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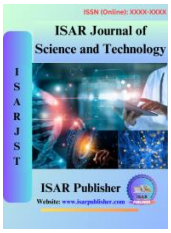

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Improving the Security in Work Environment through a Network-Based Visitors Management System (VMS): A Case of the Federal Polytechnic, Ilaro Administrative Block

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Abstract: Increased insecurity calls for concerted efforts in beefing up the security apparatus within residential and business areas. In achieving this, the reliance of manual means of granting visitors in and out of premises can no longer provide the needed results as this as failed often than not by granting access to unknown visitors that comes in under false identity in order to perpetuate harm or untold damage to life and properties. This research tends to implement a Visitor Management System (VMS) within the study area that will digitally monitor and record the influx of visitors in and out of the administrative block of the study area. The system is a network based solution that runs a on a peer-to-peer network architecture within two-users. The system comprises of outdoor (VTH) and indoor (VTO) VMS devices and an IP Dome Camera all networked using a cat5e network cable. The system allows for visitors to be screened by the rector's secretary via the indoor monitor system before approving the access for the visitor. The implementation of the VMS at the premises of the study area had shown reduced visitors at the waiting room, ensures by security by allowing only verified visitors into the administrative block and better records and monitor of visitors that goes in and out of the building.

Keywords: *Indoor, Insecurity, Networking, Outdoor, Peer-to-Peer, Records, Visitor Management System.*

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INTRODUCTION

Traditional paper logs or guest books are widely used in organizations and educational institutions for recording visitor access, but they are not only time-consuming but also introduce inefficiencies in the visitor management process. The manual process of visitor handling in organizations involves the visitors presenting their identification cards and providing necessary information in a physical logbook. Handwritten entries are prone to errors, and the manual nature of these systems often leads to incomplete or inaccurate information. This is particularly problematic when dealing with a significant influx of visitors, as operators struggle to efficiently verify the identity of individuals entering the building (Noor, Sulaiman and Khor, 2007). One significant aspect of sustainable office management is the effective control and monitoring of visitor activities within these official structures. Traditional Visitor Management System (VMS) has shown many drawbacks such as; time-consuming, labor-intensive, over reliance on papers, security challenges (Chiang, 2018).

Traceability is another limitation of traditional VMS and the absence of a systematic and digitized record poses a significant obstacle in the event of a security incident or historical review. The absence of traceable achieves and proper retrieval system in traditional VMS logs provide little to no data analytics or reporting capabilities, making it difficult for organizations to gain insights into visitor patterns, potential risks, or areas for improvement (Griffin, T., Moore, *et. al*, 2010). In addition, the wear and tear of paper over long time of usage and insufficiency of paper logs raises concerns about data security and compliance with privacy regulations thus, making encryption of access control impossible. (Norizan Anwar, *et.al*, 2012).

In eliminating these problems there is need for cooperate establishments to incorporate a digitized VMS that as automated features is that address modern security and visitor management practices, offering a comprehensive solution to enhance efficiency, security, and long-term data traceability (Mogare, Sumit, *et.al*, 2017). Visitor management is crucial for maintaining corporate security control and efficiently directing visitors to designated areas within a facility. However, as corporate security needs intensifies, a more sophisticated approach emerges (Anwar, N., M. N. Masrek and Y. R. Rambli, 2012). In high-security corporate settings, the traditional manual process is replaced by advanced methods, such as scanning identification cards for archival purposes (Noorhuzaimi, M. N., S. Junaida, A. Noraziah and K. Chen, 2008). This digitization expedites the check-in process and facilitates a more systematic and secure storage of visitor data. In situations where access control is paramount, this digitization enables rapid communication with designated hosts and issuance of access permissions, contributing to a more robust security infrastructure. However, traditional visitor management methods have several limitations. The manual entry of visitor information is laboring and time-consuming, leading to potential delays in

processing visitors. The accuracy of written reports may be compromised due to variations in handwriting, introducing risks of errors or incomplete information. Additionally, written reports impede real-time monitoring procedures, limiting the effectiveness of security measures. The shift towards digitized and automated visitor management systems addresses these challenges, offering a more efficient, secure, and streamlined approach that aligns with the evolving needs of corporate security practices (Satari, B. S., N. A. Abd Rahman and Z. M. Zainal Abidin, 2014). In meeting up with the realities of current times, an increasing number of corporations have introduced automated VMS in an attempt to integrate facilities and enhance the effectiveness of their internal security control procedures. With recent advances in information and communications technology, visitor management systems now offer more than just personnel access control but also integrate a wider range of user-friendly services, such as the authority of accessing certain areas or floors, records of visitor activities, compilation of statistics and reports, digital surveillance, and management of parking conditions. This trend has undoubtedly made automated VMS indispensable to corporate security control. Visitor management system (VMS) are crucial for achieving Sustainable Development by influencing visitor activities to maximize positive impacts and minimize negative ones. They have proven effective in natural and historic sites, reducing damage to fragile buildings and geological features. VMS are increasingly very important in historic, cultural, and natural heritage sites for the benefit of guests and local communities (Chiabai, A., Paskaleva, K., Lombardi, P., 2013). Automated VMS often use keycards, but these can be lost or damaged, leading to irreparable losses. Biometric identification technologies, such as facial features, fingerprints, and DNA, are being developed to provide unique, universal, and permanent identification. Face recognition is the most natural and undetectable approach. The distinct collection methods are noticeable and therefore more susceptible to deception.

In order to manage and keep an eye on visitors within a company, Behzad Shoarian Satari, Nor Azlina Abd Rahman, and Zety Marla (2014) developed the Face Recognition Visitors Management System (FRVMS). The system creates legitimate visitor IDs including the visitor's name, date, time, and facial image using face recognition as an authentication technique. The purpose of this system is to improve security against unauthorized access, including asset theft and espionage.

Using facial detection and recognition, Amritha Nag, Nikhilendra J N, and Mrutyunjay Kalmath (2018) created a method to improve door security in sensitive areas. The system has automatic door access control, email notification, facial detection and identification, and image capture. For face identification, OpenCV reduces the size of the image without sacrificing important details. Moreover, the technology enables door lock remote access through the Telegram Android app. For security reasons, the taken pictures are emailed.

Hasam (2010) The HASAM Company created the VMS 3000 visitor management system, which is appropriate for businesses and construction sites. It provides tourists comfort through high security levels and automated processes. RFID technology is integrated into the system to track and manage visitors. Web-based or intranet systems can be used for communication with the very stable VMS 3000. To improve security, it supports contact chip cards, biometric, active, and passive RFID tags. The system is easier to use and supports a variety of scanners, including business card readers, passport scanners, national ID readers, and conventional document scanners because it is fully integrated with an access control system.

Aryah (2012) The Smart Lobby visitor management system was created by The Aryah Company. It tracks visitors with the use of digital cameras, badge printers, fingerprint technology, and secure software. This system delivers a safe atmosphere, lowers losses from scams, and a comprehensive management system for monitoring visitor activity. Customizable name badges, company logos, and visitor data such as name, company, and contact name are among the benefits. To add images and stamp badges with arrival date, time, and incremental serial numbers for security, a digital camera is utilized. Because the system only needs to enter visitor names and information once and does not require registration for subsequent visits, it saves time. Since the information is already in the database, all that is needed for the subsequent Visit.

(Arti Kate, Vaibhav Magar, Vaibhav Vyavahare, Sayali Somwanshi, 2019) The BeagleBoard with Zigbee real-time home security system with remote fire warnings and intrusion detection is presented in the article. It makes use of cutting-edge technologies like cameras, GSM, and FTP servers, but it is devoid of alerting features like phone calls, SMS, and emails, as well as live streaming.The goal of this project is to put a gadget at a home's main door that uses a USB webcam to take pictures and a PIR sensor to detect movements from visitors. The photos are emailed to the home owner and are momentarily kept on a Raspberry Pi.

In 2013, Md. Nasimuzzaman Chowdhury, Md. Shiblee Nooman, and Srijon Sarker created a system that links any door to the internet, enabling door access to be controlled remotely. If a guest is left unattended, the designated person can observe the visitor via a webcam after being alerted by Twitter. The visitor's photo is captured by the system, which then emails or tweets the attachment. Messages can be sent through the internet and show up on the door's screen. In the event of an emergency, evidence can be obtained by remotely controlling the door lock.
This study details how to install a video intercom and IP camera-based visitor management system at The Federal Polytechnic, Ilaro's administrative block using a local area network architecture.

A DESCRIPTION OF THE STUDY AREA.

The study site is representative of a typical Nigerian student community. The Federal Polytechnic Ilaro is located near the Nigerian city of Abeokuta, inside Ilaro in Yewa town. Throughout the year, average temperatures range from 25 to 28 degrees Celsius (77 to 82 degrees Fahrenheit). Decree No. 33 of July 25, 1979, established the Federal Polytechnic, Ilaro. On November 15, 1979, the Polytechnic welcomed its first students on a makeshift location given by the town of Ilaro, an ancient settlement in Ogun State. About 0.5 kilometers from the Ilaro township intersection, the Anglican Grammar School property served as the Polytechnic's original location. Before relocating to its permanent location in 1983, the Polytechnic was housed on this temporary location, when it relocated to its long-term location, around three kilometers from Ilaro Township, along Ilaro/Oja-Odan Road. Additionally, Idi-iroko, the town that separates Nigeria and the Benin Republic, is roughly 60 kilometers away. The historic town of Ilaro is situated

landlocked between Lagos and Ogun State's capital, Abeokuta. On its permanent campus, the Polytechnic covers an area of 898.116 hectares. Currently, the Polytechnic is home to more than 20,000 students.

The east and west campuses of the Polytechnic are shown in their master plan. The Main Library, the Directorate of Student Affairs, the Medical Center, Poly-consult and Industrial Services, the Post Office, the Works and Services Department, the Petrol Station, Staff Schools (Nursery, Primary, and Secondary), staff quarters, student hostels, sports facilities, Skye Bank, United Bank of Africa Plc, Ilaro Polytechnic Microfinance Bank Ltd, the Student Computer Center, the School of Applied Science, and the School of Management Studies are all situated within the east campus. The West Campus is also home to the Engineering and Environmental Studies Schools, the Administrative block, Central Examination office, Directorate of Information and Communication, Multipurpose Hall, Raheem Oloyo Conference Centre . About one kilometer separates the primary Administrative block from the "beautiful gate," which is the school's primary entrance. The office of the management team, which consists of the Registrar, Deputy Rectors, Rector, and Polytechnic Bursar, is located within the main Administrative block. The Main Administrative Block receives 100 visitors per day on average, which equates to 500 visits per week and over 1,800 visits per month.

VISITOR MANAGEMENT SYSTEM IMPLEMENTATION

The VMS is an hardware and Software based solution. The hardware configuration comprises of networking materials like Power of Ethernet (PoE) Switches, IP Cameras Visitor Outdoor and Indoor Units and Cat5e network cable for connecting the hardware. The software configuration involves the IP address technic and the configuration of the Switch and the Visitor units. The implemented VMS for this research is a peer-to-peer system that is limited to two users who can both initiate calls or respond to calls from both ways.

The Hardware Implementation

The hardware consists of the Video Intercom Outdoor Station (VTO) (Outdoor Station), Video Intercom Indoor Monitor (VTH), IP Dome Camera and the POE Switch. The block diagram in fig. 1, shows the connection of the hardware components of the VMS system. The VTO, VTH and IP Dome Camera are all connected via a 4-port PoE Switch which is connected to a 24V power supply source.

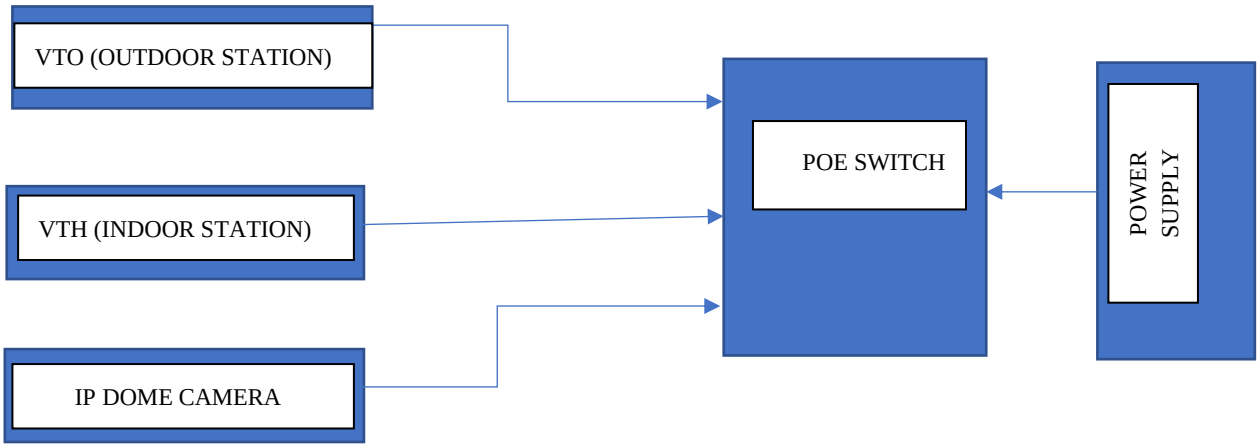

Figure 1: Block Diagram of the Hardware Implementation

The implemented system as shown in fig.2, is a peer-to-peer local network configuration that comprises of two users – the reception and the rector's office and calls can be initiated and responded to from either of the users. In implementing, one unit of the VTO, VTH and IP Dome Camera was used.

The VTH is an indoor system that allows users to see live video footage from the reception via the IP Dome Camera and also serves as a two-way communication audio unit through its built in microphones and speakers that allows for communication with the reception. In addition it makes visitor identification easy before granting access to the visitor.

The VTO is a rugged outdoor device built to withstand harsh weather conditions. It comes with built in camera or allows for independent connection of cameras that captures live footage of visitors and environment to the VTH. It also allows for a two-way communication with the VTH via its built-in audio infrastructures. The VTO comes with a night vision capabilities that enhances visibility in low-light or nighttime conditions.

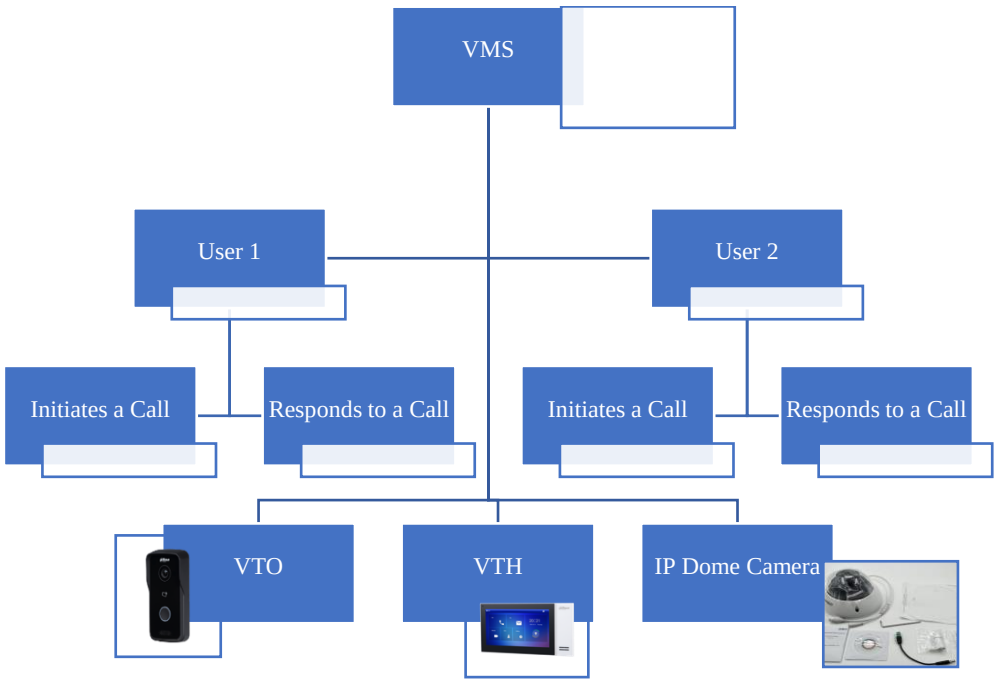

Figure 2: Block Diagram Showing the operation of each unit of the Hardware

Software Implementation

The software design has already embedded into the VTH Video Intercom Indoor Station. This device is embedded with an operating system that is openly accessible or customizable by end-users. They use embedded firmware developed specifically for the devices by the manufacturers. This firmware is closed and proprietary, meaning it is not intended for end-users to modify or access the underlying operating system. The device manufacturer uses proprietary, closed, and proprietary embedded firmware for their devices, tailored to their specific functionalities and security requirements

The software implementation is achieved by using the inbuilt applications of the VTO, VTH and IP Cameras to configure them for connectivity with each other. Fig. 3 shows the IP address configuration of the system for LAN connectivity of the devices while fig.4, shows the configuration of the VTO and VTH devices.

Figure 3: Network Configuration.

Figure 4: VTO and VTH Configuration

Working Principle of the Visitor Management System

The Visitor Management System is a security solution designed to improve visitor control and authentication at the study area. The installed system as shown in fig.5, comprises several key components, including the Video Intercom Outdoor Station (VTO) for outdoor communication, an IP Camera for effective identification and monitoring, and a PoE Switch for central hub connectivity. The VTO is strategically placed outdoors to facilitate communication between visitors and the user or operator within the premises. Equipped with video and audio communication capabilities, it allows visitors to request entry and converse with the host. The IP camera captures additional video feeds, providing a comprehensive view of visitors as they arrive or depart. The PoE switch facilitates connectivity and simplifies installation by providing power over the Ethernet cable to all connected devices, eliminating the need for multiple power sources. The Video Intercom Indoor Station (VTH) serves as the control center, enabling users or operators to configure the camera and other connected devices. It plays a multifaceted role, including visitor authentication, arrival confirmation, visual authentication, two-way communication between the indoor station and outdoor components, handling notification alerts, and maintaining records of interactions. Data flow is ensured through the PoE switch, allowing real-time identification and authentication of visitors. This system enhances security and simplifies the visitor management process, making it a vital tool for controlling access and ensuring location safety.

Figure 1: Installed Switch with connected network switch for VTO, VTH and IP Camera at the Study Area Premises.

CONCLUSION

A Visitor Management System (VMS) equipped with IP cameras and video intercom technologies is a comprehensive solution for monitoring visitors within a company. The technology captures high-resolution video, increasing security and making registration and monitoring easier. Real-time communication between guests and security workers speeds up check-in and improves the overall visitor experience. The intercom system may be utilized for distant communication, allowing workers and guests to connect more efficiently. The integration of these technologies also promotes a proactive security strategy by providing vital data for incident investigations and preventive actions.

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