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A Mobile Access IP-Based Video Surveillance Model for a University Campus Security

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ABSTRACT

University campuses face a lot of challenges when it comes to security of facilities and human beings due to the large geographical areas occupied, physical structure of the buildings and population. Current security measures in most universities in Nigeria include employing security personnel and installing CCTV in some sensitive places for monitoring this has limitation in terms of poor coverage and static monitoring restricted to specific locations. This paper presents an IP based surveillance model for a Nigeria University-Osun State University, Osogbo. The conceptual architecture model is designed using software engineering approach. The implementation model which provides remote access to video streams irrespective of the access locations will go a long way in addressing problem associated with maintaining security, deter crime, monitoring environment and protecting lives and properties on the university campuses especially now that Nigeria is confronted with security threat.

Keywords: IP-based Surveillance System, Mobile access, security .

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1. INTRODUCTION

The growing popularity of internet and advances in telecommunication and mobile technologies have change the video surveillance model for better security in various organizations. Surveillance systems which originated from traditional analogue CCTV have developed into digital and IP-based technologies. In traditional CCTV the access tools and methods were dependent on user's location, e.g. operating room [1], with limitations in terms of access, upgrade and scalability. Recently, automated video surveillance systems utilize integration of real-time and more effective computer vision and intelligence techniques into digital and IP-based technologies. Video surveillance systems accommodating wireless or mobile technologies provide seamless access irrespective of geographical locations and the access devices such as desk top, laptops, PDAs, Tablets, cell phones. In an IP surveillance system, an IP camera records video footage and the resulting content is distributed over an IP (Internet Protocol) network.

In the view of [2],IP surveillance system provides additional benefits such as:

- Improved ability for remote viewing and control by authorized person with IP standard. IP storage makes it possible to store data in any geographic location.
- Greater ease of distribution. An image of a crime suspect, for example, can be immediately distributed to officials.
- The ability to connect to email and other communications systems so that alerts can be sent automatically.

University campuses pose many unique challenges when it comes to security of facilities and human beings due to the large geographical areas occupied, physical structure of the buildings and population. Current security measures in most universities in Nigeria include employing security personnel and installing CCTV in some sensitive places for security with limitation in terms of poor coverage and static monitoring restricted to specific locations.

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This paper presents an IP based surveillance model for a Nigeria University- Osun State University, Osogbo Campus. The model developed enables video streams to be sent over the internet for remote monitoring irrespective of the access locations will go a long way in addressing problem associated with maintaining security, deter crime, monitoring environment and protecting lives and properties on the campus.

2. LITERATURE REVIEW

Fereshteh and Affendey (2013) presents comprehensive and systematic review of video surveillance systems. The research classification framework is expanded on the basis of architecture of video surveillance systems, which is composed of six layers: Concept and Foundation Layer, Network Infrastructure Layer, Processing Layer, Communication Layer, Application Layer, and User Interaction Layer. The review revealed that research in real-time video computing increased greatly in design and implementation of network infrastructure, user interaction over various devices such as handheld device and ordinary monitoring device, communication and processing which performed essential action to provide effective applications while few researches have investigated the deployment of extracted and retrieved information for forensic video surveillance[4]

Generally, security systems can be classified into four categories [5], [2], [6], [7]

- Hardware-based, the simplest systems where both monitoring and control are implemented in hardware,
- Passive systems, where only the monitoring is remote (the control is manual),
- Phone based systems, with monitoring and control performed through the phone (wired and/or cellular) network
- Web-based systems, identical to phone-based but using the Internet as the communication infrastructure.

Several researchers have presented video monitoring schemes for monitoring and protecting different environments and people. [8]Kim, Cho and Kim (2015) present a surveillance system that can help in protecting children from the intelligent criminal and crime prevention by tracking and monitoring abnormal face in wide-area surveillance using wide-area surveillance cameras and PTZ cameras with the high magnification. The AdaBoost algorithm employed in the design can track abnormal face by moving the center of the face to the center of the whole image.

The result of the experiments shows 95.5% of the abnormal facial recognition rate and the average speed of 17 frames of abnormal were obtained.

Video surveillance systems accommodating wireless or mobile technologies are areas of ongoing research. The key research areas are focused around architectural considerations required to support receivers' mobility and their security and dependability aspects or innovative solutions based on wireless (sensors) and mobile technologies[9],[10],[1].The researched scenarios are usually presented using small or medium size surveillance systems or other innovative solutions[11].

3. METHODOLOGY

Two major research approaches are employed in this research work – Analysis and experiments. The analysis of the system was done by method of requirement engineering to produce a working document containing the proposed system specification and models. The process of requirement engineering adopted include analysis of issues associated with video surveillance system and system requirements. Data needed for design specifications such as building master plan, university infrastructure and security framework were obtained from the university works and security units. The system architecture was modeled using Unified Modeling Language (UML) to specify both the active and passive entities of various modules of the architecture represented inform of class and sequence diagram. The experimental aspect of the research is the design implementation which involves installation, configuration, testing.

3.1 System Design and Architecture

The University Web based Mobile Surveillance System Design Architecture is presented in figure 1. A Local Area Network was set up within the University's backbone Wide Area Network (WAN) structure so as accommodate all network devices and assign their individual network and IP addresses. The design architecture consists of a network router, switches, the University's main surveillance system server and the host of other network devices

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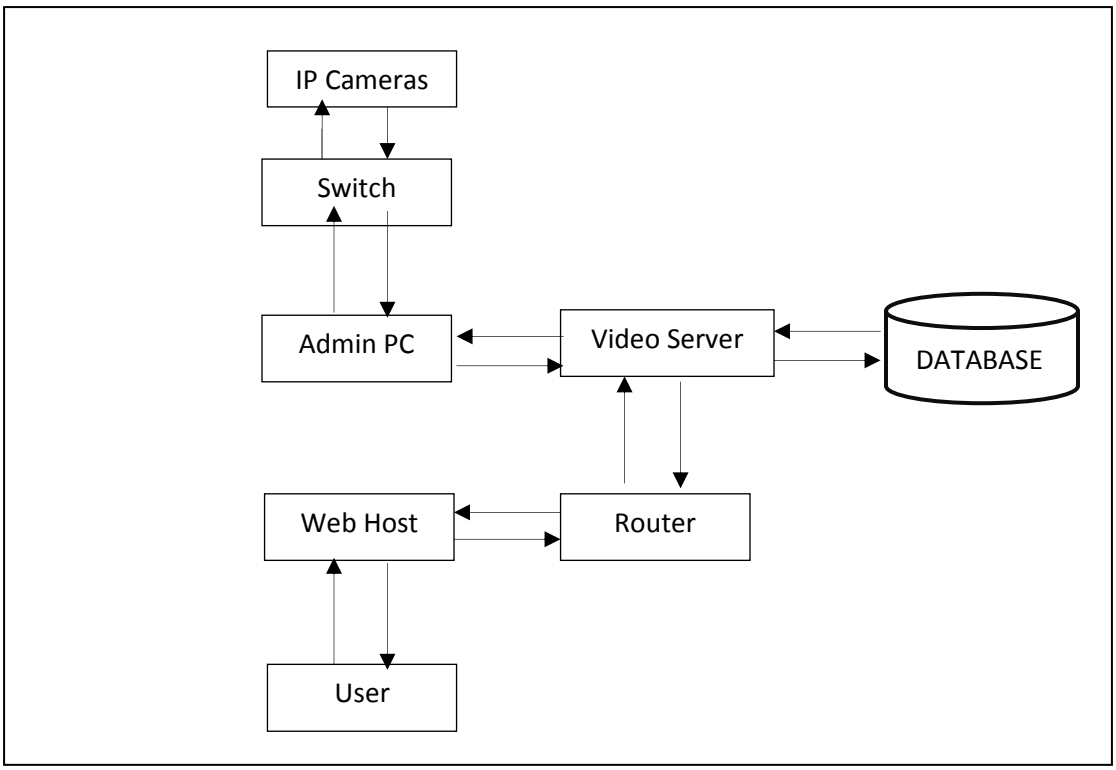

Figure 1 : Block Diagram for University IP- based Video Surveillance System

The Wireless IP Cameras were stationed at the entrances of the Science, Engineering and Technology building which has 6 entrances, with two cameras at each entrance point, making it twelve in the SET building. The same manner of arrangement was repeated in the Administrative building and Health Sciences buildings each with six entrances also. Each building has a total of 12 cameras which makes the sum total of cameras on the network Thirty six (36).

Each switch in each building has the capability to accept up to 32 feeds of camera inputs at the frequency rate of 5GHz which provide opportunity for scalability. The switches and the cameras are powered with the use of PoE (Power over Ethernet) and are connected to UPS (Uninterruptable Power Supply) for backup power supply in case of unprecedented power outages. The network switch were then connected to the video network server wirelessly but the use of cables to access the camera feeds is also possible in this design.

4. DESIGN IMPLEMENTATION

Figure 2 depicts the Conceptual Implementation Model of a University Web based Video Surveillance System. The video software installed with playback function installed on video network server has the ability to record several footages from cameras and viewing of live feeds. There was an IP camera software installed on video server enable control over each camera with its special functions. The IP cameras were also assigned distinctive Static IP addresses on the network so that they can be accessed individually with the use of the software.

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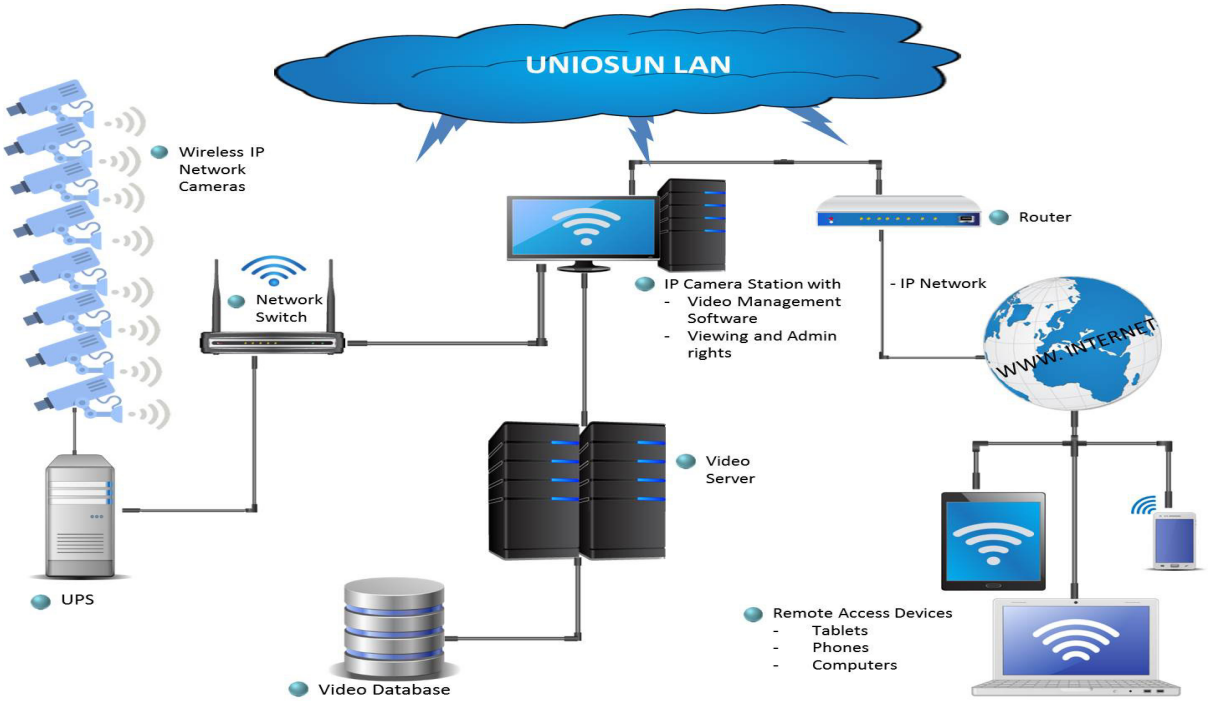

Figure 2: Conceptual Model of a University IP based Video Surveillance System

The video feeds recorded are stored in the university surveillance server. The design architecture provides opportunity for real time viewing of video streams and opportunity to query previous recorded video feeds in terms of date and time specified. The school website was used as the portal through which anyone with the administrative rights to view feeds from the cameras, can remotely log on to, in addition to monitoring from the server room, The mobile and IP technology integrated into the web environment designed for this system provides access to the surveillance system through devices such as tablets, phones anywhere in the world for authorized users etc.

4.1 Camera IP Set Up and Video Compression Format

The use of DropCam HD Wireless IP Cameras with video compression format H.264 with built in 802.11b/g Wi-Fi was strictly employed. This gadget features HD video quality, 2 way audio, motion detection and alerts. A major advantage with DropCam HD is the setup process which has been made very simple. They can transmit high VGA resolution video in either Motion JPEG or MPEG-4 streams and deliver high video quality ranging from 3G to HD and everything in between (from 40 Kbps to upwards of Mbps).

Power to the cameras was with the use of Power over Ethernet (PoE), a standard which transmits power over Cat 5 Ethernet Cables.
The video compression format helps to convert the raw video feeds to a lighter type video and still keep its video quality on the high .This helps in saving a lot of space on the video server for storage and also reduces consumption of bandwidth during transmission of the video data around the network.

Cameras are given a static IP address which is in line with that of router of the backbone network of the University. It is done on the Camera Management system application installed on the administrator workstation. Static IP addresses were used so as single out each camera and its location exactly. The use of DHCP for the IP addresses was neglected due to the random generation of IP's and thereby making it difficult to track events in specific locations, if the IP's tend to change at any time.

4.2 Viewing The Video Feeds

To view the camera feeds, a unique page where video feeds could be viewed on the World Wide Web was created and appended to the school website. The page has a login where only privileged users with the rights can login to the page to view videos.

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In the page, the Video Management Application is what the user sees and interacts with. It has a URL input where the IP address of the specific camera which is desired to be viewed can be played on any of devices like tablets, smartphones capable of video streams. The view of such a camera accessed is then relayed to the user from the video server as shown in figure 1. Full playback functions are also available for ease of viewing such as zoom, tilt, rewind and pause for better viewing experience. Video feeds from past events stored on the video server can also been played.

UML Sequence Diagram for this architecture is shown in figure 3 showing the relationship interactions among the various active and passive entities entities such as users, webserver, adminserver, video servers, and IP Cameras installed.

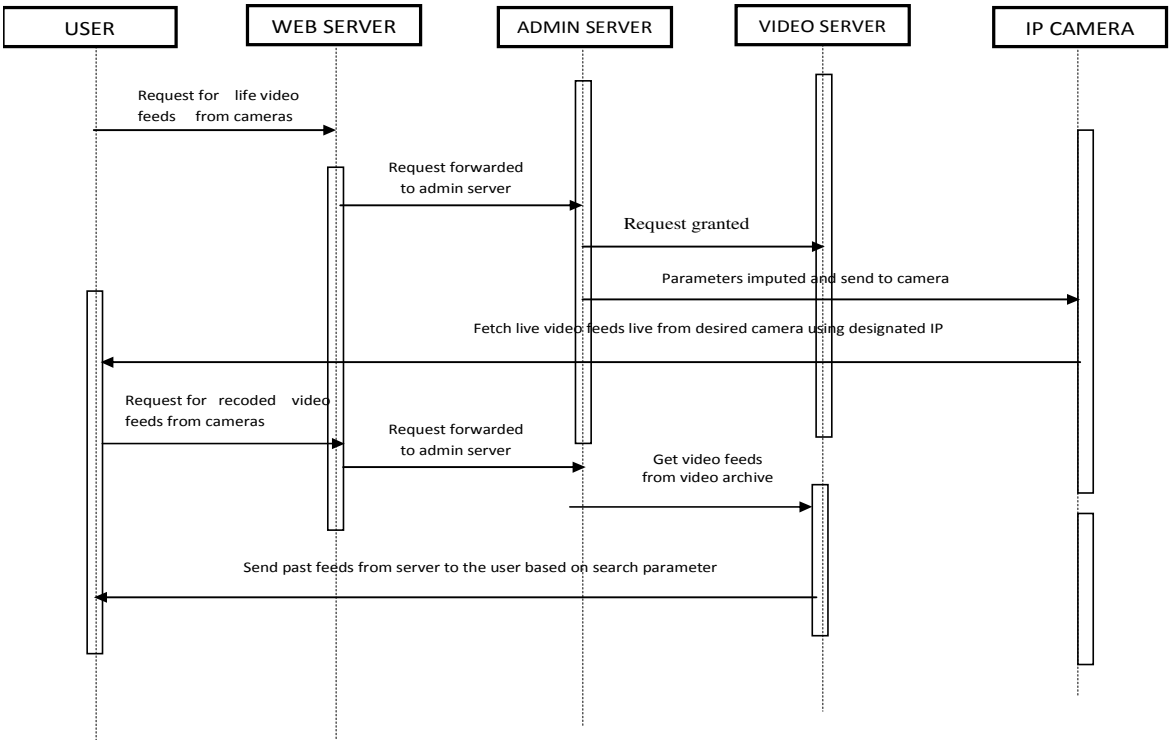

Figure 3: UML Sequence Diagram for University Video Surveillance System

5. CONCLUSION

In this paper, design architecture and implementation of a university web based surveillance system was presented. The network was design using software engineering approach to provide a real time platform for video feeds to be captured and stored for several days in a big storage (server) for instant view and play over mode.

Our design is scalable by providing capability of accommodating more video cameras in the nearest future. The limitation of this design is that view is only limited to window platform and the storage medium (server) may not be sufficient for storing data for several months. Further research work could be done to enhance the storage on cloud -based server environment.

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