Wireless Networking Fundamentals Project-3:

Real Time video broadcast supporting multiple clients using Socket Programming , OpenCV and PyShine.

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Theory:

This project demonstrates a real time broadcasting system that allows connection to multiple clients from the server.

Algorithm:

Receiver side:

- Setting up of the TCP socket and binding it with the socket address
- Accept all the incoming connection requests and run the show_client as soon as the connection request is accepted. Threading library is used to run multiple tasks simultaneously.
- The show_client function receives the video as a byte stream and converts it back by decoding it.
- Pyshine function helps in creating the window for the video and OpenCV in displaying the frames or the images as a video.

Transmitter side:

- The transmitter uses the function VideoCapture() of the OpenCV library to capture the video from the inbuilt webcam of the laptop. We can also transmit a locally stored video.
- The socket is set up and bound with the address.
- The connection request is sent to the receiver.
- When the client leaves, an appropriate message saying the Client ,along with its IP address, has disconnected, while the other users are still transmitting the data.

Code:

Server:

```
import socket, cv2, pickle, struct
import imutils
import threading
import pyshine as ps
import cv2

server_socket = socket.socket(socket.AF_INET,socket.SOCK_STREAM)
host_name  = socket.gethostname()
host_ip = "192.168.1.86"
print('HOST IP:',host_ip)
port = 9999
socket_address = (host_ip,port)
server_socket.bind(socket_address)
server_socket.listen()
print("Listening at",socket_address)
```

```
def show_client(addr,client_socket):
    try:
        print('CLIENT {} CONNECTED!'.format(addr))
        if client_socket:
            data = b""
            payload_size = struct.calcsize("Q")
            while True:
                while len(data) < payload_size:
                    packet = client_socket.recv(4*1024)
                    if not packet: break
                    data+=packet
                packed_msg_size = data[:payload_size]
                data = data[payload_size:]
                msg_size = struct.unpack("Q",packed_msg_size)[0]

                while len(data) < msg_size:
                    data += client_socket.recv(4*1024)
                frame_data = data[:msg_size]
                data  = data[msg_size:]
                frame = pickle.loads(frame_data)
                text  =  f"CLIENT: {addr}"
                frame =  ps.putBText(frame,text,10,10,vspace=10,hspace=1,font_scale=0.7,
background_RGB=(255,0,0),text_RGB=(255,250,250))
                cv2.imshow(f"FROM {addr}",frame)
                key = cv2.waitKey(1) & 0xFF
                if key  == ord('q'):
                    break
            client_socket.close()
    except Exception as e:
        print(f"CLIENT {addr} DISCONNECTED")
        pass

while True:
    client_socket,addr = server_socket.accept()
    thread = threading.Thread(target=show_client, args=(addr,client_socket))
    thread.start()
    print("TOTAL CLIENTS ",threading.activeCount() - 1)
```

Client:

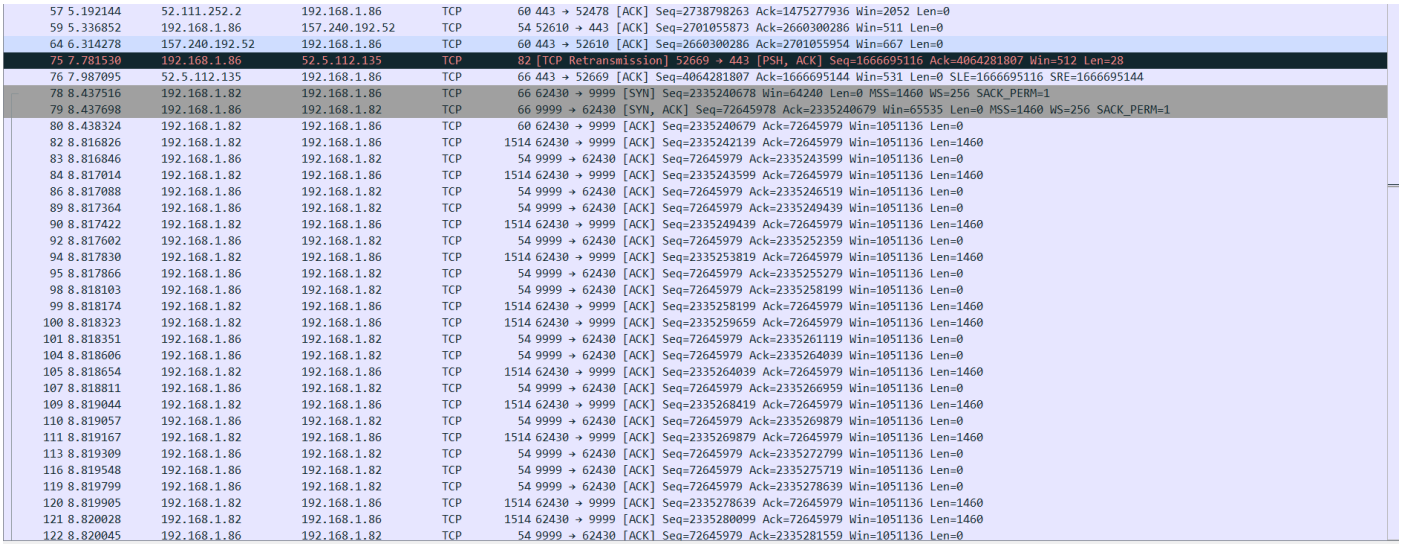
```
import socket,cv2, pickle,struct
import pyshine as ps
import imutils
camera = True
if camera == True:
    vid = cv2.VideoCapture(0)
#else:
#    vid = cv2.VideoCapture('videos/mario.mp4')
client_socket = socket.socket(socket.AF_INET,socket.SOCK_STREAM)
host_ip = '192.168.1.11'

port = 9999
client_socket.connect((host_ip,port))
```

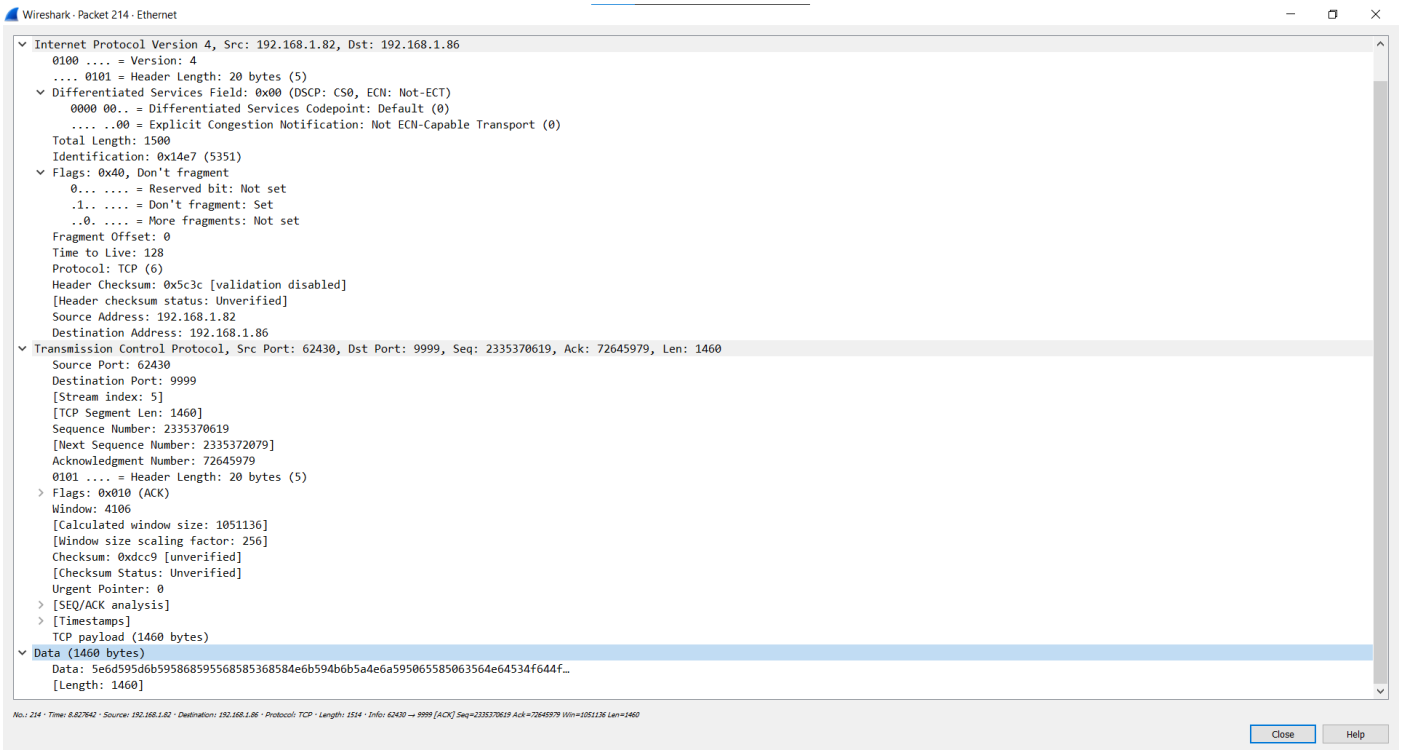
```python
if client_socket:
    while (vid.isOpened()):
        try:
            img, frame = vid.read()
            frame = imutils.resize(frame,width=380)
            a = pickle.dumps(frame)
            message = struct.pack("Q",len(a))+a
            client_socket.sendall(message)
            cv2.imshow(f"TO: {host_ip}",frame)
            key = cv2.waitKey(1) & 0xFF
            if key == ord("q"):
                client_socket.close()
        except:
            print('VIDEO FINISHED!')
            break
```

Results:

1) Wireshark Captures:

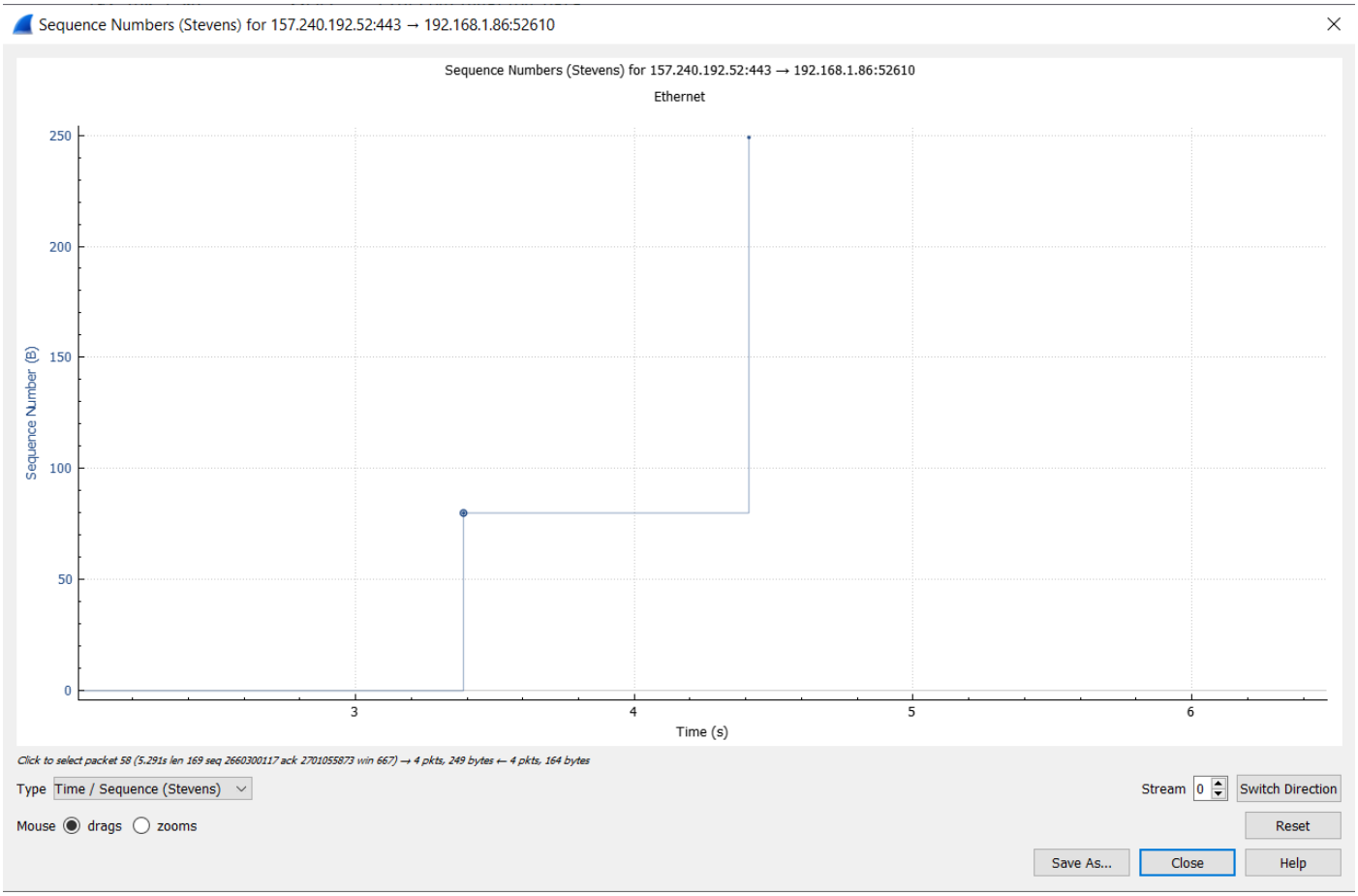


57	5.192144	52.111.252.2	192.168.1.86	TCP	60 443 → 52478 [ACK] Seq=2738798263 Ack=1475277936 Win=2052 Len=0
59	5.336852	192.168.1.86	157.240.192.52	TCP	54 52610 → 443 [ACK] Seq=2701055873 Ack=2660300286 Win=511 Len=0
64	6.314278	157.240.192.52	192.168.1.86	TCP	60 443 → 52610 [ACK] Seq=2660300286 Ack=2701055954 Win=667 Len=0
75	7.781530	192.168.1.86	52.5.112.135	TCP	82 [TCP Retransmission] 52669 → 443 [PSH, ACK] Seq=1666695116 Ack=4064281807 Win=512 Len=28
76	7.987095	52.5.112.135	192.168.1.86	TCP	66 443 → 52669 [ACK] Seq=4064281807 Ack=1666695144 Win=531 Len=0 SLE=1666695116 SRE=1666695144
78	8.437516	192.168.1.82	192.168.1.86	TCP	66 62430 → 9999 [SYN] Seq=2335240678 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
79	8.437698	192.168.1.86	192.168.1.82	TCP	66 9999 → 62430 [SYN, ACK] Seq=72645978 Ack=2335240679 Win=65535 Len=0 MSS=1460 WS=256 SACK_PERM=1
80	8.438324	192.168.1.82	192.168.1.86	TCP	60 62430 → 9999 [ACK] Seq=2335240679 Ack=72645979 Win=1051136 Len=0
82	8.816826	192.168.1.82	192.168.1.86	TCP	1514 62430 → 9999 [ACK] Seq=2335242139 Ack=72645979 Win=1051136 Len=1460
83	8.816846	192.168.1.86	192.168.1.82	TCP	54 9999 → 62430 [ACK] Seq=72645979 Ack=2335243599 Win=1051136 Len=0
84	8.817014	192.168.1.82	192.168.1.86	TCP	1514 62430 → 9999 [ACK] Seq=2335243599 Ack=72645979 Win=1051136 Len=1460
86	8.817088	192.168.1.86	192.168.1.82	TCP	54 9999 → 62430 [ACK] Seq=72645979 Ack=2335246519 Win=1051136 Len=0
89	8.817364	192.168.1.86	192.168.1.82	TCP	54 9999 → 62430 [ACK] Seq=72645979 Ack=2335249439 Win=1051136 Len=0
90	8.817422	192.168.1.82	192.168.1.86	TCP	1514 62430 → 9999 [ACK] Seq=2335249439 Ack=72645979 Win=1051136 Len=1460
92	8.817602	192.168.1.86	192.168.1.82	TCP	54 9999 → 62430 [ACK] Seq=72645979 Ack=2335252359 Win=1051136 Len=0
94	8.817830	192.168.1.82	192.168.1.86	TCP	1514 62430 → 9999 [ACK] Seq=2335253819 Ack=72645979 Win=1051136 Len=1460
95	8.817866	192.168.1.86	192.168.1.82	TCP	54 9999 → 62430 [ACK] Seq=72645979 Ack=2335255279 Win=1051136 Len=0
98	8.818103	192.168.1.86	192.168.1.82	TCP	54 9999 → 62430 [ACK] Seq=72645979 Ack=2335258199 Win=1051136 Len=0
99	8.818174	192.168.1.82	192.168.1.86	TCP	1514 62430 → 9999 [ACK] Seq=2335258199 Ack=72645979 Win=1051136 Len=1460
100	8.818323	192.168.1.82	192.168.1.86	TCP	1514 62430 → 9999 [ACK] Seq=2335259659 Ack=72645979 Win=1051136 Len=1460
101	8.818351	192.168.1.86	192.168.1.82	TCP	54 9999 → 62430 [ACK] Seq=72645979 Ack=2335261119 Win=1051136 Len=0
104	8.818606	192.168.1.86	192.168.1.82	TCP	54 9999 → 62430 [ACK] Seq=72645979 Ack=2335264039 Win=1051136 Len=0
105	8.818654	192.168.1.82	192.168.1.86	TCP	1514 62430 → 9999 [ACK] Seq=2335264039 Ack=72645979 Win=1051136 Len=1460
107	8.818811	192.168.1.86	192.168.1.82	TCP	54 9999 → 62430 [ACK] Seq=72645979 Ack=2335266959 Win=1051136 Len=0
109	8.819044	192.168.1.82	192.168.1.86	TCP	1514 62430 → 9999 [ACK] Seq=2335268419 Ack=72645979 Win=1051136 Len=1460
110	8.819057	192.168.1.86	192.168.1.82	TCP	54 9999 → 62430 [ACK] Seq=72645979 Ack=2335269879 Win=1051136 Len=0
111	8.819167	192.168.1.82	192.168.1.86	TCP	1514 62430 → 9999 [ACK] Seq=2335269879 Ack=72645979 Win=1051136 Len=1460
113	8.819309	192.168.1.86	192.168.1.82	TCP	54 9999 → 62430 [ACK] Seq=72645979 Ack=2335272799 Win=1051136 Len=0
116	8.819548	192.168.1.86	192.168.1.82	TCP	54 9999 → 62430 [ACK] Seq=72645979 Ack=2335275719 Win=1051136 Len=0
119	8.819799	192.168.1.86	192.168.1.82	TCP	54 9999 → 62430 [ACK] Seq=72645979 Ack=2335278639 Win=1051136 Len=0
120	8.819905	192.168.1.82	192.168.1.86	TCP	1514 62430 → 9999 [ACK] Seq=2335278639 Ack=72645979 Win=1051136 Len=1460
121	8.820028	192.168.1.82	192.168.1.86	TCP	1514 62430 → 9999 [ACK] Seq=2335280099 Ack=72645979 Win=1051136 Len=1460
122	8.820045	192.168.1.86	192.168.1.82	TCP	54 9999 → 62430 [ACK] Seq=72645979 Ack=2335281559 Win=1051136 Len=0



2) Steven's Graphs:

Steven's graph shows the increase in sequence numbers with time. This helps us know when the delays occurred or when the transfer of packets hung.



3) Throughput: