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April 21, 2017

ECE465-001

Socket-based Remote Controller for Drones

Hardware and Software Settings

<u>Development PC</u>

CPU	Intel i5-3570K
RAM	16 GB
OS	Windows 8.1 Professional
Software	VMWare Workstation Pro 12.0.0
Programming Language	C

<u>Server/Client Virtual Machines</u>

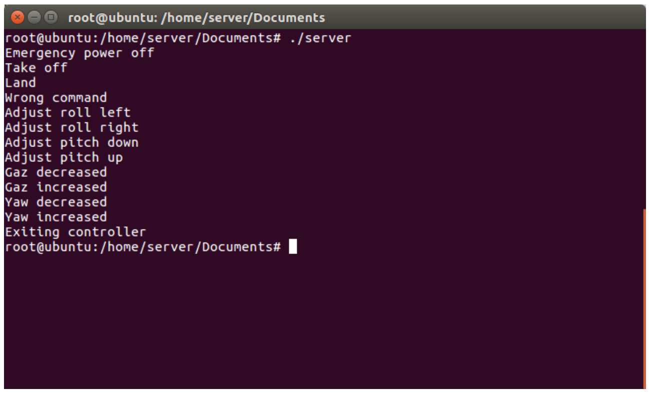
CPU	1 Processor/2 Cores
RAM	4 GB
OS	Ubuntu 16.04.02 LTS
Required Packages	`git, build-essential, autoconf, libtool, libavahi-client-dev, mplayer, libavcodec-dev, libavformat-dev, libswscale-dev, libncurses5-dev, unzip`

Transport Protocol Between Client and Server

UDP was used as the transport protocol between the server and client. This protocol was chosen since using a controller does not require 100% packet transmission. When using a controller, inputs are sent often enough that a lost packet would not make much of a difference. The smaller amount of overhead also makes UDP faster. An example of where UDP may be a better choice than TCP is in the event of an emergency power off. If a TCP connection does not receive the emergency power off command, there is a wait between until it can be sent again and no commands would be able to be sent. With UDP if this packet is lost, it can be immediately be sent again until it is received by the drone.

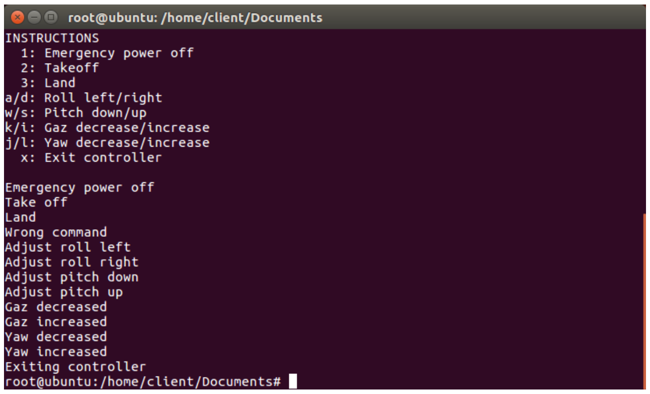
Console Screenshots

Server console



```
root@ubuntu: /home/server/Documents
root@ubuntu:/home/server/Documents# ./server
Emergency power off
Take off
Land
Wrong command
Adjust roll left
Adjust roll right
Adjust pitch down
Adjust pitch up
Gaz decreased
Gaz increased
Yaw decreased
Yaw increased
Exiting controller
root@ubuntu:/home/server/Documents#
```

Client console

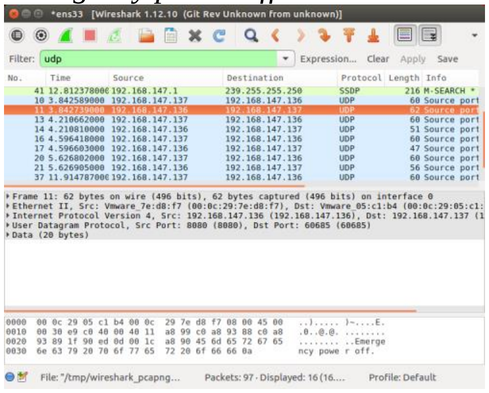


```
root@ubuntu: /home/client/Documents
INSTRUCTIONS
  1: Emergency power off
  2: Takeoff
  3: Land
a/d: Roll left/right
w/s: Pitch down/up
k/i: Gaz decrease/increase
j/l: Yaw decrease/increase
  x: Exit controller

Emergency power off
Take off
Land
Wrong command
Adjust roll left
Adjust roll right
Adjust pitch down
Adjust pitch up
Gaz decreased
Gaz increased
Yaw decreased
Yaw increased
Exiting controller
root@ubuntu:/home/client/Documents#
```

Wireshark Screenshots

Emergency power off

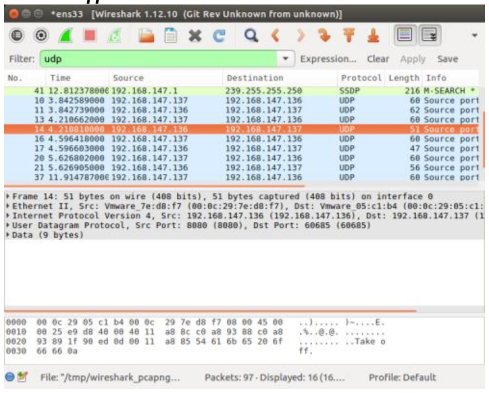


```
*ens33  [Wireshark 1.12.10  (Git Rev Unknown from unknown)]
Filter: udp                                    Expression...  Clear  Apply  Save
No.   Time          Source            Destination       Protocol Length Info
   41 12.81237800€ 192.168.147.1     239.255.255.250   SSDP        216 M-SEARCH *
   10 3.842589000  192.168.147.137   192.168.147.136   UDP          60 Source port
   11 3.842739000  192.168.147.136   192.168.147.137   UDP          62 Source port
   13 4.210662000  192.168.147.137   192.168.147.136   UDP          60 Source port
   14 4.210810000  192.168.147.136   192.168.147.137   UDP          51 Source port
   16 4.596418000  192.168.147.137   192.168.147.136   UDP          60 Source port
   17 4.596603000  192.168.147.136   192.168.147.137   UDP          47 Source port
   20 5.626802000  192.168.147.137   192.168.147.136   UDP          60 Source port
   21 5.626905000  192.168.147.136   192.168.147.137   UDP          56 Source port
   37 11.91478700€ 192.168.147.137   192.168.147.136   UDP          60 Source port
▸ Frame 11: 62 bytes on wire (496 bits), 62 bytes captured (496 bits) on interface 0
▸ Ethernet II, Src: Vmware_7e:d8:f7 (00:0c:29:7e:d8:f7), Dst: Vmware_05:c1:b4 (00:0c:29:05:c1:
▸ Internet Protocol Version 4, Src: 192.168.147.136 (192.168.147.136), Dst: 192.168.147.137 (1
▸ User Datagram Protocol, Src Port: 8080 (8080), Dst Port: 60685 (60685)
▸ Data (20 bytes)

0000  00 0c 29 05 c1 b4 00 0c  29 7e d8 f7 08 00 45 00   ..)..... )~....E.
0010  00 30 e9 c0 40 00 40 11  a8 99 c0 a8 93 88 c0 a8   .0..@.@. ........
0020  93 89 1f 90 ed 0d 00 1c  a8 90 45 6d 65 72 67 65   ........ ..Emerge
0030  6e 63 79 20 70 6f 77 65  72 20 6f 66 66 0a         ncy powe r off.

File: "/tmp/wireshark_pcapng...    Packets: 97 · Displayed: 16 (16....    Profile: Default
```

Takeoff



```
*ens33  [Wireshark 1.12.10  (Git Rev Unknown from unknown)]
Filter: udp                                    Expression...  Clear  Apply  Save
No.   Time          Source            Destination       Protocol Length Info
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   11 3.842739000  192.168.147.136   192.168.147.137   UDP          62 Source port
   13 4.210662000  192.168.147.137   192.168.147.136   UDP          60 Source port
   14 4.210810000  192.168.147.136   192.168.147.137   UDP          51 Source port
   16 4.596418000  192.168.147.137   192.168.147.136   UDP          60 Source port
   17 4.596603000  192.168.147.136   192.168.147.137   UDP          47 Source port
   20 5.626802000  192.168.147.137   192.168.147.136   UDP          60 Source port
   21 5.626905000  192.168.147.136   192.168.147.137   UDP          56 Source port
   37 11.91478700€ 192.168.147.137   192.168.147.136   UDP          60 Source port
▸ Frame 14: 51 bytes on wire (408 bits), 51 bytes captured (408 bits) on interface 0
▸ Ethernet II, Src: Vmware_7e:d8:f7 (00:0c:29:7e:d8:f7), Dst: Vmware_05:c1:b4 (00:0c:29:05:c1:
▸ Internet Protocol Version 4, Src: 192.168.147.136 (192.168.147.136), Dst: 192.168.147.137 (1
▸ User Datagram Protocol, Src Port: 8080 (8080), Dst Port: 60685 (60685)
▸ Data (9 bytes)

0000  00 0c 29 05 c1 b4 00 0c  29 7e d8 f7 08 00 45 00   ..)..... )~....E.
0010  00 25 e9 d8 40 00 40 11  a8 8c c0 a8 93 88 c0 a8   .%..@.@. ........
0020  93 89 1f 90 ed 0d 00 11  a8 85 54 61 6b 65 20 6f   ........ ..Take o
0030  66 66 0a                                           ff.

File: "/tmp/wireshark_pcapng...    Packets: 97 · Displayed: 16 (16....    Profile: Default
```
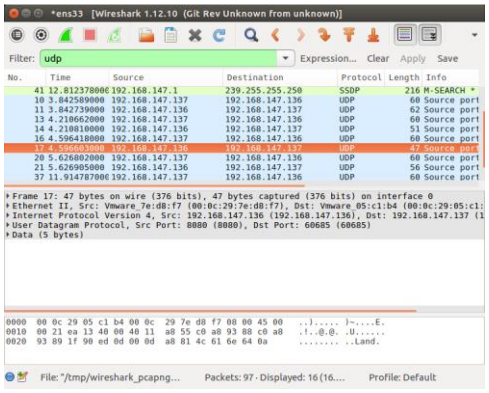

Land



```
*ens33  [Wireshark 1.12.10  (Git Rev Unknown from unknown)]
Filter: udp                                    Expression...  Clear  Apply  Save
No.   Time          Source            Destination       Protocol Length Info
   41 12.81237800€ 192.168.147.1     239.255.255.250   SSDP        216 M-SEARCH *
   10 3.842589000  192.168.147.137   192.168.147.136   UDP          60 Source port
   11 3.842739000  192.168.147.136   192.168.147.137   UDP          62 Source port
   13 4.210662000  192.168.147.137   192.168.147.136   UDP          60 Source port
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   20 5.626802000  192.168.147.137   192.168.147.136   UDP          60 Source port
   21 5.626905000  192.168.147.136   192.168.147.137   UDP          56 Source port
   37 11.91478700€ 192.168.147.137   192.168.147.136   UDP          60 Source port
▸ Frame 17: 47 bytes on wire (376 bits), 47 bytes captured (376 bits) on interface 0
▸ Ethernet II, Src: Vmware_7e:d8:f7 (00:0c:29:7e:d8:f7), Dst: Vmware_05:c1:b4 (00:0c:29:05:c1:
▸ Internet Protocol Version 4, Src: 192.168.147.136 (192.168.147.136), Dst: 192.168.147.137 (1
▸ User Datagram Protocol, Src Port: 8080 (8080), Dst Port: 60685 (60685)
▸ Data (5 bytes)

0000  00 0c 29 05 c1 b4 00 0c  29 7e d8 f7 08 00 45 00   ..)..... )~....E.
0010  00 21 ea 13 40 00 40 11  a8 55 c0 a8 93 88 c0 a8   .!..@.@. .U......
0020  93 89 1f 90 ed 0d 00 0d  a8 81 4c 61 6e 64 0a      ........ ..Land.

File: "/tmp/wireshark_pcapng...    Packets: 97 · Displayed: 16 (16....    Profile: Default
```

Transport Protocol Between Server and Drone

UDP was also used as the transport protocol between the server and drone for the same reasons it was used between the client and server.

Code Installation Instructions

- Install dependencies listed above in “Required Packages” on server machine
- Move server folder to server machine, client folder to client machine
- Navigate to server folder and run: `unzip out.zip -d /path/to/server/folder` then `make`
- Navigate to client folder and run: `make`
- Start server by running: `./server`
- Start client by running: `./client`

**Tested on Ubuntu 16.04.02*