

# Overview of Wireless CCTV Camera Network-Based Surveillance System

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**ABSTRACT:** This paper presents a technique for configuring, interfacing and networking a wireless IP-based camera for real-time security surveillance systems design. The real-time implementation techniques proposed for configuring, interfacing and networking the IP camera is through vendor software. The live streaming video based on the proposed technique can be adapted for image detection, recognition and tracking for real-time intelligent security surveillance systems design. The analysis shows that the software displays the best video animations from the IP-based cameras when compared with the performance of the other methods..

**KEYWORDS:** Closed-circuit television, Internet protocol, Security surveillance, IP-based cameras, Wireless networking, animations.

## I. INTRODUCTION

Traditionally, the surveillance monitoring system is done in the larger room and by the amount of manpower. But nowadays, a monitoring surveillance system can be done through an online network. This type of monitoring is less time consuming and can reduce manpower. Moreover, it gives the user flexibility to monitor their properties wherever they want as long as they have an internet network. Security of lives and properties is an aspect of life that cannot be toyed with. Governments and individuals desire to know the conditions of their highly valued properties every second of life even though these properties are located in different places across the globe. Surveillance is the monitoring of the behaviour, activities, or other changing information, usually of people to influence, manage, direct, or protect them. Alternatively, surveillance can be the observation of individuals or groups by government organizations but can also relate to disease surveillance, which monitors the progress of a disease in a community while not directly

observing individuals (Sandeep et al., 2012; Semertzidis et al., 2010).

This work is concerned with the configuring, interfacing and networking of IP-based cameras for real-time security surveillance systems design. The word surveillance may be applied to observation from a distance utilizing electronic equipment such as CCTV cameras and IP cameras, or interception of electronically transmitted information such as Internet traffic and/or phone calls. It may also refer to simple, relatively no- or low-technology methods (Akpan et al., 2015).

### A. Design Goals and Scope

The primary goal of this design is to maximize the number of query-specified objects the system returns while minimizing the bandwidth required to upload the images containing these objects. We also limit the scope of our design, noting the following non-goals (Zhang et al., 2015):

1. Each vision algorithm has a certain accuracy and degree of confidence in the results it returns. Improving the accuracy of vision algorithms is outside this paper's scope.
2. Enough cameras are present and use a high enough resolution and frame rate so that with high probability, the resulting raw video streams capture objects of interest.
3. In a Vigil deployment, cameras are line-powered, so there are no battery-conservation issues.

## II. LITERATURE REVIEW

### A. Method of Surveillance

There are different types of surveillance methods available in the world today, examples of which are; Computer surveillance, telephones, social network analysis, biometric surveillance, aerial surveillance, data mining and profiling, corporate surveillance, human operatives, satellite

imagery, identification and credentials, global positioning system, mobile phones and surveillance camera. However, video surveillance systems have since the 1970s consisted of National Television System Committee (NTSC) or Phase Alternating Line (PAL) analogue cameras connected over a coaxial cable network to VHS tape recorders or digital video recorders (DVRs) in a monitoring station. Such surveillance systems are often comprised of black and white, poor quality analogue videos with little or no signal processing, recorded on the same cassette. Most of the recorded images are of insufficient quality to hold as evidence in a law court. It is also expensive to have human operators monitoring real-time camera footage all round the clock. The effectiveness and response of the operator are largely dependent on his/her vigilance rather than the technological capabilities of the surveillance system as expressed (Karampelas & Bourlai, 2017; Schafer, 2013)).

## B. Overview of IP Video Surveillance System

IP- Surveillance refers to a security system that presents a user the ability to monitor and record video/audio over an Internet protocol-based computer network such as a local area network or the internet. IP – surveillance also known as video or IP CCTV uses the IP network technology as the backbone for transporting the information. As a result of the digital nature and method of video distribution, IP-based surveillance systems introduce a host of advanced functionalities that enhance greater control and management of lives and record video data thereby making them highly suitable for security surveillance applications. Some of this includes remote accessibility, high image quality easy and future proof integration, scalability, flexibility, cost-effectiveness, event management and intelligent video (Matthews et al., 2013; Nilsson, 2008). The structure of this IP based system is shown in Figure 1.

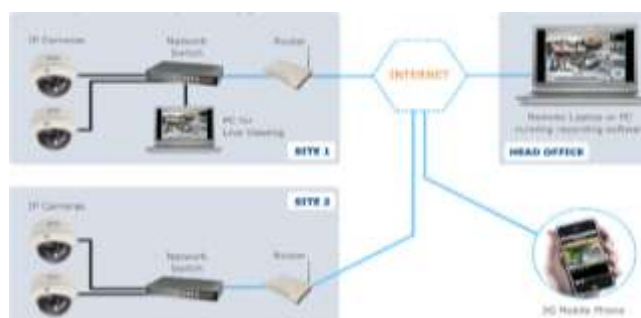


Figure 1: The IP Video Surveillance System. (Becky et al., 2021)

## C. Concept of Wireless CCTV Surveillance System

There are many existing devices in the market such as CCTV Cameras, IP cameras, Infrared sensors, Laser sensors etc. CCTV: Implementation of CCTV cameras is very costly and has drawbacks since it requires constant monitoring of every activity which is not as easy. Continuous manual visualization hampers productivity and time. Criminals can penetrate the CCTV system, thereby facilitating criminal acts.

Those looking for affordable yet reliable security technology may be interested in the flexibility of network cameras for their property and surveillance needs. The network cameras available today work with IP networks including the Internet. This makes the ability to view what is happening in front of the camera nearly limitless. From wherever you are, you can monitor your property and even review recorded video footage. Network cameras give you the power to tap into your security system whether you're on-site or off-site. Network video surveillance has several

advantages of CCTV video, including such high-end features as megapixel and HDTV resolution, built-in video intelligence, and scalability. The next subsection presents a brief description of some essential devices and concepts needed for wireless CCTV surveillance systems (Kovacs, 2018).

### IP Camera

Implementation of IP cameras is also very costly and not feasible. This system causes major problems as it becomes open to hackers via the internet (i.e. false bomb threats could call in hoaxers while watching the cameras). This is a big shortcoming in this present world of hackers (Xu et al., 2018).

### Infrared Sensor and Laser Sensor

These devices are quite economical in comparison to the above devices however they have some drawbacks too. These devices are difficult to install and rarely available. One of the major disadvantages of infrared sensors is the size required to provide good resolution to the signal as described.

### Network Bandwidth

IP cameras typically generate between 0.2 Mbps and 2 Mbps of traffic on a network. This figure varies with size, frame rate and image compression used. A typical 100 Mbps office network can have several cameras attached, without affecting standard traffic.

### Camera Image Compression

IP cameras use either MJPEG (Motion Joint Photographic Expert Group) or MPEG 4 (Moving Pictures Expert Group) compression techniques for image transmission. MJPEG saves each frame as a JPEG whereas MPEG only retains information about the differences between the captured frames. MJPEG is a JPEG based compression codec. It is the current top choice for video surveillance as it is inexpensive to implement and simple to decode, requiring a few modifications on top of existing JPEG compression systems (Priya & Amritha, 2016; Uhm et al., 2021).

### D. Principle of Operation of IP Camera

Network cameras are widely described as a combination of a camera and computer into the same unit. The network camera usually has its IP

address with which it accesses the network directly just like any other network device. Everything needed for viewing images over the network is built into the unit. It also has inbuilt software for a Web server, FTP server, FTP client and e-mail client. Other features include alarm input and relay output functions. More advanced network cameras can also be equipped with many other value-added options such as motion detection and analogue video output. The lens of the network camera captures the image represented as the light of different wavelengths and passes the image through the optical filter. The block diagram of the IP camera is shown in Figure 2. The function of the optical filter is to ensure that infrared light is removed so that the necessary colours are displayed. The image sensor further converts the image, which is composed of light information, into electrical signals. These signals from the image sensor are then converted from analogue to digital format making them now in a format that can be compressed and transferred over networks (Seralathan et al., 2018).

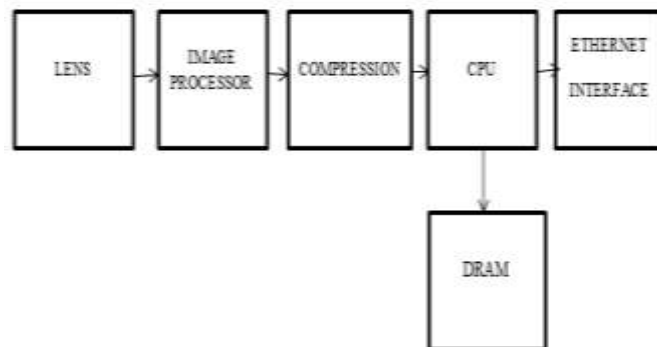


Figure 2: Building Blocks of an IP-based Camera.(Gold et al., 2019)

### Network Camera

A network camera is also commonly referred to as an IP camera. Network camera technology is similar to computer technology in that both have a unique IP address. Cameras connect to a network and can work wherever a network connection is accessible. The biggest difference between a standard web camera on a computer and a network camera is that webcams require a direct connection to a computer. Network cameras can be wireless and still work through a network. Cameras are set up to capture video and transmit what is recorded over an IP network. This allows people to view in real-time what is being captured. Recordings can be captured 24/7, on a certain schedule, or when motion or audio is detected. This camera technology makes it easy for anyone to implement a security or surveillance system on their property.

Network cameras are available for use indoors and outdoors. Outdoor cameras have specific technology to account for the changing light and darkness without compromising the quality of the video. Cameras built for outdoor use must also be protected from the elements including rain and wind to protect their components and the network camera software. Indoor cameras may also require special coverings to protect the electronics from heat, humidity, and other materials that may be present indoors which are harmful to the camera. Network cameras used for security and monitoring are also built to thwart attempts at vandalism by those who do not wish to be caught on camera. Traditionally cameras are fixed to a location where high traffic is present and in areas where monitoring is preferred. Cameras can be fixed to a location including in dome housing in the ceiling (Kruegle, 2011).

Pan-Tilt-Zoom (PTZ) network cameras give the user the ability to pan, tilt, and zoom. The camera has the option to follow activity as it happens and the user can get closer to the action with the motion features. The ability to move the camera during monitoring and recording allows for more specific video images that may be beneficial

to later prosecution such as when zeroing in on a suspect's activity. Cameras come in many shapes and sizes depending on the specific needs of the customer. A mix of camera types may be suitable in some environments so a customizable solution such as those offered by VideoSurveillance can be the ideal choice in security. Before investing in network camera security systems, it is important to consider your overall needs. Network camera technology is certainly a flexible option that will grow with your company and provide the enhanced monitoring experience you need (Michelsoni, Rinner & Foresti, 2010).

### III. IMPLEMENTATION

To access the IP camera for live video streaming or real-time video transfer, either wirelessly or using hardwire connection, also, either for local area network connection (LAN) or for wide area network connection (WAN), there are ways through which this can be achieved. In this section, the software involved in interfacing the IP camera with the computer at the monitoring end and the stages of installation of each of the software till a live video is streamed or transferred are discussed. Below is the list of the ways to interface the IP camera:

1. using mobile software,
2. using Mozilla firefox web browser and
3. using MATLAB (The MathWorks, 2012a) with SIMULINK

#### A. Using Mobile Software (iCsee)

STEP 1: Download the ACDSee Pro app from Google Play Store on Android or App Store iOS devices.

STEP 2: On the home screen press Local Login, shown in Figure 3. One can also create an account instead, but it is not necessary. The advantages of using an account are: Simply download the app onto another device and log in to that account to access the cameras instead of manually adding them again, and Access the notifications/motion alarm settings to be able to receive remote alerts on your Android/iOS device.

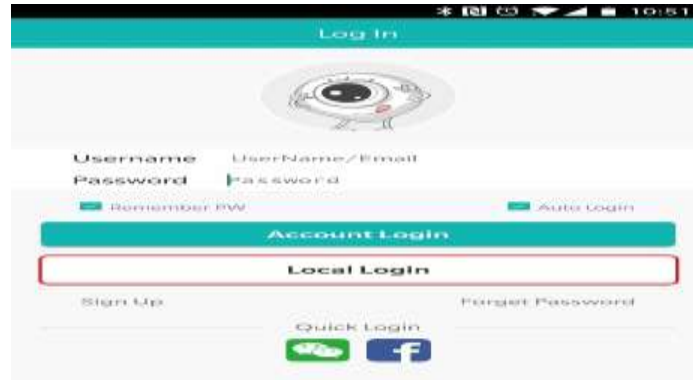


Figure 3: diagram of step 2.

STEP 3: Click the + icon in the top right of the screen.

STEP 4: Click on "Set up my device to Wi-Fi

STEP 5: You should now see your internet network name appear, please enter your network password in the password box and press confirm as shown in Figure 4.

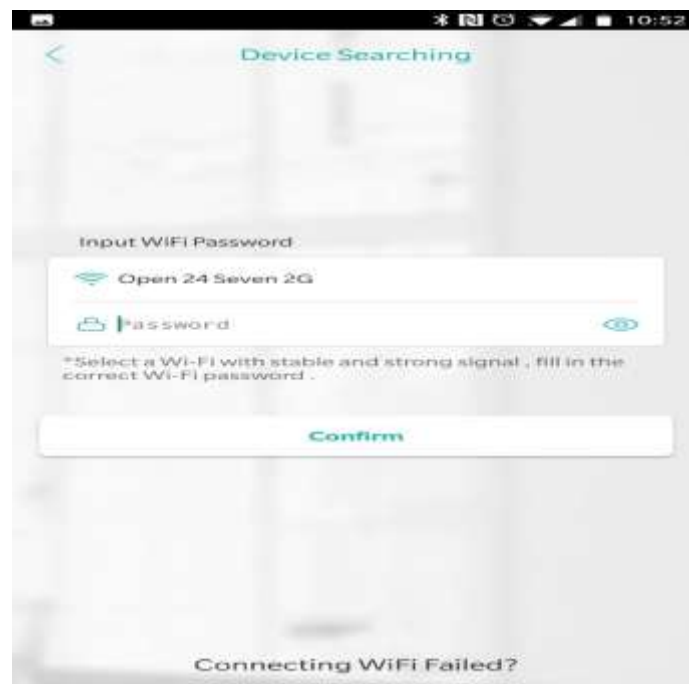


Figure 4: diagram of step 5.

STEP 6: When the app has found your camera it should ask you to enter a password for the camera. Enter the same password in both fields.

STEP 7: The app should now take you through to the device list with your camera showing. Simply click on your camera to bring up the live video feed.

#### B. Using Mozilla Fire-Fox Web Browser

The function of this stage is to pre-amplify the audio signal from the microphone which is very weak so that it can be set for modulation. This stage consists of an NPN transistor, common

emitter configuration, with collector feedback biasing, biasing resistors and capacitors. The input to this state is from the base of the transistor while the output is from the collector. The capacitors at this unit serve as coupling unit filter networks and frequency determination of input signal.

#### C. Using Matlab Web Browser

In this second method, the IP addresses of the IP camera and the host computer are ensured to be on the same network. If, however, this is done, then MATLAB will be made to run on the laptop that will receive the live video. On the MATLAB

default desktop layout, at top of this page, the desktop is clicked, then it is scrolled down to the web browser option, the sequential stages and processes from the start till the live video is streamed. One of the main objectives of this work is to set aside all the aforementioned software used in accessing or interfacing the IP camera with the laptop except with MATLAB/SIMULINK. To achieve this, MATLAB as a powerful computer programming language is used to access and interface the IP camera with the host computer. The processes and the stages involved are explained below. The IP address for the camera is entered. As soon as the page pops up, and the Enter key is pressed on the keyboard, The Username is supplied and the page pops up. Note that the page is the inbuilt webserver which is one of the inbuilt characteristics of the IP camera. The desired web browser is signed in but in the case of this study, we only signed in with Firefox.

#### IV. CONCLUSION AND RECOMMENDATION

Real-time capturing and viewing streaming video from an IP-based camera on the host computer has been proposed. As a future direction, work has started on techniques to capture streaming video using a web browser with a view for the design and implementation of online detection and recognition of multiple targeted images in real-time for intelligent security surveillance systems design and deployment. Video surveillance has become a foremost global strategic tool for fighting the war against terrorism, preventing crimes, protecting corporate assets and enhancing public safety. Since they serve the needs of the military, government, utilities, corporate, medical, retail, hospitality, transportation and education, no individual can claim not to be affected by this trend. Despite the challenges to its widespread deployment in some regions, the future is very bright for this technology. This paperwork and the processes outlined in it will therefore be useful for both local and international security agencies. It will as well be useful for industries watching over equipment and workers for security purposes, it will also be useful for an individual to watch over his/her property, it will as well be useful in the banking sector.

This report has succeeded to a great extent, in exposing the very basic principles involved in wireless CCTV network-based. In the event of actual implementation, cloud storage should be introduced, and finally, a face tracking system should be introduced.

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