Indian Journal of Science and Technology, Vol 10(38), DOI: 10.17485/ijst/2017/v10i38/116967, October 2017
ISSN (Print) : 0974-6846
ISSN (Online) : 0974-5645

Live Video Streaming from Remote Location Using Raspberry Pi

S. Neha Vimala[1]*, M. Veda Chary[2] and K. Ravi Kiran[2]

[1]Embedded Systems, CMR College of Engineering & Technology (CMRCET), Hyderabad - 501401, Telangana, India; nehasrirangam@gmail.com
[2]Department of ECE, CMR College of Engineering & Technology, Hyderabad-501401, Telangana, India; mvedachary@cmrcet.org, kravikiran@cmrcet.org

Abstract

Objectives: Through this paper, design of a reliable real-time (Live) video streaming and surveillance system is proposed, which can be broadcasted over a Local-Area Network (LAN/ WLAN) with remote access. **Methods/Statistical Analysis:** Proposed system design features Raspberry Pi along with night-vision camera, programmed using Python programming language. Raspberry Pi's IP address is fetched and VNC server is setup to create virtual desktop on host device for remote-user. Host device is a Personal Computer/Smartphone connected to same LAN/ WLAN on which Raspberry Pi is connected. VLC media player serves as source for live streaming on host device running a VNC viewer.
Findings: Previously, live video surveillance meant massive machinery, restricted to larger spaces and usually involved Closed-circuit television cameras. The technological advancements, ease of access and usability in Latter-day gadgets brought forth easier connectivity, bridging the gap between virtual and the real worlds. This makes dealing with indispensable concepts like security and surveillance much convenient, even for a remote user. Keeping in mind all these concepts, an effective; simple yet powerful design for a live video streaming and surveillance system has been proposed. For effective implementation of the design, Raspberry Pi 3 Model B along with a Raspberry Pi NoIR camera V2 module has been used and VLC media player acts as the streaming medium for the live video broadcast, initiated by the code written in Python. VNC server and viewer are used for remote connections over the Local-Area Network. And since a night-vision camera is being utilized, it allows the user to keep an eye on the area even in dark and low light conditions with ease.
Application/Improvements: The system proposed offers numerous amounts of applications due to its versatility. Through this design, a hassle-free live video streaming/surveillance may be effortlessly availed even by an average user.

Keywords: Live Streaming, Python, Raspberry Pi, Video Surveillance, Virtual Network Computing, VLC Media Player

1. Introduction

Having an effective video surveillance system is not only beneficial but also adds a sense of surety and comfort to the user[1]. There may be no better reassurance than having a visual proof. Video monitoring and surveillance have now become much affordable to an average user, with widespread technologies providing great usability[2]. Modern day technology offers devices which are easy to install and convenient to handle. Hence, managing and monitoring the behaviour in spaces like homes, supermarkets, factories, hospitals, hotels, banks, and schools etc. has become much easier for the user, also providing far-flung accessibility. Earlier, video surveillance came with bulky set up which was only confined to larger spaces, and conventional set up involved CCTV cameras. Efficient use of the technology and resources can reduce all this hassle. The main aim of the proposed design is to offer easy surveillance of an area, to a distant user via live video streaming on the VLC media player over LAN/ WLAN[3]. Raspberry Pialong with a night-vision camera module is used in design implementation[4,5]. The code for programming the Raspberry Pi and initiating the live

*Author for correspondence

video, broadcast to the VLC media player is written using Python programming language. Further, Virtual Network Computing is employed to establish remote connections between Raspberry Pi set up and the host device, for remote accessibility over a Local-Area Network[6].

2. System Design and Architecture

Block diagram of the proposed system is shown in Figure 1. Raspberry Pi is interfaced with the camera module and then VNC server is enabled on it as well as host machine. Authenticated remote user will now be able to access the Raspberry Pi's desktop from a host device i.e. a PC or a Smartphone running a VNC viewer; connected over LAN/WLAN.Once the code (Python script) for the live video stream is initiated, VLC media player starts broadcasting the HD video over the Local-Area Network.

2.1 Overview of Raspberry Pi

The proposed system is implemented using a Raspberry Pi 3 Model B shown in Figure 2. Raspberry Pi is a cost-effective, credit-card sized computer that connects to a computer monitor or a TV, and uses a standard mouse and keyboard. Raspberry Pi 3 is the third generation Raspberry Pi which replaced Raspberry Pi 2 Model B in Feb'2016. It is one of the most versatile pieces of technology. Features offered are[7]:

- Broadcom BCM2837 64-bit ARMv8 Quad Core Processor,
- 1.2GHz speed,
- BCM43143 Wi-Fi with IEEE 802.11b/g/n support,
- Bluetooth,
- 1GB RAM, and
- 40pin extended GPIO.

Raspberry Pi is the primary module; initially plugged to a monitor, connected to the LAN/WLAN for the first boot and then its IP address is configured, which is later on used for establishing remote connections via VNC i.e. Virtual Network Computing. Once the VNC server is setup, Raspberry Pi along with the camera module can now be accessed on a host device with VNC viewer. Raspberry Pi 3 runs on the Raspbian OS and is programmed using Python.

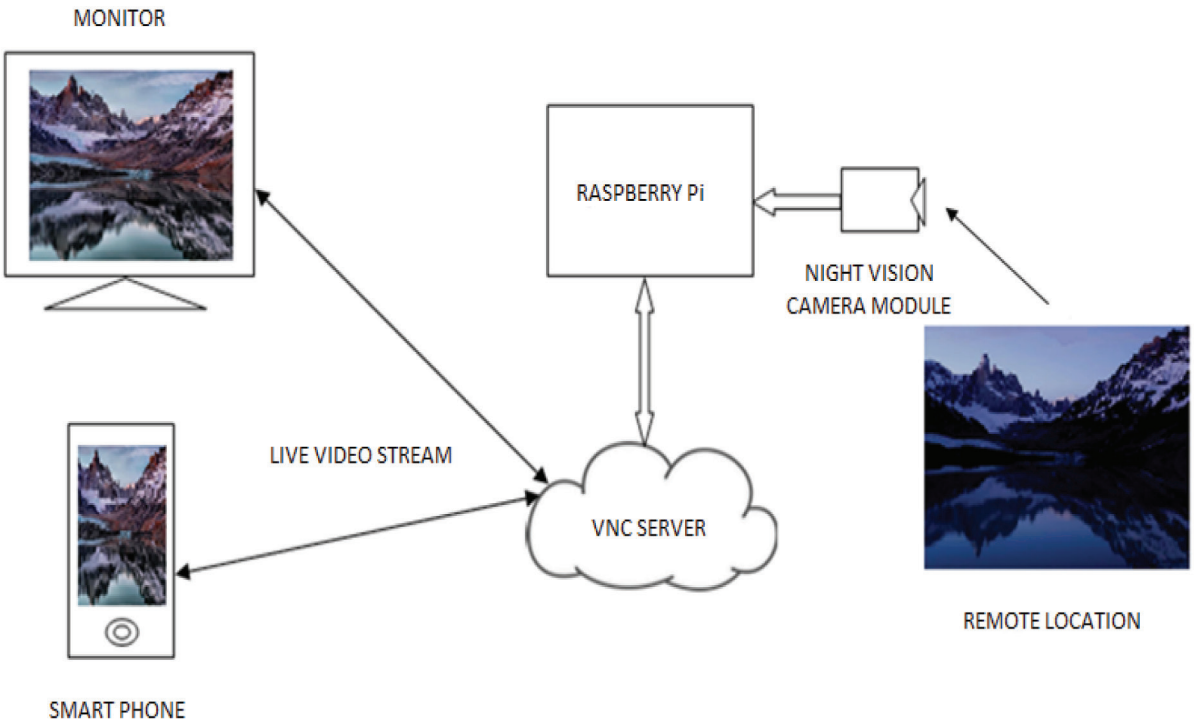

Figure 1. Block diagram.

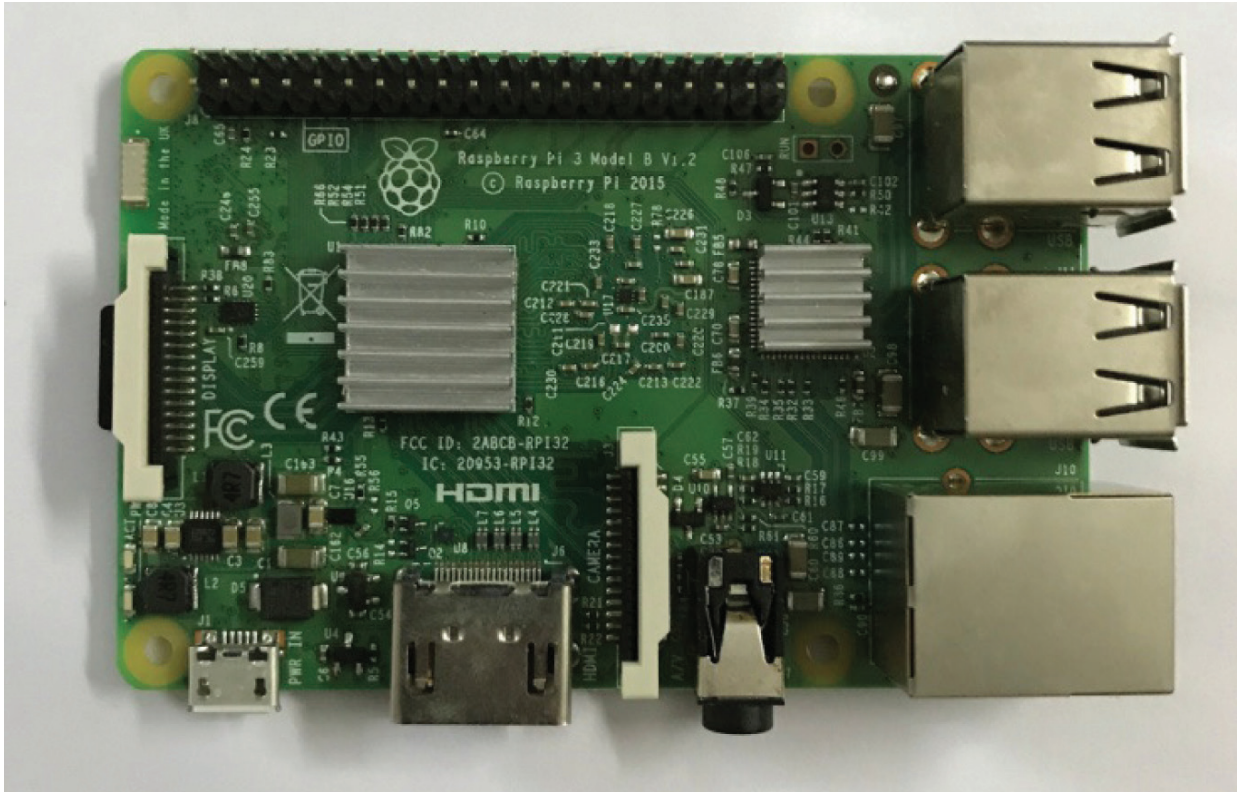

Figure 2. Raspberry Pi 3 model B.

2.2 Interfacing the Camera Module with Raspberry Pi

Raspberry Pi NoIR camera V2 module (Figure 3) is used has been employed for video broadcasting. Pi NoIR camera V2 module is night vision camera module custom designed add-on for Raspberry Pi[8]. It is connected to the Raspberry Pi's camera port through a CSI bus which is the Camera Serial Interface; its designated use is to interface the cameras. Key features include:

- Night vision. (does not employ an infrared filter),
- Fixed-focus lens for high-quality imaging,
- 8-megapixel native resolution sensor capable of 3280 x 2464 pixel static images, and
- Supports 1080p30, 720p60 and 640x480p90 video.

The Pi camera is connected to the Raspberry Pi 3 board and powered up. It is then enabled on Raspberry Pi GUI. Once this is done, the Pi camera delivers high-quality imaging when commanded. And being a night vision camera, it is also perfect for low light photography.

3. Remote Installation

The remote installation enables the user to operate the Raspberry Pi's desktop interface indirectly from a different device. For the proposed system, remote connections between the Raspberry Pi and the host machine are established using RealVNC server shown in the Figure 4. VNC is Virtual Network Computing, a graphical desktop sharing system; it uses RFB i.e. Remote Frame Buffer for remote computing[9]. Once setup, to establish the remote connections, the user needs to sign up for the service by providing an email address with a password for Raspberry Pi's authentication on the host device. Once the setup is complete, the VNC viewer (Figure 5) is downloaded on the host and logged into the service with the password previously provided. Registered Raspberry Pi's desktop can now be accessed on a window on the host device; VNC server creates a virtual desktop which only exists in Raspberry Pi's memory.

Figure 3. Raspberry Pi NoIR camera V2 module.

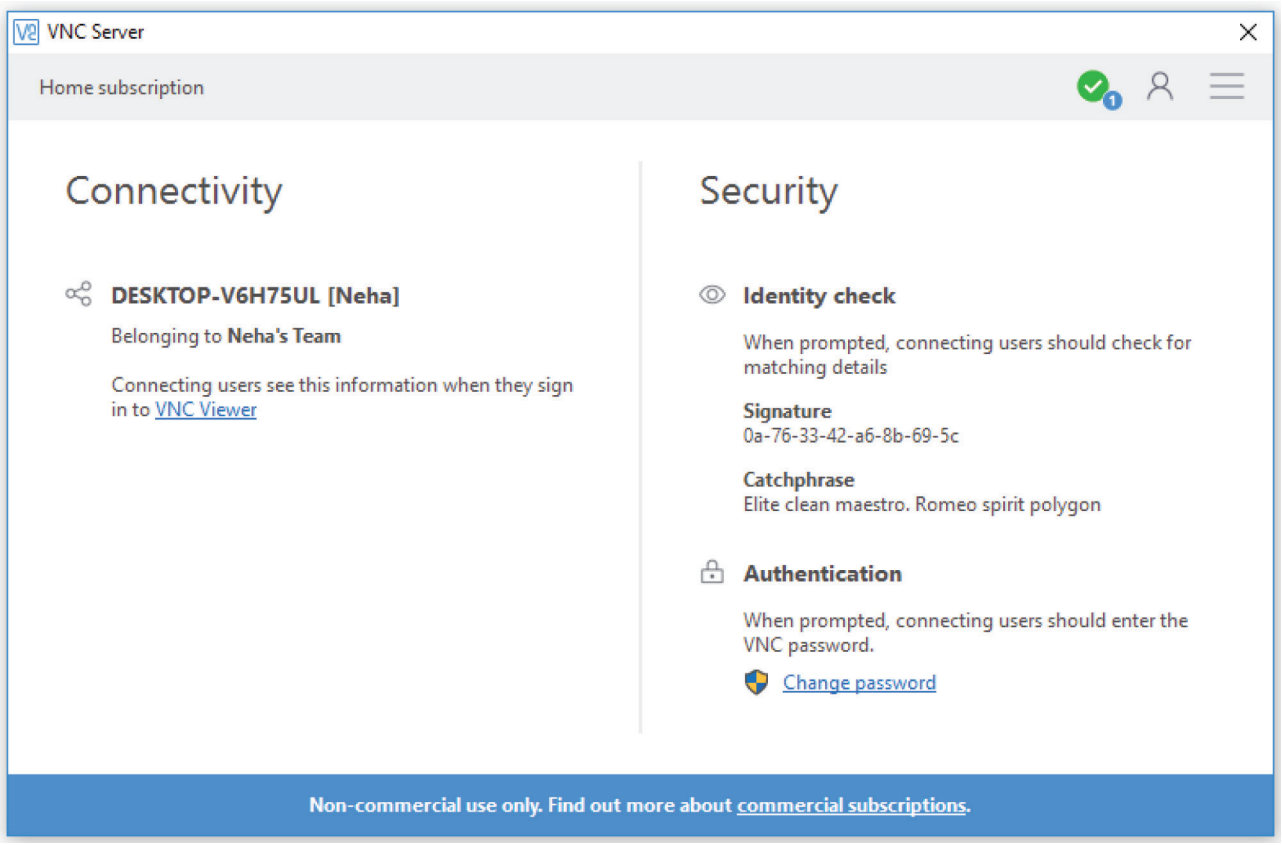

Figure 4. VNC server.

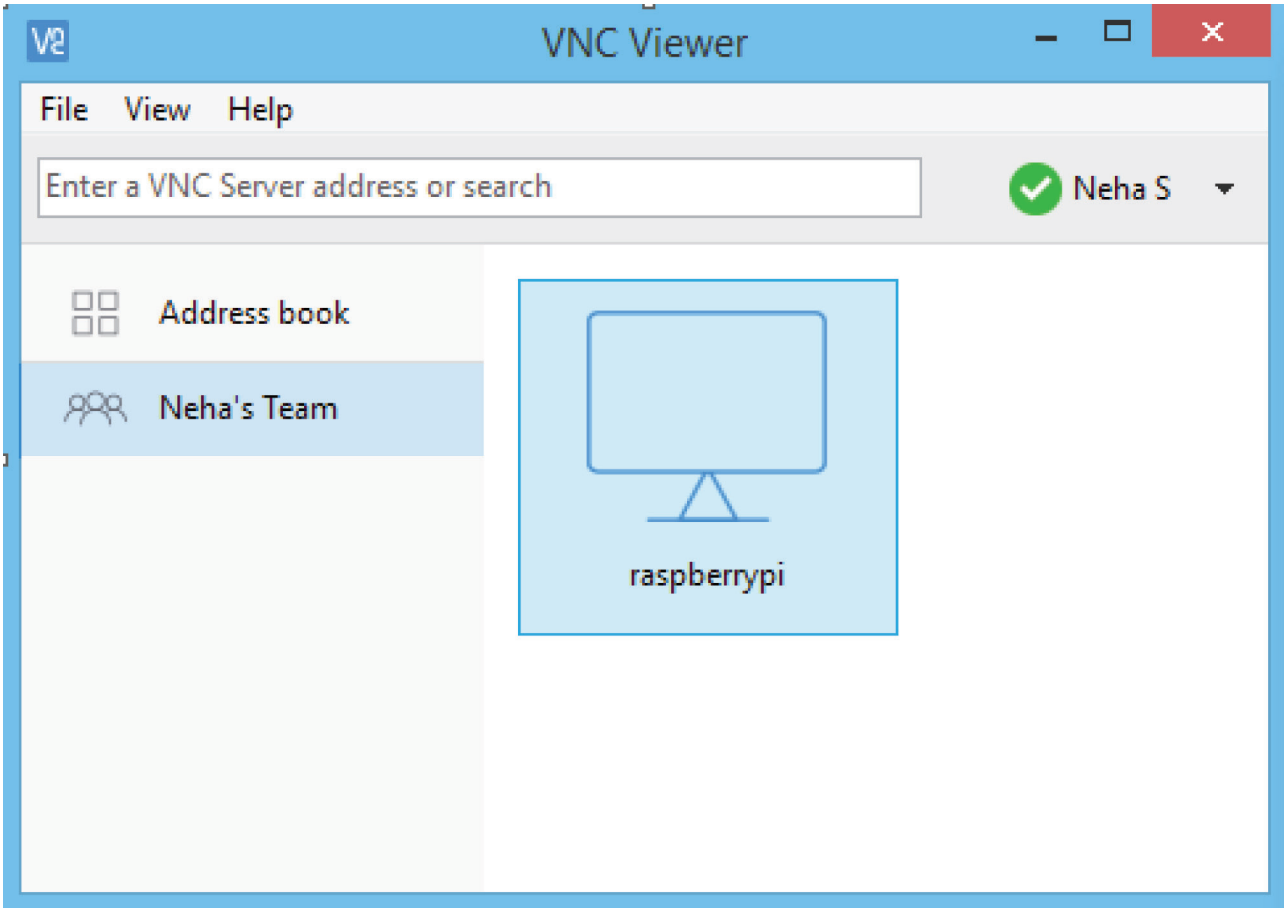

Figure 5. **VNC viewer.**

3.1 VLC Media Player (for Live Video Broadcast)

Live video streaming is to transmit or receive real-time video and audio coverage of an event over the internet. The proposed system uses VLC media player; it serves as the source or medium for live streaming from the Raspberry Pi set up at the remote location which can be accessed from a host device through Virtual Network Computing over LAN/WLAN. A code is written in Python for broadcasting live video stream on to VLC media player on the host machine. For this, VLC media player is downloaded on both Raspberry Pi, as well as the host[10]. Raspberry Pi's IP address is fed into VLC's network stream bar to initiate the stream (Figure 6).

4. Hardware Implementation

The proposed design uses Raspberry Pi 3 board and Raspberry Pi NoIR camera V2 module as primary components in system execution. Raspberry Pi uses Raspbian operating system and is programmed in Python, which is a powerful yet easy-to-use programming language that allows connecting the system to the real world. Execution process begins with initially booting up the Raspberry Pi. A 16GB micro SD card is given a proper format using SD Formatter and setup with latest Raspbian OS. To do so, the Raspbian OS is downloaded from Raspberry Pi's official website in Zip file format. The downloaded files are then extracted to the micro SD card, after which it is inserted into the SD card slot on the Raspberry Pi. The Raspberry Pi is now plugged into a monitor via HDMI adaptor cable; input connections like keyboard and mouse are properly established and powered up using a 2.5A micro

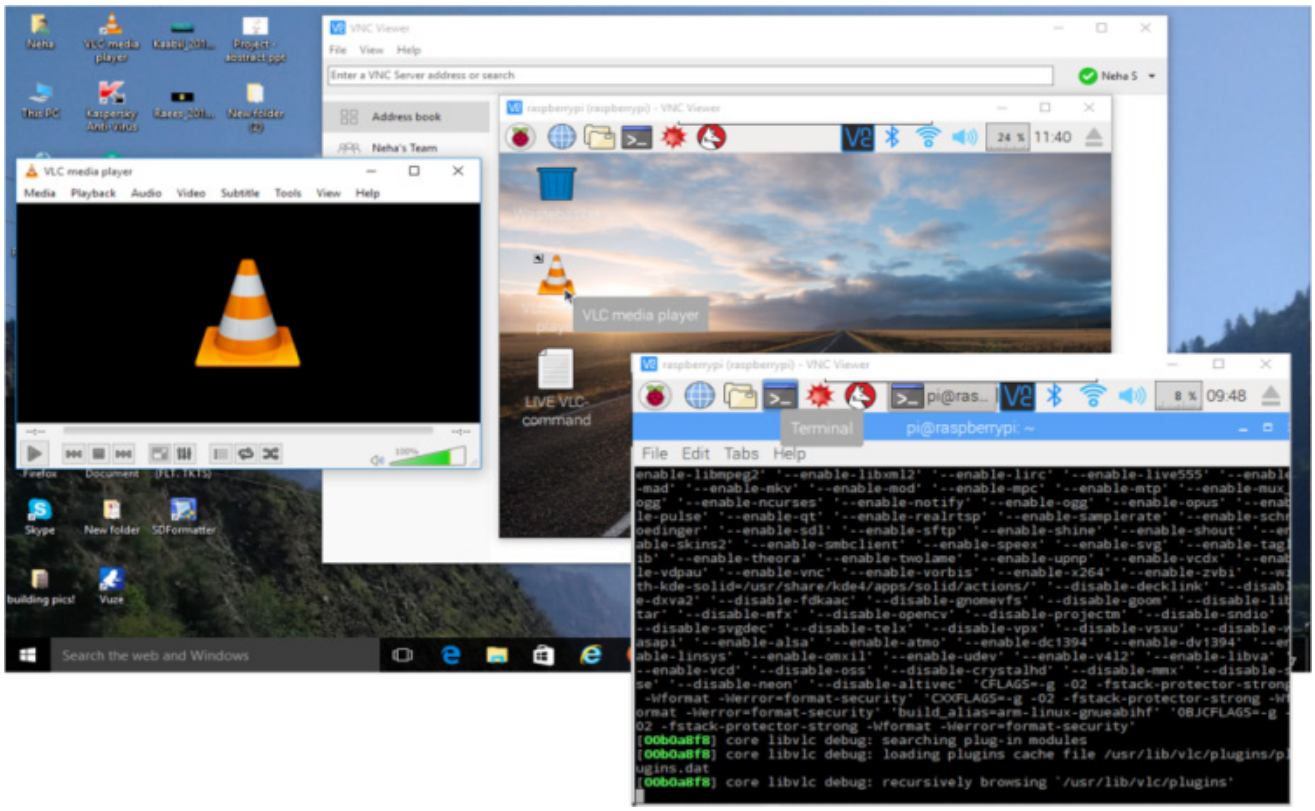

Figure 6. Initiating the live stream on VLC.

USB power supply or an equivalent battery pack. Once the Raspbian operating system is installed, the initial boot completes as shown in Figure 7. The Raspberry Pi is then connected to the internet over LAN/WLAN and Pi's IP address is fetched; camera interface, as well as VNC server, is enabled. In order to establish the remote connections over VNC server, the user needs to sign up for the service by providing working email address and a secure password for authentication. Now that the VNC server is setup as shown in Figure 8. VNC viewer is downloaded on the host device for accessing the Raspberry Pi's desktop remotely. The VNC server creates a virtual desktop onto the VNC viewer which only exists in Raspberry Pi's memory. Now, VLC media player which is the streaming medium for the live video broadcasted over Local-Area Network is downloaded on both Raspberry Pi as well as the host device. The host device can be any PC or Smartphone connected to same LAN/WLAN on which Raspberry Pi is connected. The Raspberry Pi can now be connected remotely without being plugged into a monitor. In order to access the Raspberry Pi's desktop on a host device, the user needs to login to the VNC viewer by providing the previously set password. The device authenticated is listed by the name 'Raspberry Pi' by default; clicking on it and providing the password establishes the connection between Raspberry Pi and the host device. Once the connection is established, the Raspberry Pi's GUI appears on a window on the host machine, as shown in Figure 9. For the camera to start the live stream and broadcast it over the Local-Area Network on a VLC media player, the equivalent code needs to be run on the Pi terminal, to command VLC to start accessing camera for the same. The code for design execution is implemented in Python programming language. Functional flow chart is represented in Figure 10.

Figure 7. Connections and Setup for Initial Boot.

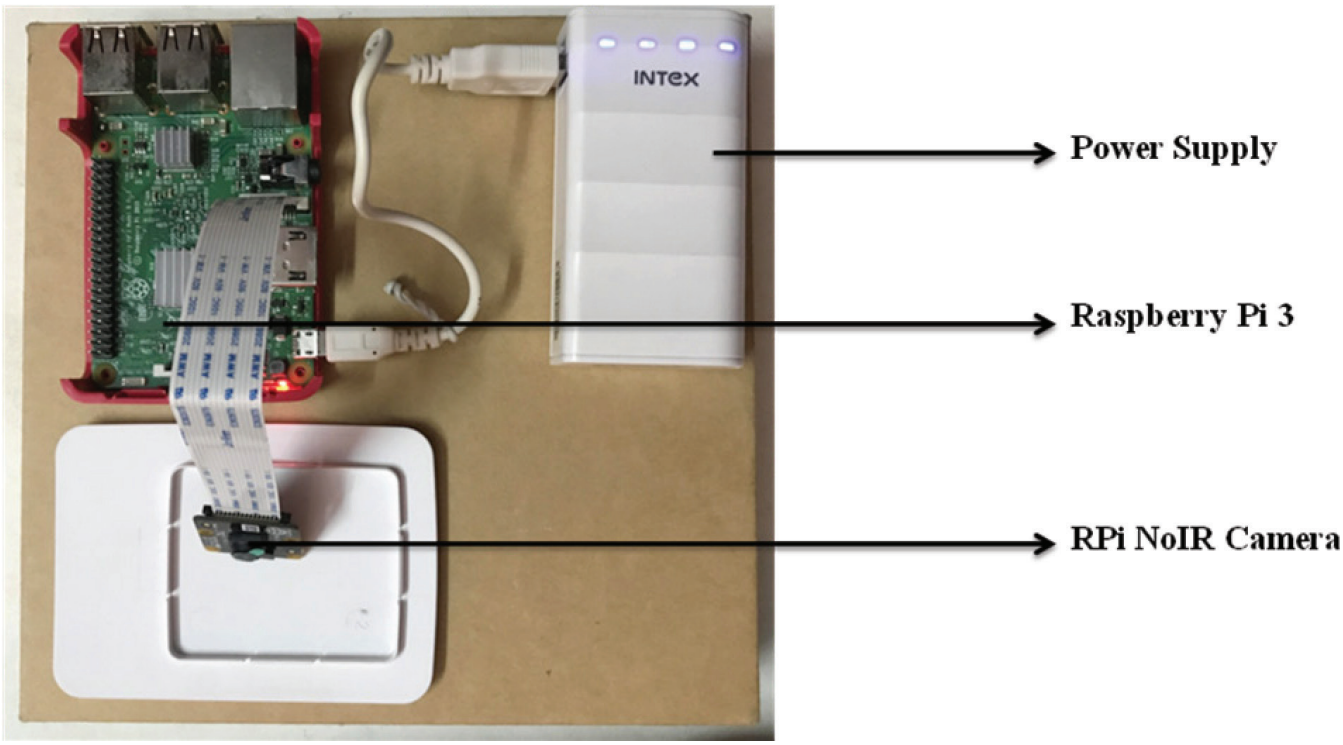

Figure 8. Remote Setup.

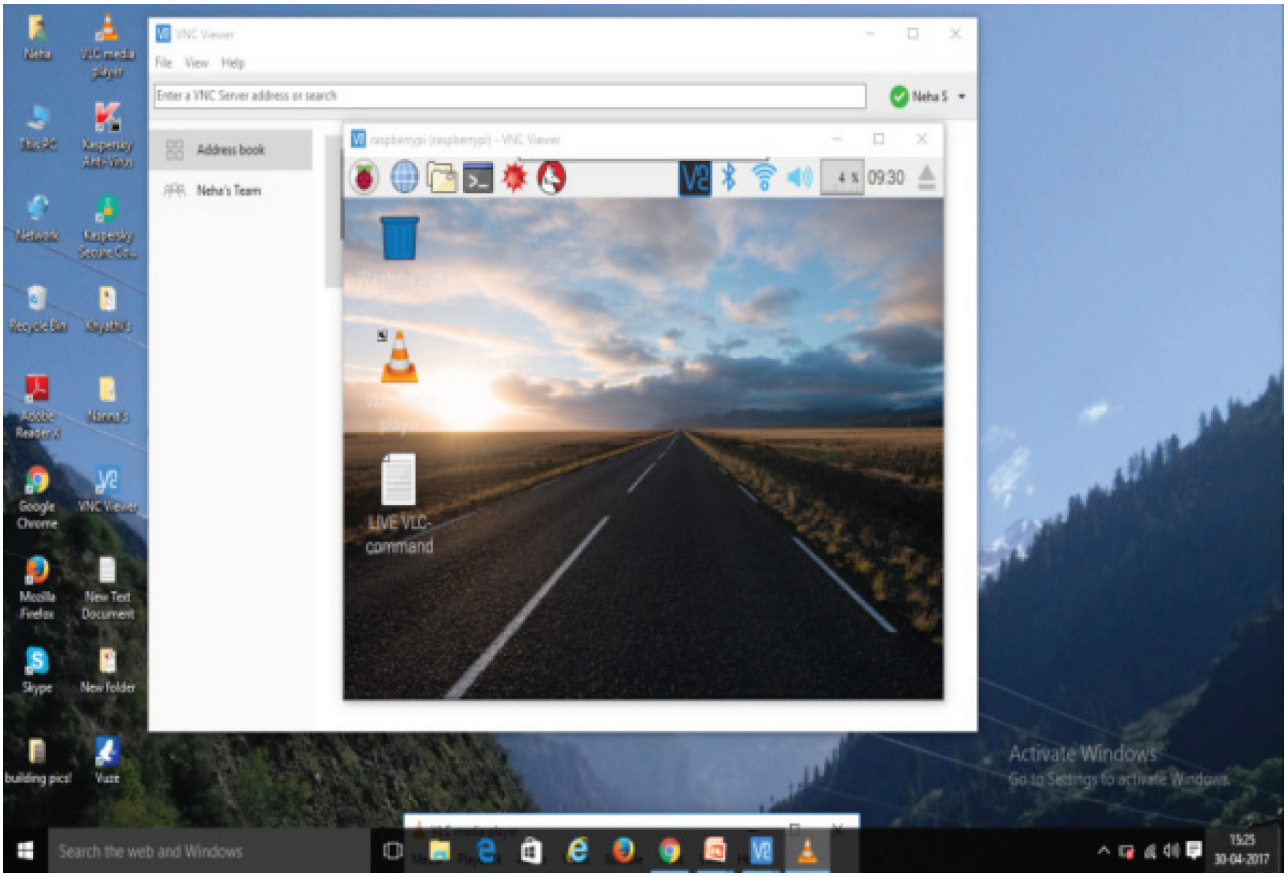

Figure 9. **Remote access on the host.**

5. Results and Discussions

The Raspberry Pi board is interfaced with the camera module, powered up using a battery pack is set in the location for remote surveillance over WLAN. It is then connected to the host machine through VNC server. Raspberry Pi's desktop is then accessed on the host running with VNC server. The code for initiating the live stream onto the VLC media player is entered in Raspberry Pi terminal. Once the code is run, Raspberry Pi's 'vid' command is used to start using the camera for video capture with zero delay, following which the captured image is flipped vertically with a width of 800pixels and a height of 400pixels with 20fps i.e. 20 consecutive images are captured per second. Then, its output is sent to the VLC media player commanding it to start streaming the data coming in, into the 8160 port on Raspberry Pi's IP address; and the output is encoded in h264, which is a format used high definition video files. Finally, VLC media player is opened on the host device and the Raspberry Pi's IP address along with HTTP protocol is fed into the network stream bar; then hitting 'play' starts the live stream.

The proposed system is implemented and the results have been reported. The results have been verified on both PC operating on Windows and an Android operated Smartphone as host machines as shown in Figure 11. The VNC server and the VLC media player are downloaded from the Google App Store when Smartphone is the host as shown in Figure 12.

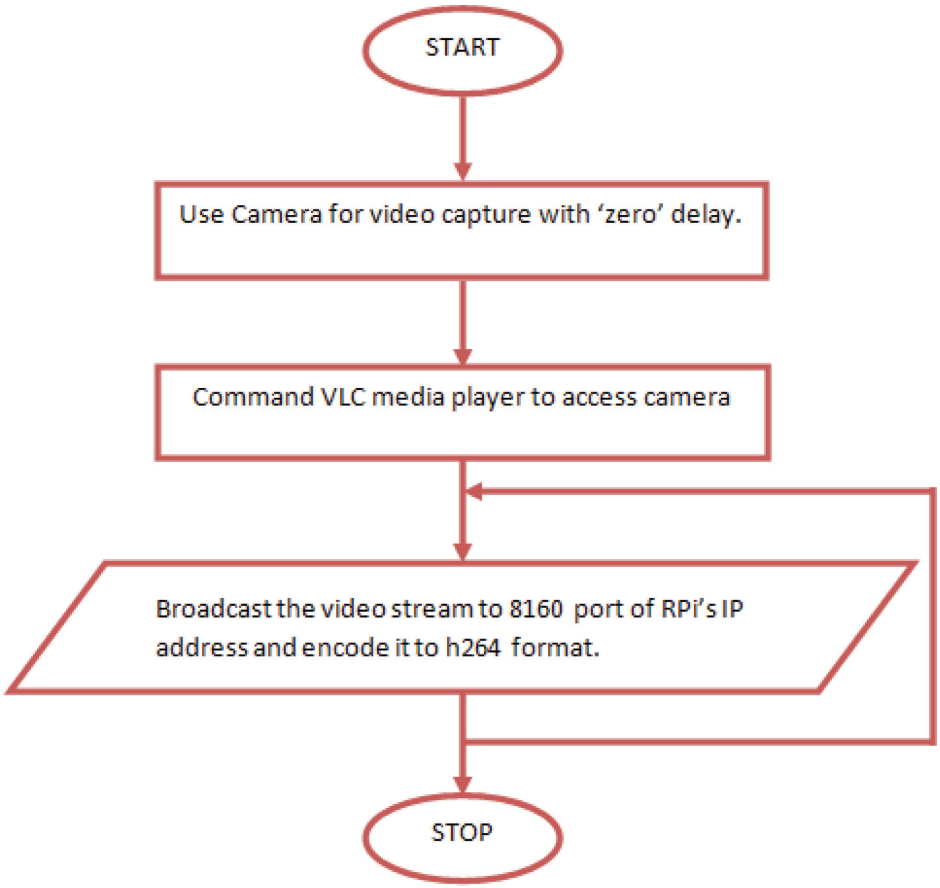

Figure 10. **Functional Flow Chart.**

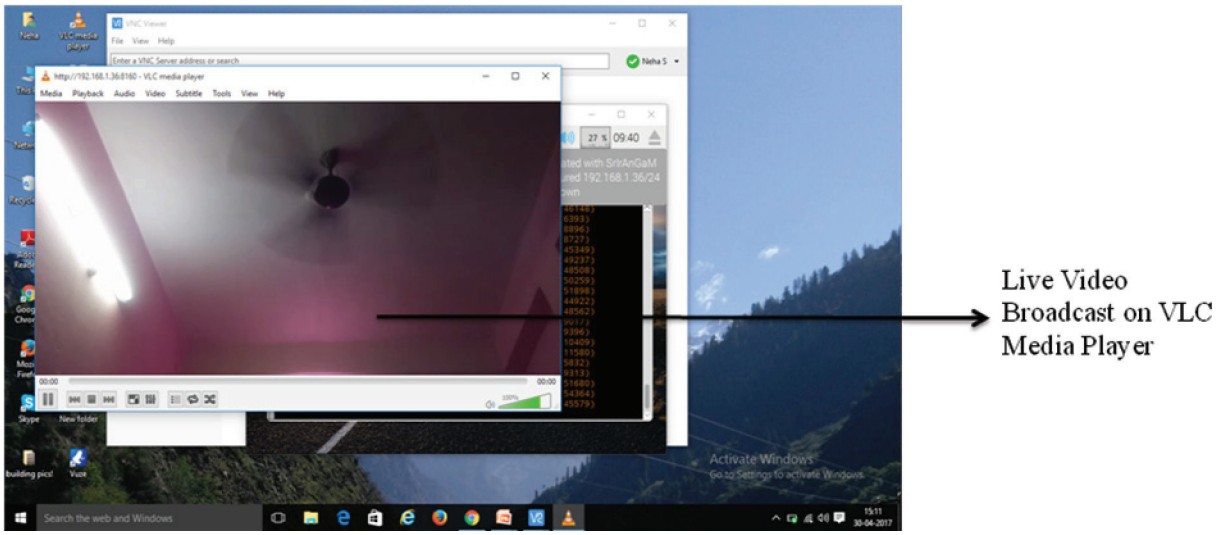

Figure 11. Result on host PC.

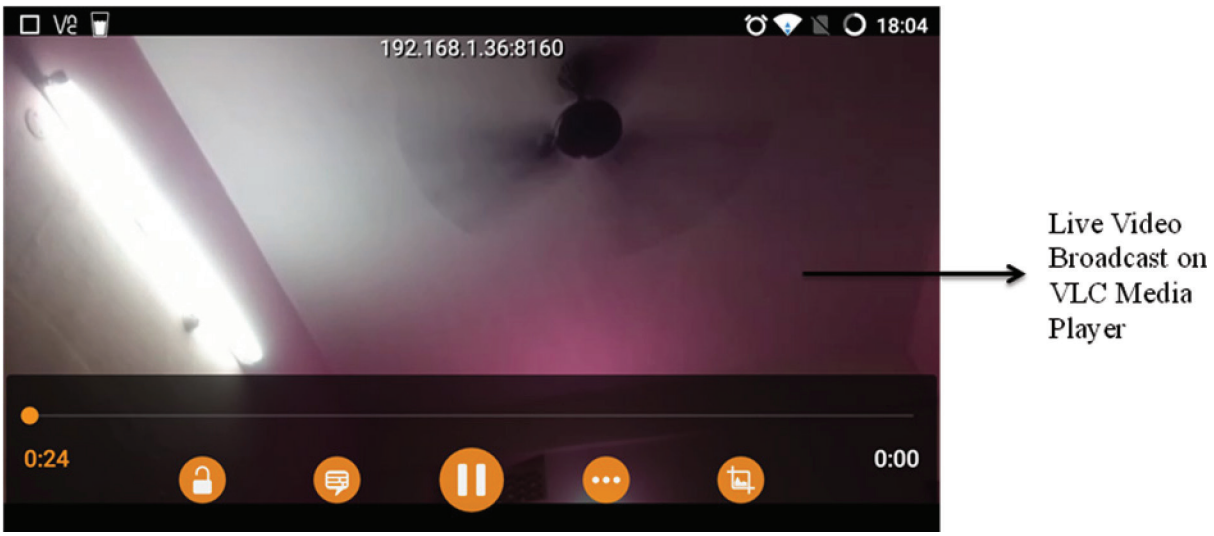

Figure 12. Result on Smartphone.

6. Conclusion

Through this paper, the design and implementation of a simple yet powerful live video surveillance system are illustrated. Ease-of-access to modern-day gadgets increased user's dexterity with technology. Prioritizing the need for easily programmable, cost-effective piece of technology; this design employs Raspberry Pi as the primary module for the job. Python programming language makes it viable for connecting this system to the real world. On the whole, this system reduces the intricacies of setting up a standard real-time monitoring system over an online network.

7. References

1. Jyothi SN, Vardhan KV. Design and implementation of real time security surveillance system using IoT. International Conference on Communication and Electronics Systems (ICCES), IEEE; 2016 Oct. p. 1–5. Crossref, Crossref.
2. Nguyen HQ, Loan TTK, Mao BT, Huh EN. Low cost real-time system monitoring using raspberry Pi. Seventh International Conference on Ubiquitous and Future Networks (ICUFN); 2015 Jul. p. 857–59.
3. Oza N, Gohil NB. Implementation of cloud based live streaming for surveillance. International Conference on Communication and Signal Processing (ICCSP); 2016 Apr. p. 996–98. Crossref.
4. Saari M, Baharudin AMB, Hyrynsalmi S. Survey of prototyping solutions utilizing raspberry Pi. 40th International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO); 2017 May. p. 991–94. Crossref.
5. Abaya WF, Basa J, Sy M. Low cost smart security camera with night vision capability using raspberry Pi and open CV. International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment and Management (HNICEM); 2014 Nov. p. 1–6. Crossref.
6. Diaz LC, Frenz MC. VNCCrack: A Tool for auditing corporate environments for the presence of insecure VNC installs. IEEE World Congress Services (SERVICES); 2015 July. p. 365–67. Crossref.
7. New Raspberry Pi 3 (2016) Review- Unboxing and Tutorial.
8. Raspberry Pi NoIR Camera v2. http://www.lion.co.il/site/HvDest/KR010071.pdf. Date accessed: 04/2016.
9. VNC (Virtual Network Computing).
10. VLC for Windows. https://get.videolan.org/vlc/2.2.6/win32/vlc-2.2.6-win32.exe. Date accessed: 24/10/2016.