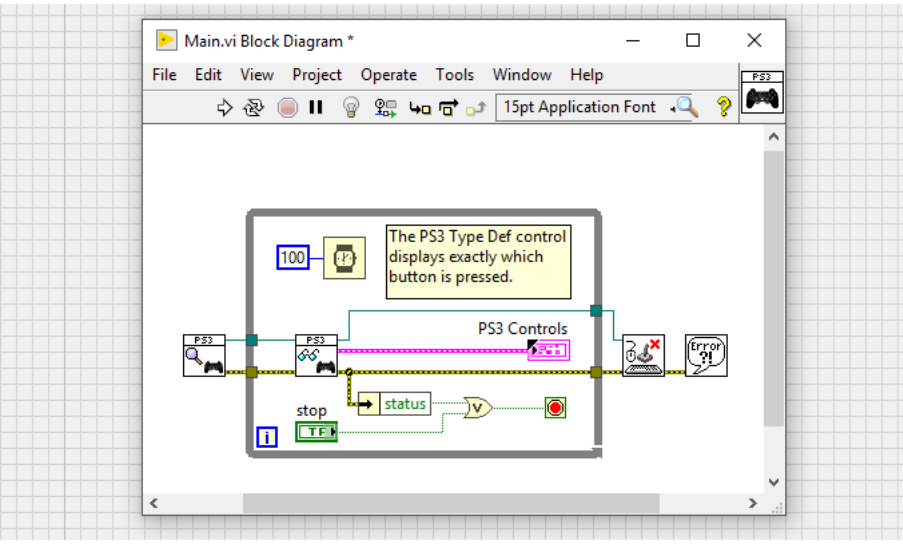
Front Panel – After Running



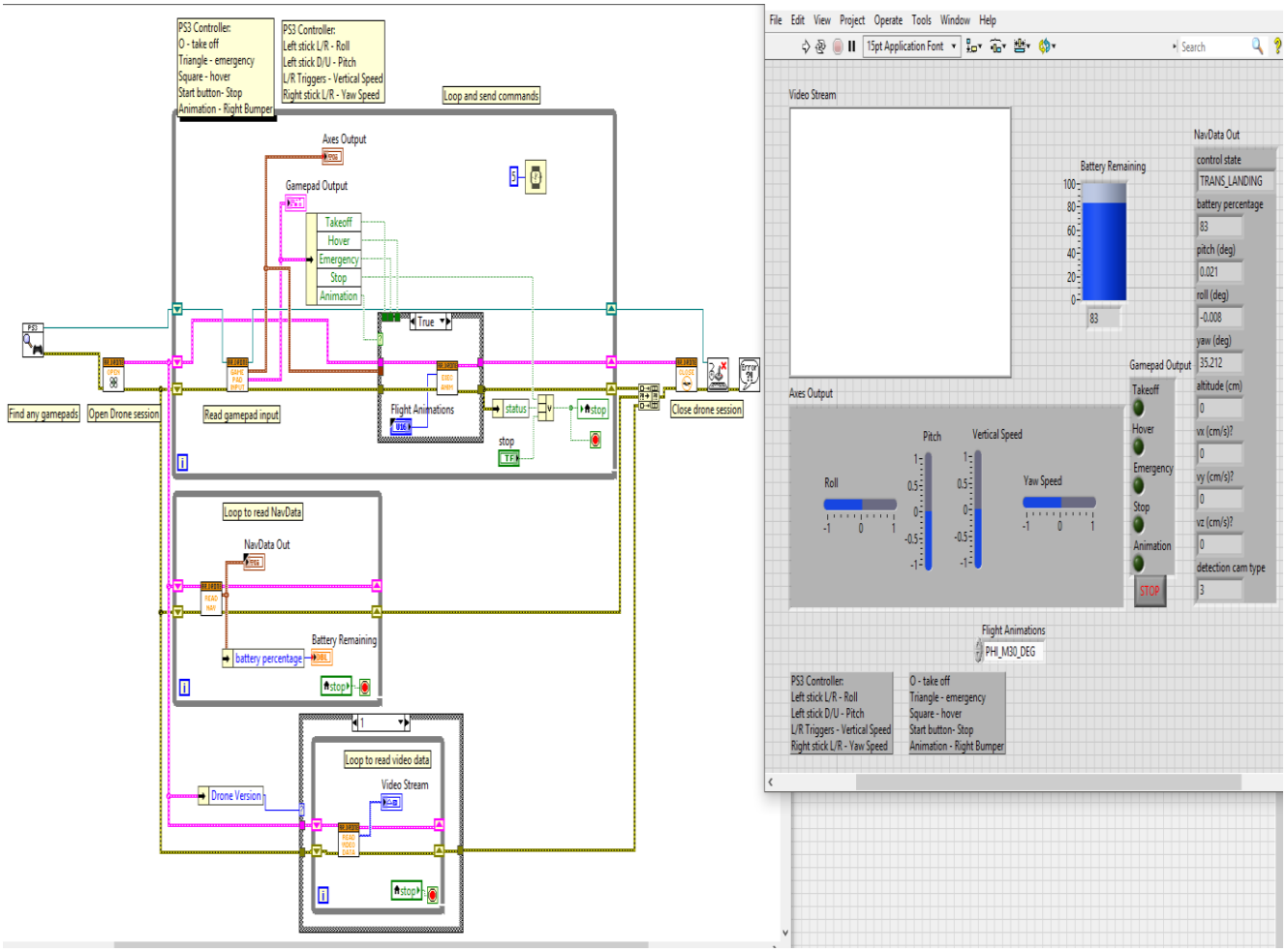
Control using PlayStation 3 Controller

Front Panel

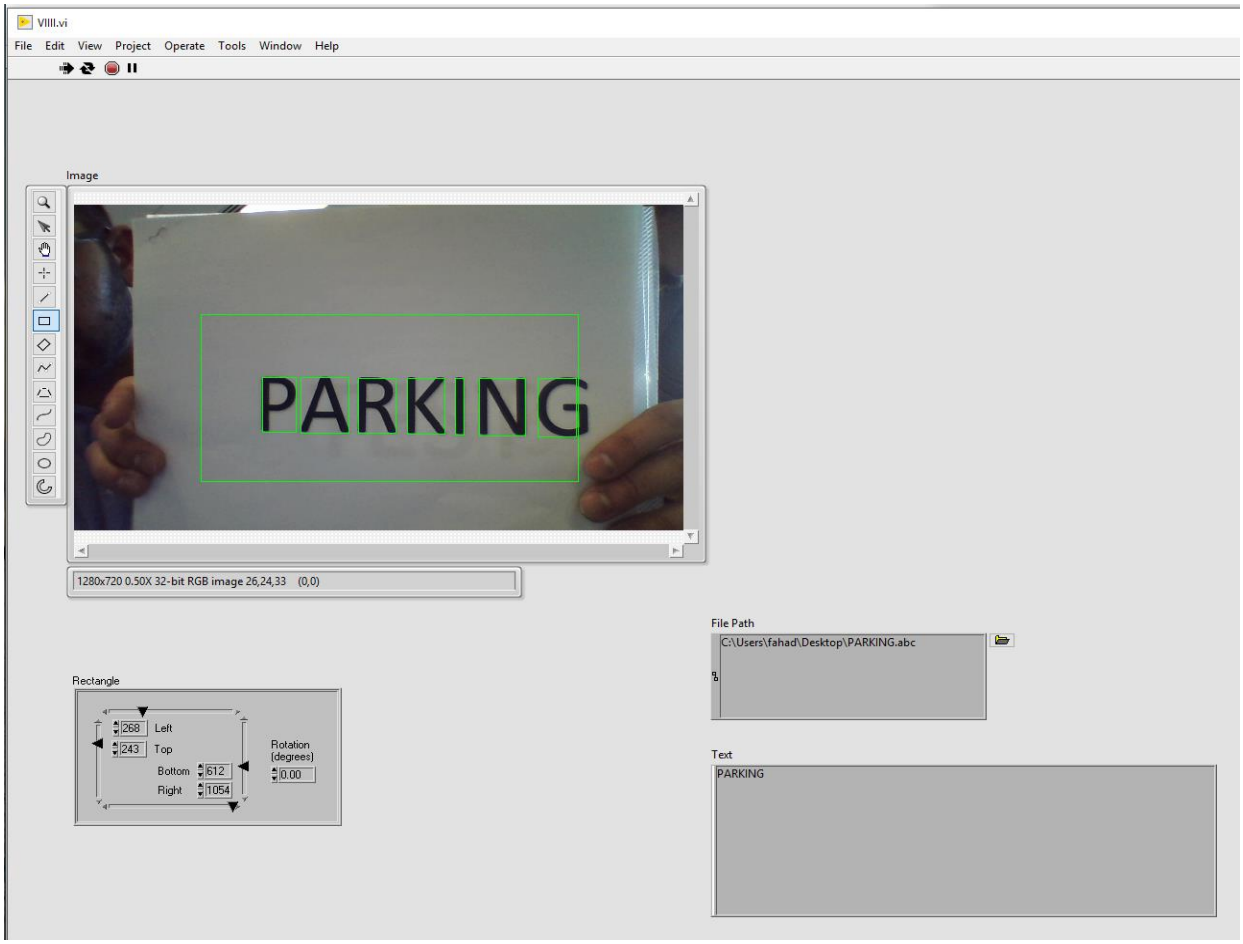
Block Diagram



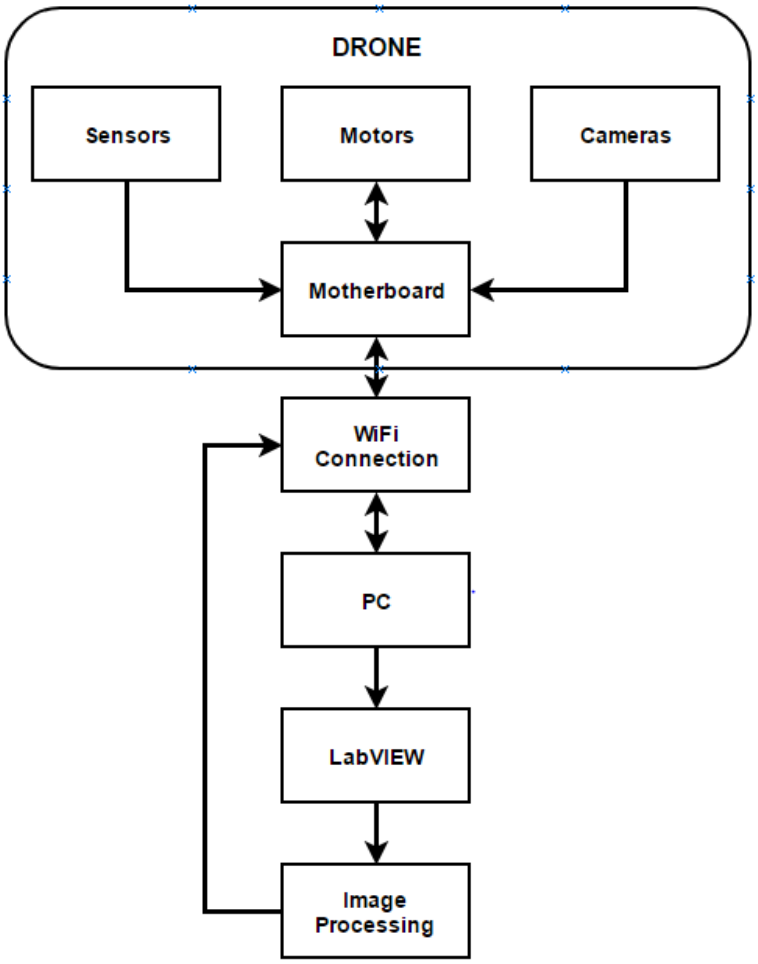
Block Diagram of Controller SubVI and Front Panel



Training using Vision Assistant

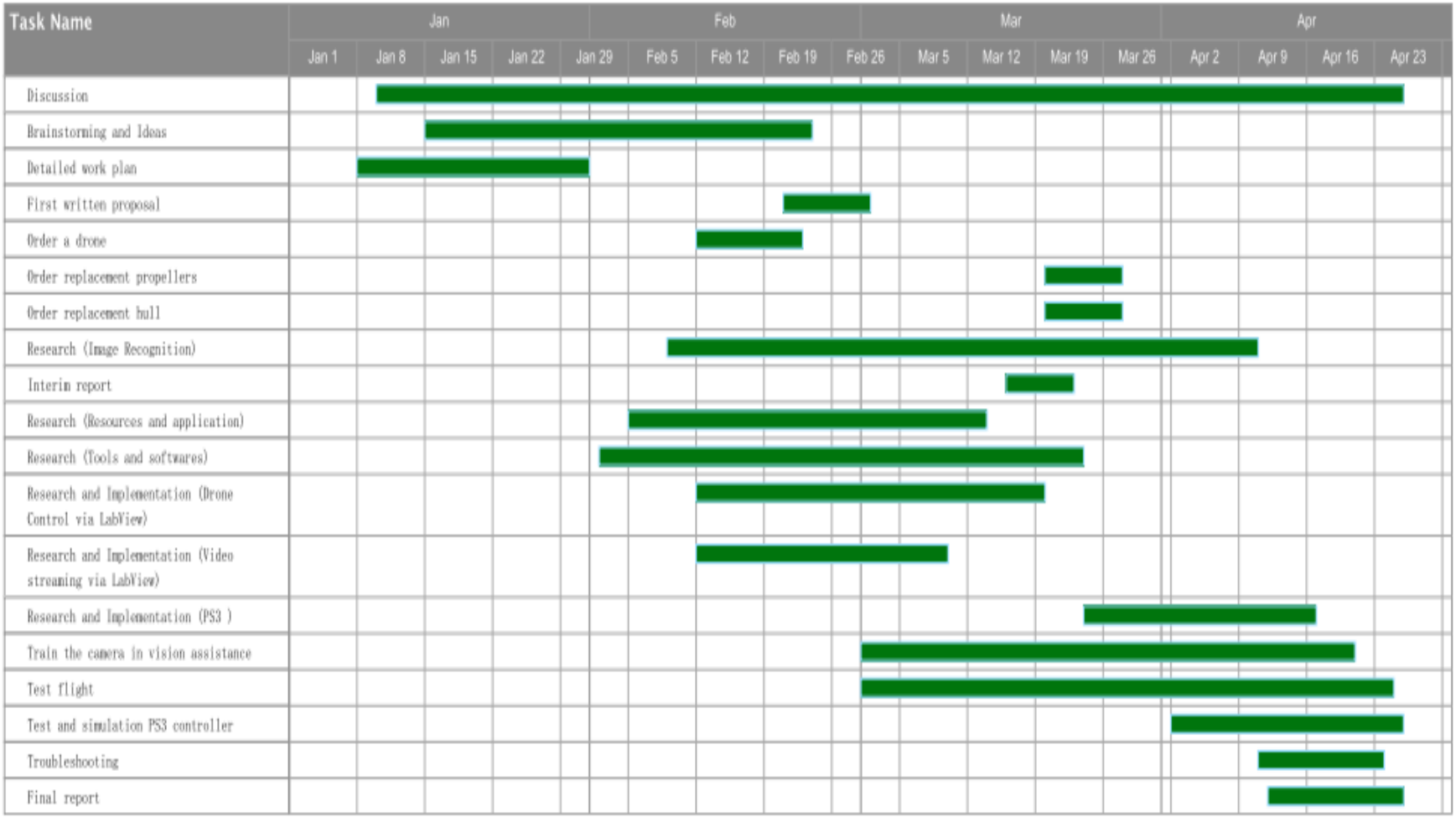


Block Diagram – Image Processing with Drones



A general block diagram of the entire system consists the main drone, connection to a PC through WiFi, and image processing through LabVIEW. The drone we are using is the Parrot AR drone. Its functionality contains a set of blocks where its main components that include the sensors, motors, and cameras are all directly connected to its motherboard. The drone's motherboard contains a 1 GHz ARM Cortex A8 microprocessor and an 8 GHz video DSP. Also, the board includes an Atheros WiFi chip, which enables the user to control the drone wirelessly. By generating its own access point, we can connect it with a PC to fly and land the drone, while showing a live video stream through LabVIEW.

Gantt Chart


Task Name
Jan
Feb
Mar
Apr
Jan 1
Jan 8
Jan 15
Jan 22
Jan 29
Feb 5
Feb 12
Feb 19
Feb 26
Mar 5
Mar 12
Mar 19
Mar 26
Apr 2
Apr 9
Apr 16
Apr 23
1 Discussion
2 Brainstorming and Ideas
3 Detailed work plan
4 First written proposal
5 Order a drone
6 Order replacement propellers
7 Order replacement hull
8 Research (Image Recognition)
9 Interim report
10 Research (Resources and application)
11 Research (Tools and softwares)
12 Research and Implementation (Drone Control via LabView)
13 Research and Implementation (Video streaming via LabView)
14 Research and Implementation (PS3)
15 Train the camera in vision assistance
16 Test flight
17 Test and simulation PS3 controller
18 Troubleshooting
19 Final report

Budget Chart

Components	Subtotal Cost ($)	13% GST/HST Tax($)	Shipping Costs ($)	Shipping Time (# of Days)	Total ($)
Parrot AR.Drone 2.0	$250	$32.50	Free Shipping	10 Days	$282.50
Parrot AR.Drone 2.0 Indoor Hull	$56	$7.28	Free Shipping	8 Days	$63.28
Parrot AR.Drone 2.0 Replacement Propellers	$16	$2.08	Free Shipping	8 Days	$18.08
NI LabVIEW Software	Free	/	/	/	$0
NI AR Drone Toolkit for LabVIEW	Free	/	/	/	$0
AR Drone FreeFlight App	Free	/	/	/	$0
Laptop	Already Owned	/	/	/	/
PS3 Controller	Borrowed	/	/	/	/
				Total	$363.86

Problems & Solutions

Problems	Solutions/Result
1. Could not connect drone camera with LabVIEW's Vision Assistant	We could not find a solution, but in the future we can use an external camera and mount it to the drone.
2. Drone camera's output is in a different format	Same as solution 1.
3. Drone propellers were damaged too easily	Even though we got another pair, they are extremely fragile and wore out quickly
4. Sub VIs would sometimes not run properly after rerunning the LabVIEW files	We had to download everything again because troubleshooting the problems with the Vis was too complex.
5. Drone's camera quality is not too good	Same as solution 1.
6. PS3 controller stops working with LabVIEW	We could not find out the solution despite downloading and configuring our Vis again as we did before when it was working.

Future Development

Drones are rapidly growing in popularity and they have become one of the handy gadgets that are in the market. Technologists have made huge progress in terms of adding applications and implementations to the drones, which is how it became so high in demand.

There are so many applications that can be done with the drones. We had a chance to work on one of them, which is image recognition using the camera of an AR 2.0 drone throughout the semester. It was a challenging topic with respect to making the drone recognize words and leads itself automatically based on the meaning behind the word. If we have more resources and sophisticated environment in the future, we can avoid them and achieve more.

As it is 13 weeks-long semester, this was a big concern and managing to do the work in a short time was hard as well as budget was another obstacle that we faced. Therefore, if time and money are given we would build the drone ourselves based on the needs of our project. Having done so will give us the opportunity to establish further tasks, because will have full control over the weight and the power of the engine and several of other things, which allows us the to make this remotely piloted aircraft as useful tool to deliver vaccines and other critical medical supplies to remote locations in the developing world, in addition to transporting supplies to remote areas that are inaccessible by roads.

Furthermore, building it will give us the chance to equip it with a high quality camera and as a result high resolution which will give the drone two features one is the ability to recognize letters from far distance and the other is to make it easier for the drone to give better image under bad weather conditions.

In addition, that will help in supplying the drone with a strong external cover which provides higher safety for the sensitive internal parts especially in severe weathers and unsafe work zones.

Moreover, to make this Unmanned Aerial Vehicle more sophisticated we can implement a GPS navigation system, doing so, as example will reduce labor and operational costs by spraying crops with fertilizers and pesticides for farmers which give them more affordable alternative way than using traditional airplanes. Another advantage of GPS system is to make the drone browse a parking spot and send notification when it finds an empty one which will save time for people looking for one.

Conclusion

Over the years, there has been more budget spent for advancements in drone technology. Their lightweight and maneuverability through the skies is their foundation. Scientists and engineers research, innovate, and improve upon their applications while taking advantage of their valuable functionalities.

We were inspired by how innovative drone applications can be, so we took on this project for our capstone. Our applications include controlling the drone through LabVIEW's AR Drone Toolkit Vis and using an external control, in our case a PlayStation 3 controller, to maneuver the drone. Most of our budget is spent on the Parrot AR drone itself and the rest were on replacement parts. Furthermore, we have created a user manual attached to this document, which contains safety protocols and instructions on how to fly the drone using various methods. Some future developments on our drone include applying various functionalities to the drone such as a delivery system, but time and increased budget was a significant problem in our situation. To conclude, we acquired a lot of knowledge about wireless control using the LabVIEW software we had previously used and discovered more various types of image processing techniques that can be applied to drone applications.

Sources

"AR Drone Toolkit for LabVIEW - LVH LabVIEW VIs for Controlling the Parrot AR Drone." *AR Drone Toolkit for LabVIEW - LVH - National Instruments*, sine.ni.com/nips/cds/view/p/lang/en/nid/211837.

"AR Drone User Manual." *Quadcopter AR Drone 2.0*, www.parrot.com/ca/drones/parrot-ardrone-20-elite-edition#in-the-box.

Biewald, Lukas. "How to build an autonomous, voice-Controlled, face-Recognizing drone for $200."*O'Reilly Media*, Lukas Biewald , 25 Oct. 2016, www.oreilly.com/ideas/how-to-build-an-autonomous-voice-controlled-face-recognizing-drone-for-200.

Denys Bohdanov, "Quadrotor UAV Control for Vision-based Target Tracking Task," in Graduate Department of Aerospace Engineering, University of Toronto, 2012.

Djsures, and Instructables. "Color Following AR Parrot Drone." *Instructables.com*, Instructables, 29 Oct. 2017, www.instructables.com/id/Color-Following-AR-Parrot-Drone/.

Gevers, Theo. *Color in computer vision: fundamentals and applications*. Wiley, 2012.

Joshi, Divya. "Exploring the Latest Drone Technology for Commercial, Industrial and Military Drone Uses." *Business Insider*, Business Insider, 13 July 2017, www.businessinsider.com/drone-technology-uses-2017-7.

Lee, Jangwon. "Real-Time Object Detection for Unmanned Aerial Vehicles." 22 July 2014, pp. 1–8., doi:10.18411/a-2017-023.

"Motherboard for AR.Drone 2.0." *Parrot Official*, 2 Oct. 2017, www.parrot.com/eu/spareparts/drones/motherboard-ardrone-20#motherboard-for-ardrone-20-details.

"Parrot AR.Drone 2.0 Elite Edition." *Parrot Official*, 9 Feb. 2018, www.parrot.com/global/drones/parrot-ardrone-20-elite-edition#technicals.