OPERATIONS MANUAL

Drone Disabling Device

FAMU-FSU College of Engineering
Team 518

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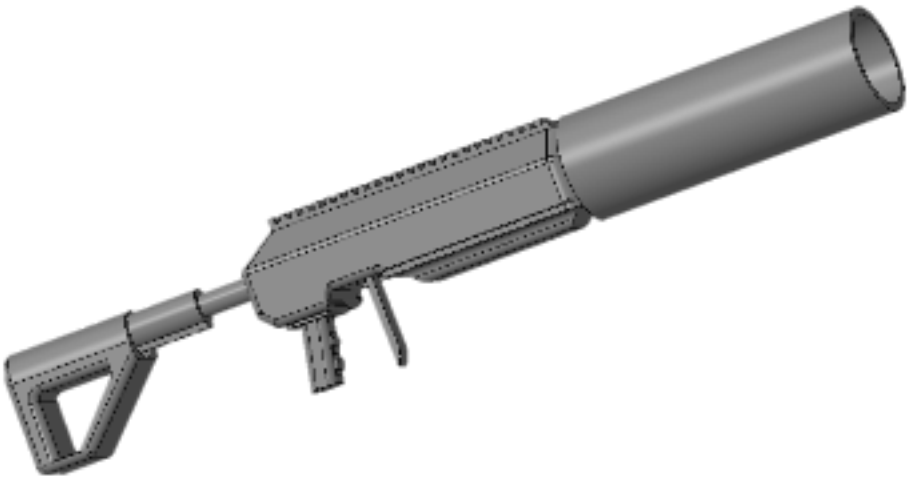

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1.0 GENERAL INFORMATION

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1.1 System Overview

This system is intended to be used to detect and neutralize commercial drones in a secure airspace using mobile cameras and computer mounted to a backpack to detect the drone and a net launcher using compressed air to neutralize the drone. This device was made through the support and sponsorship of Northrop Grumman and is in intended to be used by military and police to secure an airspace.

1.2 Project References

Provided below is a list of references used in preparation of this document.

http://www.hpasystems.com/why-hpa-.html

1.3 Organization of the Manual

This Manual is made up of six separate components that describe the operation of the device.

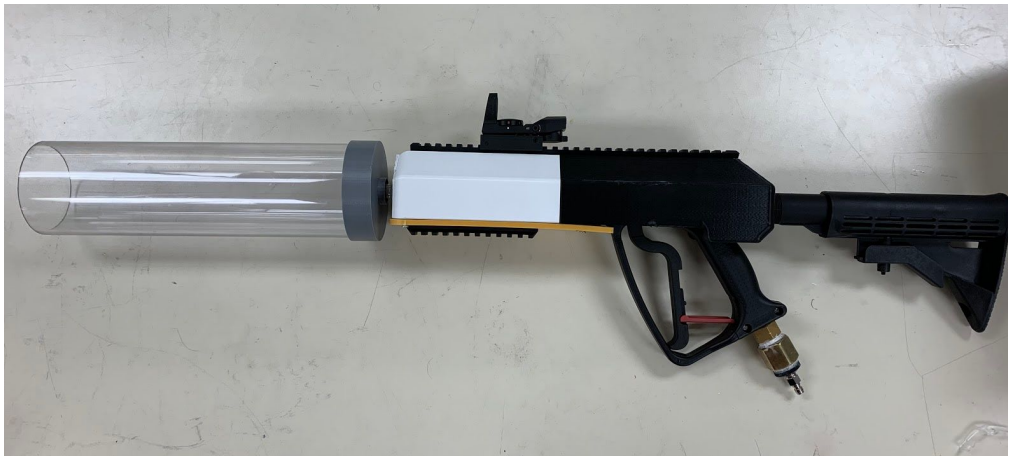
- **1.0 General Information**
  - This section gives a basic overview of the device and its intended uses.
- **2.0 Component Description**
  - This section details the components that make up the system and how.
- **3.0 Integration**
  - This section describes how to assemble the system correctly.
- **4.0 Operation**
  - Details how to safely operate the device safely and neutralize drones.
- **5.0 Troubleshooting**
  - This section gives advice in case of possible failures and how to fix common problems that may arise.

2.0 Component Descriptions

2.0 Component Description

This section provides a description of all components used in the assembly and operations of the device. Details for each component are listed below for the net launcher, backpack, and detection system.

2.1 Net Launcher



The net launcher is the most important component for neutralizing the drone it consists of the PLA frame that holds the components together mounted to this frame are picatinny rails to support various attachments, the trigger system, an ergonomic stock to improve accuracy, and the net holder

2.1.1 PLA Frame

The PLA frame is 3D printed and is used to hold the components together as well as improve the visuals of the device. The picatinny rails mounted to the frame can be used to attach an array of sights grips or even frequency jammers to the device.

2.1.2 Net Holder

The net holder is the plastic tubing extending from the frame and is where the net and cap are loaded before the device is launched. This is attached to the trigger system with a steel tube inside of the frame.

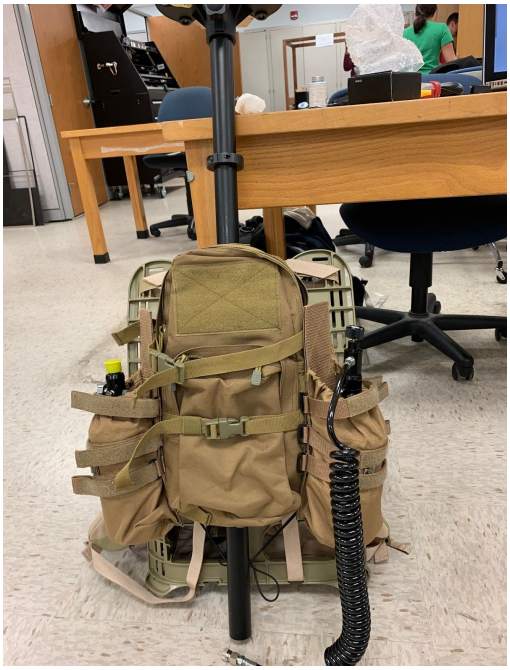
2.1.3 Stock

The stock can be adjusted for the users comfort with six different positions and is important to give the user a stable base to fire from to enhance accuracy and precision.

2.1.4 Trigger System

The trigger system is made of a standard pressure washer handle that is able to handle the 800 psi that comes from the compressed air tanks mounted on the backpack. It has a max rating of 5000 psi.

2.2 Backpack



The backpack is the second major component of our design. The pack is intended to provide the operator with mobility and comfort while using the device. It features two pouches to hold air tanks, a main pack (in the middle) to house electrical components and any external equipment needed, and the mounting used for the cameras. Because of the frame used, weight is properly distributed throughout the pack and provides the user with comfort. To equip the backpack, use the two shoulder straps that are attached to the frame. Loosen the straps first before wearing the pack in order to equip it easier. Once the shoulder straps are resting over the users shoulders, the straps can be tightened to ensure a snug fit. A list of its components can be found below.

-MOLLE II rucksack frame
-MOLLE II rucksack shoulder straps
-Valken air tank pouch x2
-Lightweight tactical daypack
-Camera mount

2.3 Detection System

2.3.1 Raspberry Pi 3 Model B with 7” LCD Touchscreen

The Raspberry Pi is essentially the “brain” of the detection system. It is a small portable computer that runs all operations involving the detection system. The LCD screen connected to it has a built in touch screen so that no mouse is necessary to run the detection software.

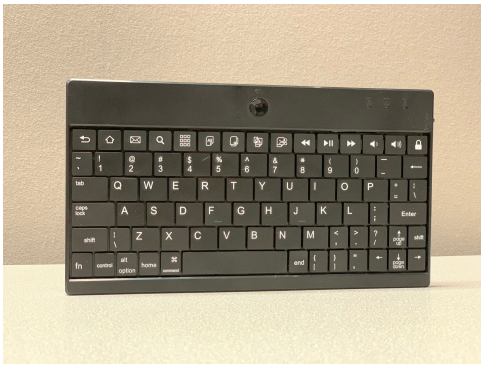
2.3.2 Intel Neural Compute Stick 2

The Neural Compute Stick 2 is a dedicated VPU that is powered via USB. This component allows for high speed machine learning processing on technology that does not have high computing speed for machine learning (such as the Raspberry Pi).

2.3.3 SJCAM SJ4000 (x3)

This is a 1080p portable camera that is used for real-time video streaming for drone detection. There are three cameras total in the system to allow for a 360 degree view.

2.3.4 Bluetooth Keyboard



This is a wireless keyboard that runs on bluetooth so that no extra usb slots need to be used up on the Raspberry Pi.

2.3.5 30 AH Portable Battery

This battery bank allows for over 11 hours of portable battery life for the detection system. It allows the Raspberry Pi to be fully functional without plugging in to wall power. It takes about 12 hours to fully charge.

2.3.6 Micro USB - USB Cable (x3)

These micro usb cables are used to connect the cameras to the Raspberry Pi.

2.3.7 USB 3 Extension Cable

This extension cable allows the neural compute stick to connect to the Raspberry Pi without interfering with the other USB connections.

2.3.8 Audio Output Device (any speaker device with a headphone jack/auxiliary cable)

A speaker or pair of headphones are necessary to output alerts when a drone is detected.

3.0 Integration

3.0 INTEGRATION OF DEVICE COMPONENTS

This section describes the steps to properly assemble the rifle with the components provided. Pictures help give a better idea of the worded explanation and show how each component should be placed. Assembly is only required for the rifle and detection system.

3.1 Assembling Rifle

The assembly of the Drone rifle is straightforward and fairly easy. Detailed steps are shown below for the entire assembly process. No power tools or equipment are needed other than a phillips head screwdriver, a 3/32” Allen key, and an adjustable wrench.

Components needed for this step are the three 3D printed parts, 12” rail system, 5” rail system, buffer tube, stock, dot sight, net tube, trigger assembly, and the 6” galvanized steel pipe.

Step 1. Buffer tube attachment.

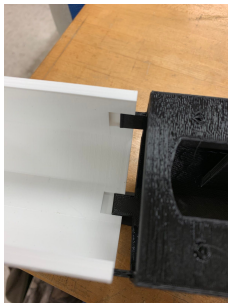
For the buffer tube, the image on the right shows the tube itself, the bolt used to attach to the body, and the bracket that is placed inside the tube. Place the silver steel side of the buffer tube on the back of the body where there is a perforation for attachment. Next, slide the bolt and bracket together down into the tube and begin screwing the bolt into the printed part. Use the #10-32 nylon nut to secure the bolt in place.

Once the tube is attached to the print, the stock is ready to be connected. To connect the stock simply push down on the back of the tab located under the stock frame, and slide the stock down the buffer tube.

Step 2. Connecting the prints

To connect the front and back prints, start by screwing in the 12” rail to the front print using the 0.125” screws provided.

Once the top rail is attached, slide the two prints together by matching the tabs located at the ends of each print.



Once the prints are secured together by the tabs, screw in the top rail to the back print to secure the two prints.

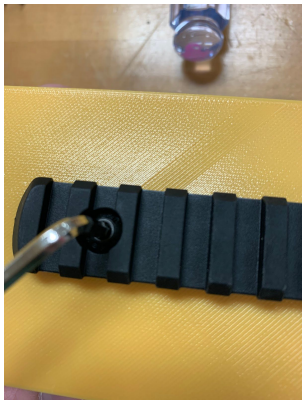
Step 3. Trigger assembly

The trigger assembly slides into the bottom of the back print. Push the trigger assembly into the print and slide it as far back as possible to ensure a snug fit.

Once snug, the trigger assembly can be secured to the prints by attaching the lower plate that is assembled in the next step.

Step 4. Lower plate/Securing trigger

The third and final print is placed along the bottom of both body prints. The 5” rail is screwed into the plate using the two allen key screws provided.



To secure the rail to the print, two tabs are screwed onto the back of the plate ensuring the screws won’t slide off the print. The image to the right gives an inside look when the tabs are connected to the plate.

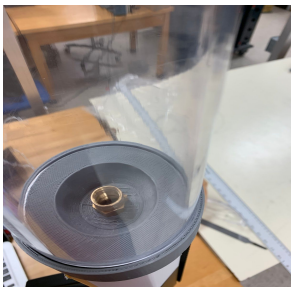
The lower plate is then connected to both prints using the 0.125” screws provided. There are four screw locations, two on each print.

Step 5. Connecting the barrels

The galvanized steel pipe slides into the front of the print and connects to the trigger assembly. Secure the pipe by twisting it in tightly.

Then connect the barrel extension adapter using the same process. Simply place the adapter onto the pipe and tighten fully. Since high pressurized air is flowing through these components, make sure they are secured before continuing.

Lastly, attach the tubing that the net is placed inside by pushing it down into the adapter.



Step 6. Sight attachment

The dot sight connects to the top rail by the use of two screws located at the bottom of the sight. Begin by loosening the screws so that the connections are able to be expanded.

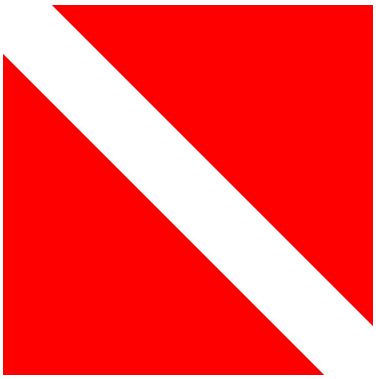
With the screws loosened, place the sight onto the rail and rock back and forth until the screws slide and is caught by the rail. Tighten the two screws using the 3/32” allen key.

3.2 Connecting Air system

Once the rifle is assembled, it is ready to connect to the air system. The rifle is connected to the air tanks by the means of a remote coil. This remote coil also features a quick disconnect. It is recommended to connect the two systems purely through the means of the quick disconnect to maintain the sealant placed on the trigger assembly. The air system should be sitting on the backpack and must be filled to properly operate the device. Pull back the sliding piece on the remote line that is connected to the tank and simply push it into the trigger assembly. Release the sliding connection and the air system is now ready to be unloaded into the trigger assembly. At this point the device is ready to fire.

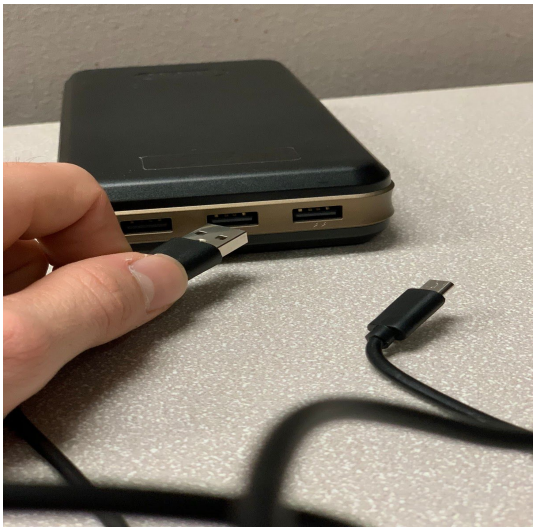
3.3 Refilling Air system

The air system will need to be refilled with an air compressor at either a scuba or paintball shop before it can be used again. It can also be filled from a 3000 psi scuba tank. It can NOT be filled with a standard air compressor because most of these max at around 150-180 psi which is not enough to fill these tanks and requires external adapters..

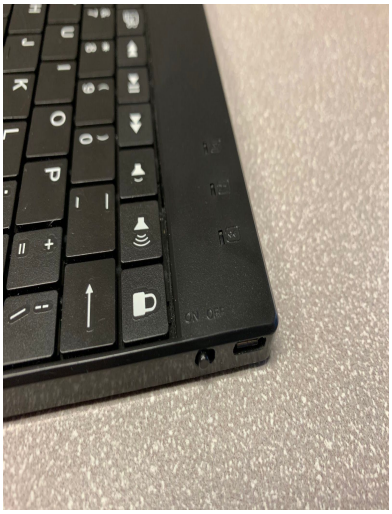


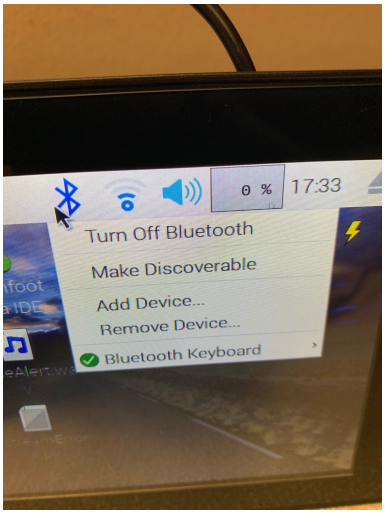
3.4 Drone Detection Device

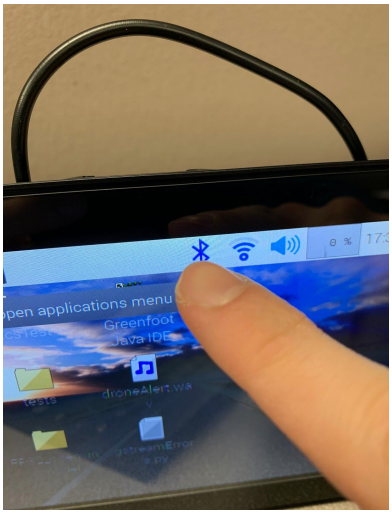
Step 1. Connect Raspberry Pi to portable battery bank. There are two separate micro usb slots that can be connected to the battery. Either one can be connected to it.



Step 2. Turn on bluetooth keyboard and ensure that it is connected to the Raspberry Pi by clicking on the bluetooth icon. The keyboard is connected if there is a green check mark next to the keyboard.





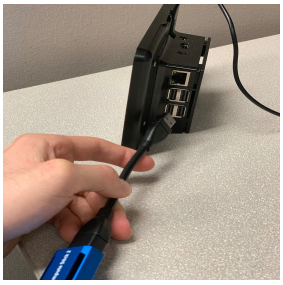


Step 3. Connect USB extension cable to the Neural Compute Stick 2



Step 4. Connect micro USB cables to cameras. When the camera turns on, ensure that the "PC Camera" option is clicked before using the detection system!


Step 5. Connect USB cables from cameras and the Neural Compute Stick 2 to the Raspberry Pi. Also connect the speaker's auxiliary cord to the headphone jack of the Raspberry Pi to output sound.




4.0 Operation

4.0 Operating System Components

This section provides the reader with a description of how to properly operate the device. A full device assembly is required in order to operate the device properly and it is recommended to double check the assembly steps laid out in the Integration section of the operation manual.

4.1 Net Launching System

Step 1. Once the launcher is fully assembled, it takes only a few steps to have the device fully operating. The first step being connecting the rifle to the air tanks. To operate in the phase, the air tanks must be filled to 3000 psi at a local sports shop. Connect the two systems by following the steps explained in the integration chapter.

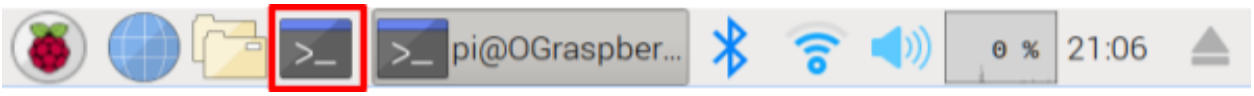
Step 2. With air connected the rifle now has power. Make sure that the trigger system is in safe mode by having the red latch behind the trigger down. This prevents accidental fires and improves device safety. Since the rifle is ready to fire it is important to begin the net loading process. To load the net into the rifle, begin by placing the cap into the tube first. It may require an external tool to push the cap down all the way into the tubing. The net will fold in following the cap.

Step 3. The rifle is now loaded and has power. To improve shot accuracy, turn the dot sight on that is located at the top rail. This will assist the user in properly aiming the device. To turn the dot sight on, twist the cap located at the top of the dot sight. The labels designating power are located on the sides of the cap. There is a red and green setting, red for day and green for night, that have three different brightness settings. The higher the number, the brighter the dot. There is a reticle choice as well located at the back of the dot sight and the reticle is determined by the users preference.

Step 4. Fire the rifle! Make sure to aim the device properly at the jammed drone that has been detected. Follow proper safety procedures and make sure to maintain proper judgement in use of this device.

4.2 Drone Detection System

Step 1. After fully assembling the detection system as seen in the assembly section of this operation manual, the Raspberry Pi should already be on after initially plugging it in. Ensure that all components of the system are properly plugged in and then open the Raspberry Pi's terminal.



Step 2. In the terminal, type the command: "~/Desktop/dronedetection.py". The drone detection script will automatically start running and the device is now fully operating!

```
pi@OGraspberrypi:~ $ ~/Desktop/dronedetection.py
```

5.0 Troubleshooting

5.0 TROUBLESHOOTING

This section provides a description on solving any issues that happen while operating the device. The three main components of the device are the net launcher, backpack, and detection system. Each component can have its own issues or errors and will need to be addressed separately.

5.1 Net Launcher

If any issues arise with the net launcher make sure to shut the air off as quickly as possible and remove the quick disconnect on the remote line. Problems that could arise are leaks, sealant rupture on the remote line adapter, cracking of the rifle body due to wear and tear, and possibility of a pipe blockage near the barrel. The best method to properly fix any issues with the device is to slowly disassemble the few components needed to better analyze the issue. This can be done by removing the lower plate and having a proper view of the internal piping. Since the trigger slides out easily with the lower plate removed it may be a good idea to do so. Once the device is deemed safe to use, it is a quick reassembly and the device can be operating normally again.

5.2 Backpack

Any issues that are found with the backpack can be fixed by removing the backpack from the operator and adjusting straps, if it is a comfort issue. Any technical issues with the equipment to the back of the pack can be fixed by unweaving the MOLLE straps that connect the part to the frame. It is recommended to do this as a last resort as weaving the MOLLE can be difficult and time consuming.

5.2 Detection System

If any issues are found with the detection system, it is likely that one of the USB-connected components are loose and need to be reconnected. If the issue persists, restart the computer and cameras. As a last resort, make sure that the battery has significant charge because at lower state of charges, the output voltage may drop in the battery and cause issues.