DESIGN AND IMPLEMENTATION OF A REMOTE SURVEILLANCE SECURITY SYSTEM

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ABSTRACT

Security is major challenge Security in most institution, as it is an integral part of any modern Institution. Most Institutions in recent times has security cameras on keys areas to check all activities on their campus, this help to monitor all activities going on in the campus. In recent times the polytechnic has acquired state of the act facilities in most departments; Geo-informatics (Edo Poly GIS), Engineering, Mass communication, etc. There is need for the Polytechnic to have a secured surveillance security system to monitor these facilities from theft and vandals. In this research we intend to design and deploy a remote surveillance security system using CCTV cameras, solar power panels, Inverters system. The camera will cover core areas of the institution, such as the gate house, the admin building, the different laboratories and the different schools. The system design and implementation is an Internet Protocol (IP) based surveillance security system. It combines remote viewing and storage of live video feedback, remote motion control of the camera, and a Personal Computer (PC). The design is a software based, the software applications are developed using Visual C - Sharp (C#) programming language to enable the proper monitoring and control of the complete system using the video feedback from the camera view and it is recorded on PC.

Key words: CCTV Camera, Monitor, Security, Surveillance

INTRODUCTION

The rate at which criminal activities are taking place in homes and offices globally is alarming; this has necessitated the installation of surveillance security systems in most establishments. The security threats ranging from armed robbery, kidnapping and recently bomb blasts has kept the entire regions on their toes to the extent that no one can be sure of his/her security in the next moment.

Currently, emergence of personal computers made security operatives to be efficient and equal to the task in keeping the entire populace to abreast with the latest security challenges in the course of discharging their duties. With flexibility of surveillance security systems being a major consideration, this work focuses on the software designs and implementation of a system that enables a remote personal computer (PC) which is connected to a wireless local area network to view the activities captured by a surveillance camera. The PC also controls the direction of rotation of the camera remotely, with the use of a pair of wireless transceivers. Due to its wireless nature and its use of IP (Internet Protocol) data packets, this system provides remote access and greater flexibility compared to other visual surveillance systems, as the system can be hosted on the internet and thus made accessible from anywhere in the world. Srinivasan et al. (2011), observed that Social motion analysis helps in solving problems in indoor surveillance applications. K. presented an attempt to give an idea of

human body tracking in surveillance area of monocular video sequences. They discussed various kinds of background modelling techniques like Background Subtraction Method, Adaptive background subtraction method, Adaptive Gause Mixture Method, 2D and 3D human body tracking methods etc. Human body modelling identifies the body positions and activities in video sequences. This system is aimed at providing a remote security system using CCTV system, provide a wireless system system to adequately cover sensitive areas in the campus in Edo State Polytechnic, Usen.

LITERATURE REVIEW

Weber (2006) introduced ultrasonic detectors to enhance the security of lives and properties. Ultrasonic detectors are active detectors that transmit ultrasonic sound waves, of frequency between 15KHz and 75KHz, that are inaudible to humans. The ultrasonic detector operates by the transmitter emitting an ultrasonic signal into the area to be protected.

The sound waves are reflected by solid objects (such as the surrounding floor, walls and ceiling) and then detected by the receiver. When the objects are stationary, the frequency of the waves detected by the receiver will be equal to the transmitted frequency. However, a moving body causes a shift in phase of the ultrasonic signal received. A phase comparator detects the shift in phase and sends a triggering pulse to an alarm. Ultrasonic motion detector has the advantage that they are very sensitive and extremely fast acting.

There is an existing monitoring system known as Closed Circuit Television (CCTV) which has been used. The major disadvantage this CCTV system is its fixed nature and lack of flexibility. The monitor on which activities are viewed is always at a fixed position, thus for effective real time surveillance monitoring, the security personnel must always be at the position where the monitor is permanently stationed which is quite tasking, if long hours are to be involved, (Keifer 2011).

The shortcomings of the existing security systems are taken care through the introduction of a PC based surveillance system. In this system, a typical IP (Internet Protocol) video surveillance system which is PC controlled (using serial communication for the interfacing), IP cameras are used. The cameras are IP addressable, thus they can be accessed from anywhere in the world via the internet or any wide area network (WAN), provided the user has the sufficient network access and security privileges to the camera. The network over which the camera transports the digital video signal is entirely wireless, thus the PC on which surveillance footage is viewed is not limited to a particular position. Serial communication is used to interface a PC to the camera holder so that the direction in which the camera holder rotates the camera is controlled by the PC. Serial communication is a mode of data transfer where only one bit of data is transferred at a time, (Mary, 2011).

Tony, 2011, discovered that the IP based surveillance system overcomes the limitations of the existing systems in the following ways:

i. IP Cameras are used wirelessly to monitor both idle and busy areas.
ii. IP cameras with motion detection capabilities can be used to detect motion in idle areas.
iii. IP cameras produce higher image resolution. Larger pictures with more image detail and clearer image quality are produced.
iv. IP cameras provide advanced PTZ features (i.e. pan, tilt, zoom) and the transmission of the commands is via a single network cable.
v. Encryption & authentication: IP cameras offer secure data transmission through encryption and authentication methods such

as WEP, WPA, WPA2, TKIP, and AES.

vi. Flexibility: IP cameras and PCs can be moved around anywhere when integrated on a wireless IP network.

vii. Remote accessibility: live video from selected cameras can be viewed from any computer, anywhere, and also from many mobile user and other devices.

viii. Better wireless reception and security:

Anthony, 2001, observed that with the digital technology, a digital (IP) camera translates the viewed image into digital signals which it then converts (encodes) into a series of IP packets that can be sent out over an IP-based network as a data stream. The IP network may be a local area network, a company wide area network, or even the public internet. At the destination, the receiver re-assembles these packets back into the original video stream. The reconstructed video can then be viewed, stored, searched, replayed, or retransmitted to virtually any location anywhere in the world.

McLean et al. (2013), observed a significant reductions in crime rates were observed in three systems in Baltimore and one in Chicago. In their studies of the CCTV system in Schenectady found that the installed cameras resulted in a significant reduction in violent crimes.

Alexandrie, 2017, reviewed seven randomized and natural experiments of CCTV, finding crime reductions between 24% and 28% in public streets and urban subway stations, but no effect in parking facilities or suburban subway stations. The findings diverged somewhat from those of Welsh and Farrington. Smaller effect sizes associated with quasi-experiments, varying study settings, and differing integration with police practices as contextual factors may explain this difference. Recent research findings show support for Alexandrie's argument that integration with police practices may determine the effects of CCTV, Piza et al. 2014.

Pisa et al. (2018), revealed that CCTV associated with significant reductions in both vehicle crime and property crime in general, with no significant effects observed for violent crime. The opinion of Public safety agencies combating violent crime problems may need to consider whether resources would be better allocated toward other crime prevention measures.

Piza, et al. (2014), discussed the relationship between monitoring and CCTV systems, they emphasized that actively monitored CCTV systems require a greater commitment of resources than do passive systems. This is especially the case if agencies wish to maintain current levels of active monitoring as CCTV systems expand—because high camera-to-operator ratios can negatively aff ect active monitoring practices

Idrees et al. (2018) explored the potential benefits that Computer Vision Technology (CVT) can provide to CCTV interventions. CVT applies mathematical algorithms to each frame of CCTV footage for the purpose of automating the detection of crime-related events. Upon detection of an image of concern, CVT alerts the CCTV operator. Within a CVT-assisted CCTV scheme, the primary role of the human operator is shifted from manually mining video footage in search of criminal behaviour to a supervisory role emphasizing assessment of detected images and response decision making. According to Norris and Mc Cahill, this may bolster the efficiency of active CCTV monitoring.

METHODOLOGY

The system will be designed and implemented using software which is based on the interrelationship between the camera and the personal computers that may be attached to the network system. It interfaces the camera in motion and with the PC which is for proper monitoring and documentation so that the security system will be effective

and efficient. The system also Interfaces between the PC and the DC motor which shows the angle at which the camera is to be moved for proper surveillance

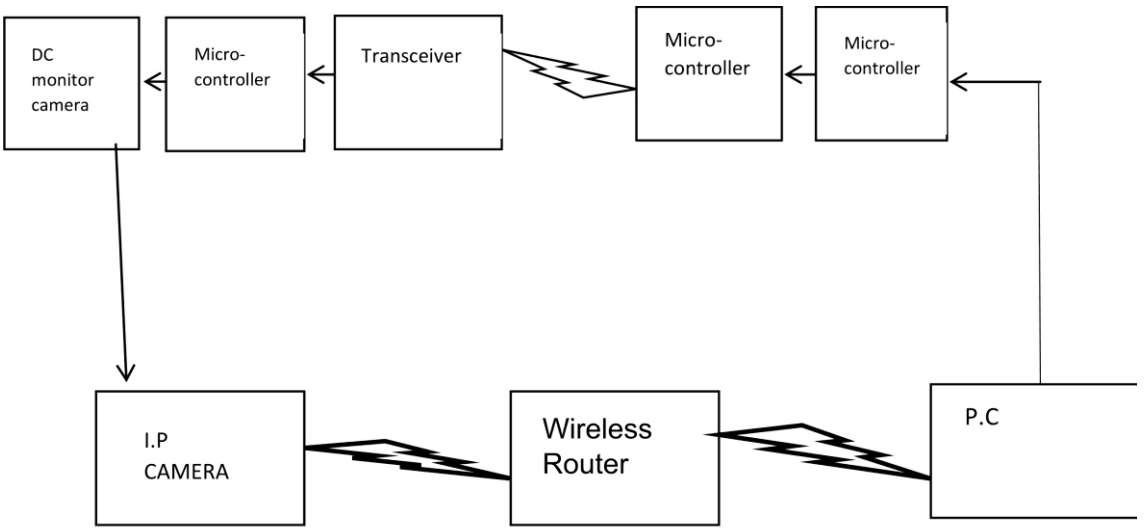

Fig1: Block diagram of the system

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SYSTEM DESIGN

From figure 1 above, the entire system is software-based design. It comprises of two major parts: (1) PC built control camera rotation, and (2) A Remote viewing video feedback from the camera. These are achieved using correspondingly; (a) via a computer interfacing serial communication, and (ii) a digital Streaming video feedbacks through a wireless IP network. A Computer interfacing, which connects the computers and peripherals together, in order for both devices to communicate with each other? From the block diagram, figure 1, the microcontroller from (B) drives the external device which is the DC motor contained in the camera holder. This interfaces with the PC and the microcontroller (B). in order to achieve this, the PC and microcontroller (B), microcontrollers (A and B) are both programmed with instructions they execute. The microcontrollers perform their various functions by executing the instructions programmed into them. A camera motion control application is developed and installed on the PC. The application creates a connection between the PC and the external circuit, and sends serial data to the external circuit through the serial port.

VIDEO STREAMING

Streaming involves sending video/audio feed in compressed form over a network and the video/audio is displayed to the viewer in real time. With streaming video or streaming media, a user does not have to wait to download a file to play it. Instead, the media is sent in a continuous stream of data and is played as it arrives.

Plug-in are part of Web browser that are used to view and listen to the video/audio stream. In a live broadcast, the video signals are converted into a compressed digital signal and it is transmitted from a special web server which enables the multicast, it sends the file to multiple users at the same time, the multicast streaming, helps to transfer data through a router, which copies and sends the streamed data to multiple viewers. 8

A digital technology uses a digital (IP) camera to translate the viewed image into

digital signals which is then converted (encodes) into a sequence of IP packets that is sent through an IP-based network as streams of data. The IP network may be a local area network, a wide area network, or a public internet. At the destination, the receiver re-assembles these packets back into the original video stream,Anthony, (2011).

The restored video can be watched, kept, explored, repeated, or retransmitted to any virtual location anyplace globally. The Encoder converts the analog video/audio signal to digital format (raw video) and compresses (encodes) the raw video via a video codec (compression/decompression), in this different format: M-JPEG, MPEG4 (H.264), Xenny, (2011).

For storage and conveying images via a network, they must be in compressed format in order to reduce disk space or bandwidth. Audios are encoded with an audio codec e.g. AAC, AMR, MP3. Encrypted audio and video streams are collected in a container bit-stream or package such as FLV, 3gp, AVI, MJPEG, MPEG4. The data (wrapper of 3gp, MJPEG or MPEG4) contains both the audio and video as two different "channels". The web server hosting the Web page requests the bit-stream from the streaming server,Tracy, (2011).

The bit-stream is delivered from a streaming server to a streaming client using a transport protocol, such as Real-time Transport Protocol (RTP). The streaming client, which is a PC, may interact with the streaming server using a control protocol, such as RTSP (Real-time Streaming Protocol). However, the PC is connected to the camera using RTSP. RTSP can be seen as the remote control for streaming and the remote has selected play so that the packets start being sent to you. The packets are UDP (User Datagram Protocol) or RTP packets, basically the same thing. The PC then uses a similar codec to repack the data stream received and decodes it to reconstruct the video and audio which can be displayed using a player or a web browser. For the interfacing process, 3 main programs are designed. Two programs are for the two microcontrollers (A and B) while the last program is the application for controlling the camera motion. The video streaming aspect of this work requires just one software to be designed and developed. It is the video player software which displays the real time video feeds from the camera.

THE APPLICATION MOTION CONTROL

The application allows users in selecting the mode which the camera motion should operate and also to select the direction of motion, based on the mode selected. There are two modes: Auto control mode and User control mode. The interface of this application contains the following components: Serial-communications control, Auto mode radio button, User mode radio button, LEFT direction check box, RIGHT direction check box, LEFT motion radio button, RIGHT motion radio button, Mode/motion monitor label, and CLOSE button.

THE MICROCONTROLLER PROGRAMS

The two microcontrollers are involved in this research is controlled by a program. The first program allows the microcontroller (A) to receive data from the PC via the pins. It sets the transceiver (A) in Tx (transmitter) mode,creates and sends the suitable data to transceiver (A) based on the data received from the PC. The program is coded in C (programming language). The second program permits the microcontroller (B) to adjust the transceiver (B) in Rx (receiver) mode. Microcontroller (B) receives a stream of data from transceiver (B) andit sets or clears the two pins in the system subject to the streams of data received from transceiver (B). It is also written in C (programming language). These programs are loaded into these microcontrollers for effective system control, as shown from figure 1.

MOBILITY OF THE CAMERAS

This application allows users to add/select the camera which the video streams would be shown, to add/select the configuration to be viewed in that particular camera video, which is to beshown, the recorded frames acquired from the camera are presented as images in the JPEG format and also play back as stored and recorded from the camera at a definite date. The flow chart for the camera vision application shows the sequence of operation of the application as shown in figure 1.

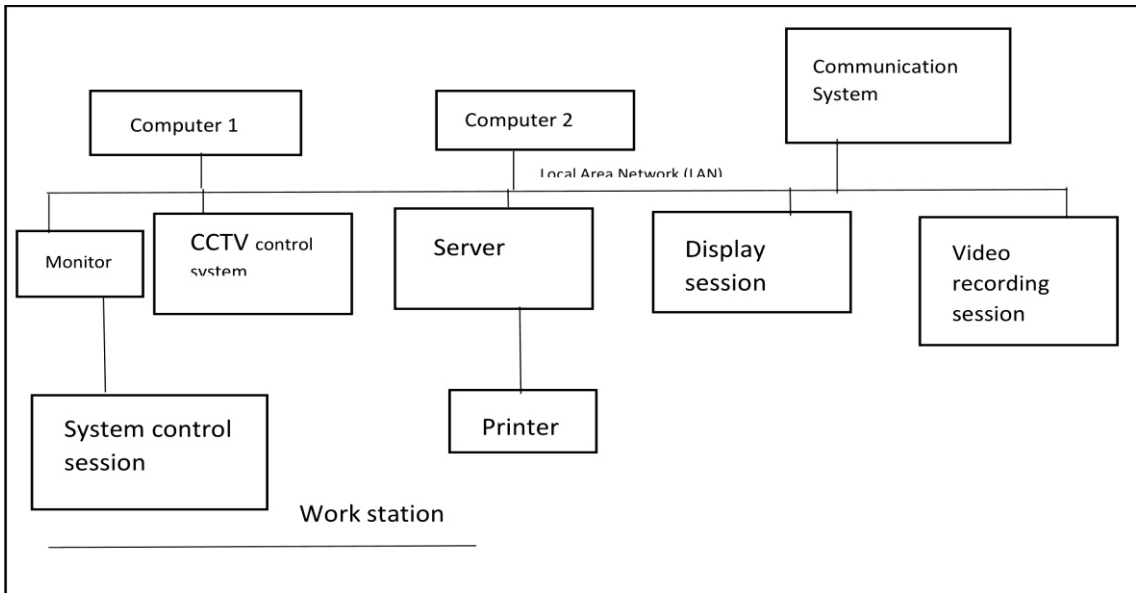

Fig 2: Control Centre Component of a Surveillance System.

SYSTEM IMPLEMENTATION

The system implementation is software based, there interrelationship between the camera and the personal computers that may be attached to the network system. It therefore involves proper interfacing of the camera in motion and the PC for proper monitoring and documentation so that the security system will be effective and efficient. Interfacing is also between the PC and the DC motor which shows the angle at which the camera is to be moved for proper surveillance. Figure 2 shows the sequence of operations on how a particular camera can be selected to view the event that are going on within the area of coverage or to play the events that had been earlier recorded. Figures 1 and 2 show the flow diagrams of the sequence of operations of the microcontrollers that perform the interfacing capabilities between the two microcontrollers and the PC. Interfacing also involves communication between the PC and the DC motor which will be controlled by the PC. Serial communication between the PC and the DC motor is used to achieve the interfacing. The realization of the interfacing actions is by the use of software known as Visual C-Sharp (C#) language. The results obtained when implemented were found to be efficient in operation.

CONCLUSION

The need for a secured system on our campus is a very important factor in any institution of learning. Security is a primary concerned for parent, student, and the school authorities, both at home, offices and institutions of learning. People want their homes, and properties to be secured, while business organizations spend heavily for the security of their domain and assets. This paper presents an idea IP video surveillance with great details on flexibility, remote access and remote control. This model is

appropriate for securing homes, industries, offices and institutions of learning. The DC stepper motor in the design of the camera motion control mechanism that helps the motor to rotates in steps, for the camera to produce clear videos so that persons and things can be appreciably recognized as the camera is in motion. This system will the institution to have a secured environment for students and staff. The system will help Edo State Polytechnic, Usen to monitor activities around some selected areas on the campus.

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