Remote control drone project idea
Team SecureIT
https://chris771.github.io/SecureIT.github.io/index.html

Overview:

As a team we decided to shift our project idea to something more simple to understand with a hope to learn more about the basics of information technology.
We agreed to work on form factor computing in particular Raspberry Pi to see its potential and how it could be used in our everyday lives.

The raspberry pi(Rpi) is a series of single-board computers developed in the UK. Each has microprocessors, memory, input/output and other features. It was designed for use in educating, demonstrating and promoting computer science in developing countries. (Wikipedia)

Raspberry Pi Picture
By Miiicihiaieil Hieinizilieir / Wikimedia Commons, CC BY-SA 4.0,
https://commons.wikimedia.org/w/index.php?curid=80140656

Form factors, which are found in any computer, is the name given to the specifications of the motherboard. It is the dimensions, type of power supply, the number of ports, the location of mounting holes etc (Wikipedia).
Standard form factors across the IBM PC compatible industry make sure that parts are interchangeable across the different generations of technology and across the different vendors. Form factors in enterprise computing make sure that server modules fit into the existing rackmount systems (Wikipedia).

Our team endeavours to create an autonomous drone using the raspberry Pi controlled remotely via wireless networks. We aim to navigate through the various software and hardware challenges this involves. The reason for using the Raspberry pi is for the versatile GPIO connector. With drones becoming an important tool for people whose jobs cover a wide area

geographically, the versatility of a Raspberry pi and in particular the GPIO can add great potential to what a drone can do in the field.

The big picture as seen by our group is a Raspberry Pi (RPi) setup to control a drone using a Wan (wide area network) with a camera to help with navigation.

Motivation:

Our groups motivation is to have a project that will teach us a wide range of skills within the IT field. This includes but is not limited to; alternative operating systems, networking, file transfer, programming, and some html. As we break down the different aspects of the technologies used to achieve our project goals our knowledge of these technologies will become greater and we will have more understanding going forward in our careers/studies.

Of course we are also motivated by the endless uses that an autonomous drone could have to assist in the community. Some of the uses we thought about were using the drone in conjunction with government authorities such as CFA, SES and police where some types of remote areas are not accessible by foot, a drone could come into play to see the damage of a fire or locate missing people.

The project chosen will not be finished because of our current knowledge but has motivated us to come back to the project once we acquire the relevant skills. It is also a project that once we had successfully made an autonomous drone could be continued making it better and more cost effective, and adding features eg: infrared cameras and other sensors.

Landscape:

At this stage this type of project is quite common for other university students to take on.
There is plenty of information on youtube and a wealth of GitHub repositories to look at where groups have completed similar projects.
There are also more advanced projects in progress with America starting to test autonomous drones for use in border security (defense One) and Australia training our army troops to use unmanned drones. (Australian Defense Force)

Defense One
https://www.defenseone.com/technology/2019/09/cbp-test-autonomous-drones-use-border/159604/

Australian Defense Force
https://www.australiandefence.com.au/defence/unmanned

Aims:

The aim of our project was to use a Raspberry Pi to control a drone remotely, with the end result being a fully autonomous drone.

A more detailed description of what we are trying to achieve is to get rid of the traditional transmitter and receiver from the standard remote control and replace it with the Pi and wireless networking. Using a 4g lte device tethered to the pi will mean the range will be greatly increased. This is not groundbreaking in the area of remote controls however highlights the potential of raspberry Pi.

The drone will be equipped with a tilt pan servo control camera that will aid in surveillance and control of the drone. We aim to have gps tracking of the drone to give accurate information on the position of the drone and also aid in control.

With the advances in battery innovation lipo batteries we will also aim to power the drone, as well as the raspberry pi and the LTE device with one battery source.

This project is simple in its intent, but along the way we as a team will equip ourselves with the necessary tools to enter the world of information technology.

Purchasing an RPi
There are many kits available that come with a power supply (ac adapter), SD card and box to house the Rpi.The one we bought was a Raspberry Pi3b+. The specifications on this model are as follows:
SoC: quad-core A53 (ARMv8) 64-bit @ 1.4GHz
GPU: Broadcom Videocore-IV
RAM: 1GB LPDDR2 SDRAM
Networking: Gigabit Ethernet (via USB channel), 2.4GHz and 5GHz 802.11b/g/n/ac Wi-Fi
Bluetooth: Bluetooth 4.2, Bluetooth Low Energy (BLE)
Storage: Micro-SD
GPIO: 40-pin GPIO header, populated
Ports: HDMI, 3.5mm analogue audio-video jack, 4x USB 2.0, Ethernet, Camera Serial Interface (CSI), Display Serial Interface (DSI)
Dimensions: 82mm x 56mm x 19.5mm, 50g

Pi Australia
https://raspberry.piaustralia.com.au/raspberry-pi-3-model-b-plus

We decided against a kit so as to minimise cost.

The current official operating system for the RPi is Raspbian-Buster. Raspbian-buster full version has a lot of free open source software for education, programming and general use. It has Python, Scratch, Sonic Pi, Java and more. Navigating the raspberrypi.org website we easily

found the latest distribution and downloaded the compressed ISO image which is compressed using the 7z format. 7z compression is at least 17% better than the normal zip type compression. But needed another freeware application to extract the ISO image.

Raspbian Download
https://www.raspberrypi.org/downloads/raspbian/

https://www.7-zip.org/download.html
7-zip is need because of how the Raspbian iso is compressed.

https://www.sdcard.org/downloads/formatter/
An sd card formatter was suggested before flashing the ISO image to the sd card.

https://www.balena.io/etcher/
Was used to flash the SD card with the uncompressed ISO image of the operating system.
This app Flashes OS images to SD cards & USB drives, safely and easily.

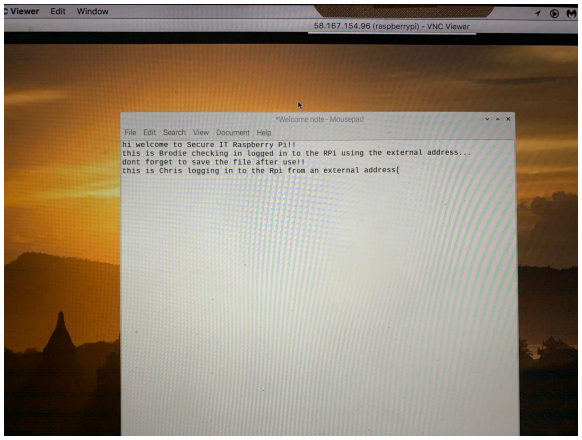
Configuration
Once the Raspbian-Buster is installed it is important to update and upgrade to the most current version of said current operating system.

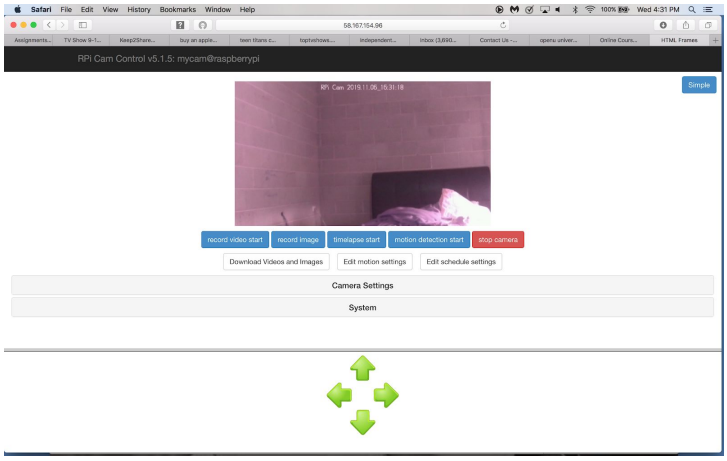
Following is the configuration of the RPi including the enabling of ssh, vnc and the i2c tools feature of the Pi to control the GPio.

Establishing a connection via SSH was next.
https://www.putty.org/ was used to connect to theRPI remotely it enable command line access to the RPI. SSH is a cryptographic network protocol for operating network services securely over an unsecured network. Typical applications include remote command line, login, and remote command execution, but any network service can be secured with SSH.

The VNC was the next thing to organise. We needed a vnc so the Pi could be remotely connected to from anywhere on the internet.
Realvnc is necessary for multiple remote connections to a single device.
This is helped by the fact my internet connection has a static ip. Others in the group can join the pi and navigate their way around the new operating system
https://www.realvnc.com/en/connect/download/viewer/

At this stage we got everything working and connected to the network
Screenshots of Brodie and Chris being able to log into the Rpi.
This is a screenshot of us both editing a file on desktop to assure us both have successfully connected to the RPi via vnc.





Scope and Limitations
Plans and progress

Before we invest in a drone we decided to use what we had on hand as far as remote controlled vehicles. Brodie already has a RC car so a halfway point was to be able to control the RC car first thus minimising outlayed cost. Progress was slow when options available to us in the form of controlling our chosen vehicle relied heavily on python programming language.
We agreed it would be easier and more practical to start using the RPi to control an rc car instead of a drone, and we had a car available to use so didn't have to purchase one.
Our lack of knowledge of Python creates some limits on how much we can program the Pi to do. We would need more time to learn Python commands and program the pi to perform basic functions.

Obviously time constraints play a big part in the limitations of this project. Our team changed members and projects from assignment two and have had five weeks to work on the new project. It will take much longer to accomplish a fully autonomous drone.

We want to show how we have accessed the Rpi remotely.

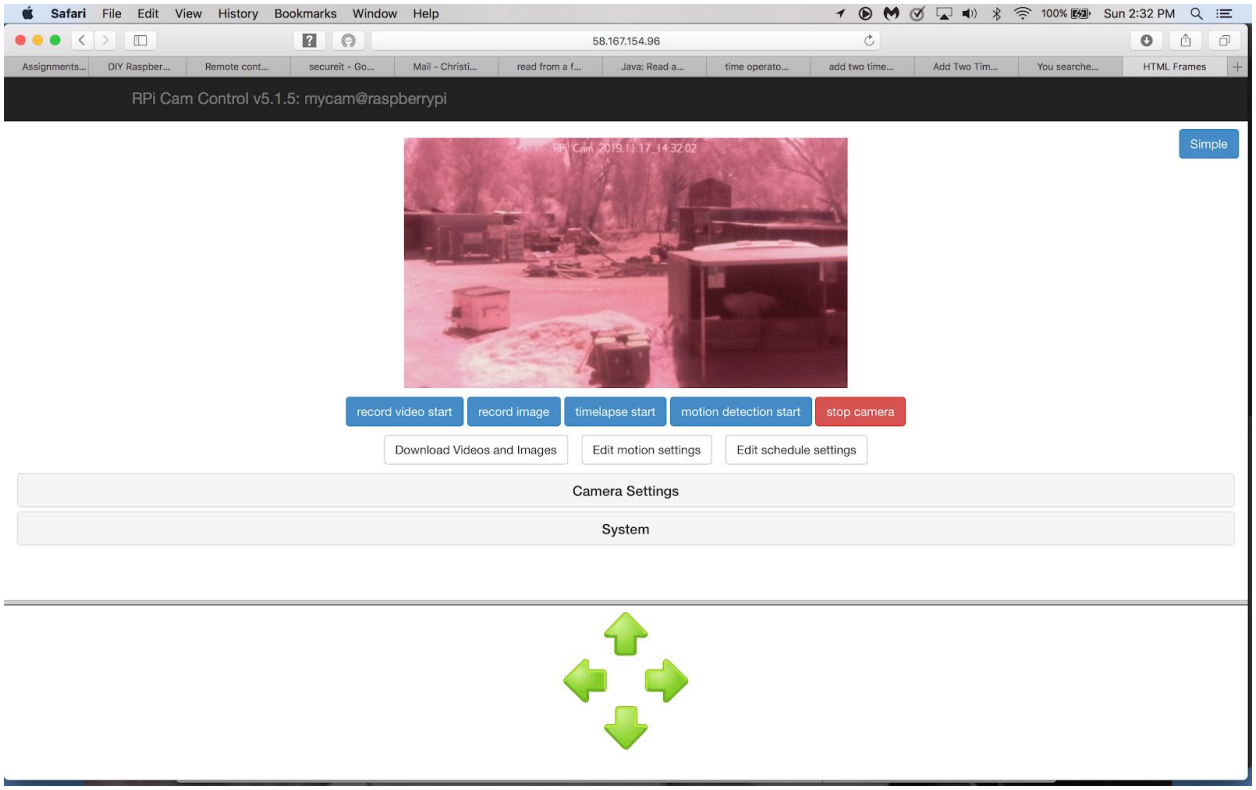
Tools and technology

Remote control car/drone
Camera with video capabilities
Raspberry Pi
VNC viewer
File Transfering software
Discord - used for instant communication
Github - our log of activity on github doesn't reflect how well we worked together. Files and information was shared in other ways and was then uploaded to github.
Google Docs - report collaboration

Testing

Testing was a big factor in keeping everyone in the loop as far as exposure to all the tools and technologies available to us. At each stage of the project testing was required making sure that each stage works before moving onto the next. Access was the most important part of testing as there ended up being 4 different ways we could interact with the RPi. SSH, VNC, FTP and finally html. Primary goal for the initial setup is to have the RPi run headless. A headless computer is a computer system or device that has been configured to operate without a monitor (head), keyboard and mouse. To do that the first toll to use is SSH. SSH, or Secure Shell, is a protocol used to securely log onto remote systems. It is the most common way to access remote Linux and Unix-like servers.

Brodie was then able to check that he could access the camera and be able to move it around to see different areas.
As the above worked we were then able to test the camera and the ability to use it remotely from Chris's computer (physically nearly 500km's away).
The tests were successfully in that the camera was accessible and operational remotely using a WAN.


Safari File Edit View History Bookmarks Window Help
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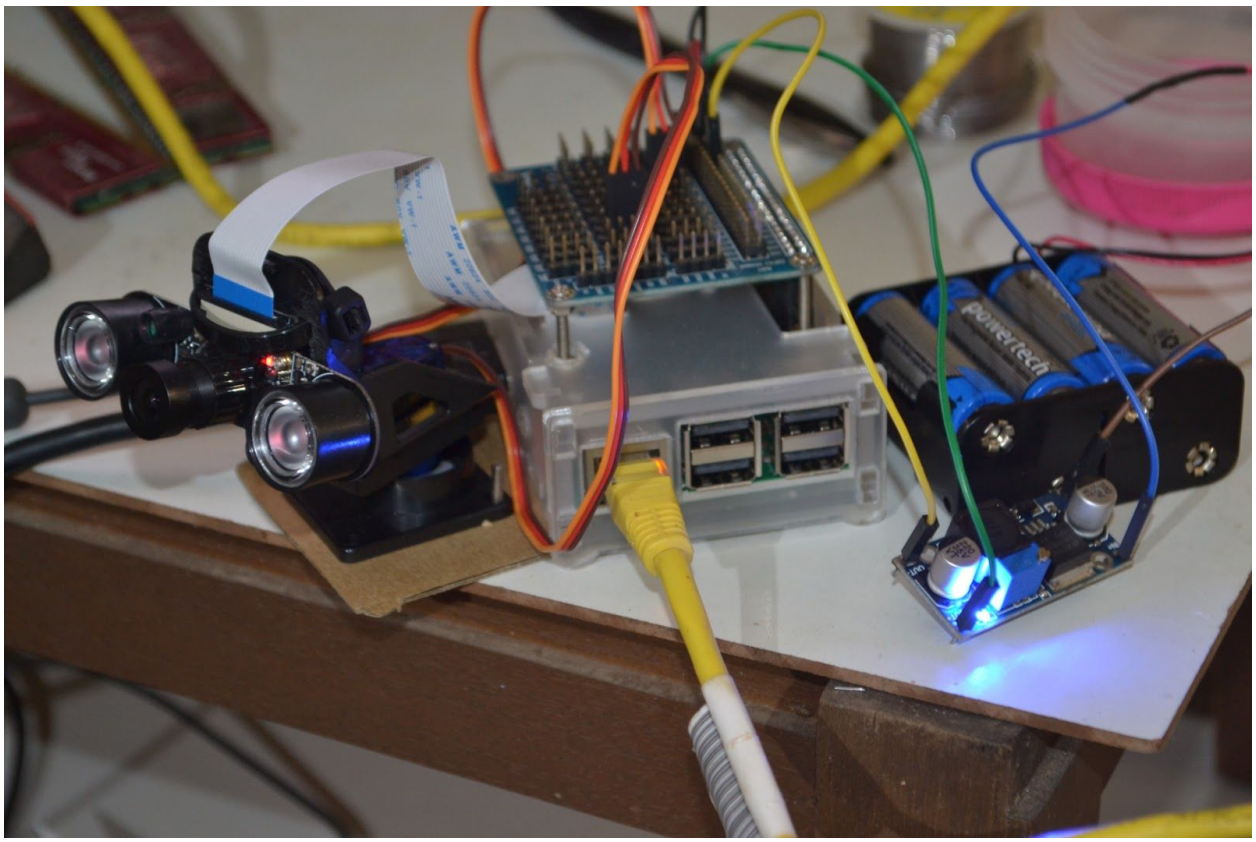
58.167.154.96
RPi Cam Control v5.1.5: mycam@raspberrypi
Simple
record video start
record image
timelapse start
motion detection start
stop camera
Download Videos and Images
Edit motion settings
Edit schedule settings
Camera Settings
System



Future testing will involve connecting the Rpi, camera and battery to the remote control car and then being able to connect remotely to drive the car.
We would then be able to purchase a drone and apply all the technology to that as opposed to the car.

Time Frame

Week No.	Brodie	Chris	Jenny
1	Watching videos on the raspberry pi	Reading about the raspberry pi and getting familiar with its capabilities	Reading about the raspberry pi and getting familiar with its capabilities
2	Bought the raspberry pi and installation of software	Reading about the raspberry pi and getting familiar with its capabilities	Reading about the raspberry pi and getting familiar with its capabilities
3	Setting up the Pi	Watching videos on the raspberry pi	Watching videos on the raspberry pi
4	Camera installation	Installation of software - VNC	
5	Logging into Pi remotely	Logging into Pi remotely	
6	Writing report Photos and videos	Organising Presentation Report Writing	
7	Camera controls	Camera controls	
8	Setting up Pi on a rc car	Learning more about python for programming	
9	Setting up on car	python	
10	Bugs and fixes	Bugs and fixes	
11	testing	testing	
12	testing	testing	

13	Bugs and fixes	Bugs and fixes	
14	Set up on drone	Python for controlling	

Risks

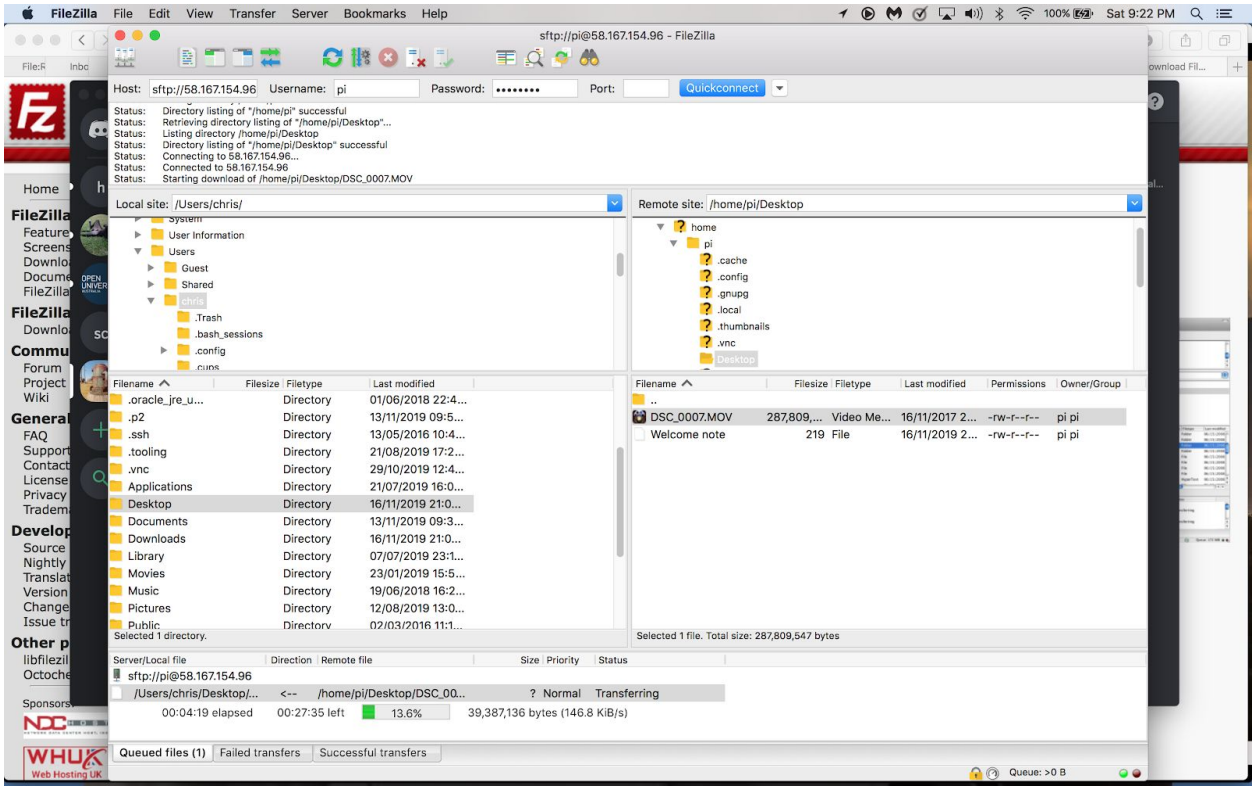
Risks associated with this project are :

There may be no-fly zones areas and depending on where we might want to fly would mean we might require a permit. In Australia we also have laws regarding flying a drone which must be adhered to.
https://uavcoach.com/drone-laws-in-australia/

There is a security risk with the pi having the ports unsecured and open for us to access. It may be possible for others (hackers) to access the ports and therefore gain our information.
https://www.acunetix.com/blog/articles/danger-open-ports-trojan-trojan/
We had to use file sharing as some of the video files were too big to send which could have caused a security risk while using file transfers.

FTP - file transfer process

FTP is an important part of administration duties. Some of the files were too large to upload to github or to send in an email so FileZilla was used. FileZilla was logged into the Rpi and files were transferred between the Rpi and laptop/desktop.



Group processes and communications

Most of our communications revolved around Discord and google docs. As a small group it was easy to delegate tasks through discord and follow up in google docs The remaining two teams members did communicate effectively throughout this assignment. We used discord and spoke almost everyday, not always about our project, which helped to build a rapport (and a friendship) between the two of us.

We used google docs to share our project work and discord for chatting and sharing web addresses for research.

We have also been able to access the Pi together and used file transferring software to share bigger files. It must be noted that between the two of us in the group work on two different platforms, Brodie works on a windows machine and Chris works on an apple mac osx. Thus creating different solutions to the same problem.

Skills and Jobs

Its assumed that our project idea will enter a flooded market that there is a need for a strong marketing team. A team that can sell our product but have the knowledge to back it up. Constant advances in code would need a dedicated team of python writers to keep up with advances in third party modules. The upkeep for github repositories is important, we have been overwhelmed by other projects that offer their wealth of knowledge free for others to clone and a change and improve.

Group reflection

Simple at first our project idea open us all to the basics of information and technology. None of us expected that a simple investment in the for of a Raspberry Pi would have such an impact on the potential learning of so many aspects of the industry. Although we were nowhere near our target we were happily lost in the intricacies of the setup and connectivity of computers in general. It was truly a thrill watching others connect to the RPi and seeing them interact with the various interfaces.

Brodie

I really enjoyed working with Brodie throughout this project. Discord worked really well for us in terms of communication and google docs to collaborate on work together. It was exciting to be able to access the RPi and to have control of the camera remotely.

Improvements could be made by learning more about the technology on my part so I might have been able to help a bit more but as it was Brodie was great at explaining what was happening at his end and what I could do from mine.

I have learnt that groups can work really well with the right mix of people and that even if some team members are not involved, a project can still have a great outcome.

Chris