Automated Fingerprint Identification System using Biometrics

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Abstract: **The proposed study focuses on the development of an Automated Fingerprint Identification System (AFIS) for the Municipal Disaster Risk Reduction and Management Office (MDRRMO) in Occidental Mindoro. The device uses fingerprint scanning technology to tackle the problem of identifying people after disasters and accidents. AFIS provides a trustworthy and effective way of identification in disaster situations where conventional identifying techniques are degraded. Residents can register and submit necessary information, including fingerprints, through their own barangays using the study's user-friendly portal. The victim's name, age, current residence, and emergency contacts can all be quickly identified thanks to this extensive database. The AFIS implementation aids MDRRMO workers by speeding up everyday tasks, but it also gives victims' families quick updates, so they are aware as soon as support is given. The suggested solution demonstrates the potential of AFIS in disaster management while addressing the drawbacks of current identifying techniques. The technology's capacity to process a high volume of fingerprints makes it easier to identify victims right away quickly and reliably, facilitating prompt medical assistance and family reunion. To guarantee proper deployment, however, concerns for the fingerprint image quality, infrastructure needs, and adherence to privacy laws must be made. Overall, this study makes use of AFIS to improve the Municipal Disaster Risk Reduction and Management Council's (MDRRMC) ability to respond to disasters and manage them effectively in Occidental Mindoro. The approach could have an influence that goes beyond the immediate area by serving as a model for other communities and organizations looking to enhance their identification procedures in the event of disasters and accidents.**

Index Terms**: Automated Fingerprint Identification System (AFIS), Disaster Management, Disaster Risk Reduction, Identification.**

INTRODUCTION

The use of Automated Fingerprint Identification System (AFIS) has been extended to aid in the identification of individuals during calamities and accidents. It might be difficult to identify the victims of catastrophes like earthquakes, floods, or hurricanes, especially if identifying documents are lost, destroyed, or unavailable. Fingerprints are a reliable biometric indicator in these circumstances.

The fingerprints of people who could be affected by disasters can be stored and compared using AFIS. The system might be used, for instance, to save the fingerprints of people who reside in areas vulnerable to natural disasters, such as earthquake-prone zones, flood-prone zones, or landslide-prone zones. By matching the victims' fingerprints with the fingerprint database that has been maintained, AFIS can be utilized to rapidly identify the victims in the event of a disaster.

In situations where it is difficult to identify victims, such as in terrorist attacks or accidents involving many casualties, AFIS can also be used. In such cases, fingerprints can be utilized as the main means of identification to promptly identify victims and give their families closure.

In conclusion, the identification of people during disasters and accidents is a crucial use of the AFIS. It offers a trustworthy and effective means of identification that can aid in the prompt recovery of victims and reunion with their families.

A road accident is an unanticipated occurrence brought on by the movement of automobiles on roads and highways. The problem of traffic accidents is widespread. According to the global status report on roads, 1.35 million people die in traffic-related incidents every year. Today, deaths from traffic accidents top all other causes of death for those aged 5 to 29. (WHO, 2018). The families, employment, communities, and states in which the victims reside are all significantly impacted by these injuries and fatalities. Although overspeeding by drivers, making

and receiving calls while driving, irresponsible driving, poor road management and maintenance, to name a few, are some of the known causes of traffic accidents. Major factors in the rate of human mortality include the emergency response team's (ERT) casual demeanor when the victims arrive at the hospital. The inability to quickly identify patients for emergency medical care is the ensuing cause.

In the past, the methods that were most commonly used for user authentication and identification either involved the use of tokens (identity cards, personal identification numbers) or knowledge-based (passwords), but all of these techniques have a number of drawbacks, including being inaccurate, unreliable, and expensive to maintain. However, facial recognition and fingerprint scanners are utilized by hundreds of millions of people every day since biometric technology has now entered the mainstream. This suggests that errors and vulnerabilities in the systems and practices that use biometric data patterns could have an effect on the same millions of people. (2023; Trend Micro Incorporated).

By comparing rolled fingerprint pictures to registered records, the Automated Fingerprint Identification System (AFIS) is used for identification. Latent print identifications are where the AFIS system's greatest potential value lies. the AFIS system's capacity to quickly search through a large number of records and display candidates.

Automated fingerprint identification systems (AFIS) provide a useful opportunity for identifying people in disasters and accidents. They offer fingerprint-based identification that is quick and accurate, which is essential in urgent situations. Because of AFIS's effectiveness, a lot of fingerprints can be processed, allowing for quick identification in emergency situations. Additionally, the incorporation of biometric data in AFIS improves security by making it harder for fraudsters to pass as someone else. AFIS is a helpful tool for police enforcement organizations and emergency response teams due of its accessibility, including remote access. There are restrictions to take into account, though. The accuracy of AFIS depends on the fingerprint quality, thus inaccurate fingerprints can occur. A strong infrastructure is also needed for AFIS, which could be problematic in places with poor access to technology or unstable power sources. To protect people's rights, it is also necessary to address legal and ethical issues, guaranteeing compliance with privacy and consent laws. Overall, AFIS has a great deal of potential for locating people during disasters and catastrophes, but its responsible and effective use depends on careful consideration of its constraints and respect to ethical standards.

As part of coping with the issue in identifying the information of a victim, the Automated Fingerprint Identification System for MDRRMO using Fingerprint Scanner will be conceptualized and thereby proposed. When there are several fatalities or there is a question about who the deceased victims are, the system will identify their identities by collecting information about their name, age, current address, people to contact, and fingerprints.

In addition to that, the system provided an interface for each barangay to enable residents to register and provide the necessary information, as well as their fingerprints. As the study was finished already it was beneficial to MDRRMO personnel, as well as the relatives of the victim, who were able to be informed as soon as help arrived.

Furthermore, the said study provided a user-friendly application that expedited, facilitated, and managed the day-to-day works and performances of the DRRMC Occidental Mindoro.

LITERATURE REVIEW

It presents a review of the relevant literature, analyzes the methods, and displays reliable data assisting the issues and solutions of the research project.

On March 18, 2018, in Sablayan, Occidental Mindoro, a bus overturned and plummeted into a ravine, killing 19 people and injuring another 21. According to the Police, the Dimple star passenger bus was passing through the road in the middle of the night that had been under repair, and then suddenly the bus slammed into barricades causing the bus to fall off the Patrick Bridge in Barangay Batong Buhay falling about 20 meters into a ravine. Identifying each victim takes a couple of time to figure out their identity because some of their identification Card is on their baggage and by the time the accident happened the rescuer first prioritized the casualties instead of determining each victim. Data from the Philippine Statistics Authority (PSA), Senator Grace Poe noted that as of the year

2014, a total of 43,853 deaths have been recorded because of a vehicular accident (Tupas, 2018). Statistics show that in Metro Manila there are about 32,000 accidents that have been reported from January to August. Some of the victims carry an identification card and some don't, so the rescuer finds it tough to know the victim's identity (Statistic, 2020).

The unidentified bodies that were recovered from the Super Typhoon Haiyan wreckage have been mass buried, according to the Tacloban City authorities. The National Disaster Risk Reduction and Management Council (NDRRMC, 2014) indicated that 6,100 persons had been killed and another 1,700 were reported missing in a report that was released on January 7, 2014. According to DOH undersecretary Janet Garin, DNA testing should be used to identify dead corpses in the Philippines. In the event that DNA is not present on that particular day, the Automated Fingerprint identifying System using Biometrics will be used as a quick identifying method.

To avoid the difficulties encountered in identifying victims of accidents such as the bus crash in Sablayan, Occidental Mindoro in March 2018, there is a need to implement effective and efficient identification methods. The use of an Automated Fingerprint Identification System Using Biometrics could be highly beneficial, serving as a rapid identification tool particularly in situations where DNA testing is not immediately available, ensuring that the identities of victims are accurately determined in a timely manner.

Council for Disaster Risk Reduction and Management. The current Provincial Disaster Management Office will henceforth be known as the Provincial Disaster Risk Reduction and Management Office, and it will be in charge of carrying out the duties outlined in Section 12 of R.A. No. 10121, or the PDRRM of 2008, including: (1) Plan, schedule, and coordinate actions for disaster risk reduction and management in compliance with NDRRMC standards and guidelines; (2) Support provincial risk assessments and emergency planning initiatives; (4) Plan and carry out provincial-level training, orientation, and knowledge management efforts for disaster risk reduction and management; (3) maintain a local risk map; and gather data on regional vulnerabilities, natural disasters, and risks associated to climate change. Identify, assess, and manage the hazards, vulnerabilities, and risks that may occur in the province; (5) run a multi-hazard early warning system that is connected to disaster risk reduction in order to deliver precise and timely guidance to local or national emergency response organizations and the general public through a variety of mass media; (8) disseminate inf and (12) serve as the secretariat and executive branch of the PDRRMC.A few differentiating and quantifiable markers serve as the foundation for an individual's personal identification. These unique identities cannot be copied, lost, shared, or forgotten since they are one-of-a-kind. The biometric technology has an advantage over the conventional methods because to its potential for improved accuracy, convenience, and cost efficiency. As a result, I conducted research and will create an important application that will keep pace with technology and help the Occidental Mindoro Disaster Risk Reduction and Management Council identify victims more quickly.

A biometric is a unique attribute of a person, such as their voice, face, fingerprints, hand shape, or deoxyribonucleic acid (DNA), that can be used to identify them automatically. Human recognition using biometrics can be used as a type of security in data processing operations to guarantee data confidentiality and integrity. Since fingerprints can be determined via biometrics, this technology will be applied in this investigation. (Thales Group, 2022).

Maintaining health records in hospital information systems is a crucial requirement, as is having a distinctive means to identify sufferers. Despite tremendous advancements in medical innovation and technology, there are still serious issues with identifying a person and their blood type in an emergency. Information and communication technology (ICT) can transmit a request for an emergency blood group and assist in locating the accident's location using a global positioning system (GPS). In this chapter, a novel victim identification method based on an autoencoder and extreme learning machine (ELM) methodologies that can increase accuracy is presented. To highlight the spatial gradients of the finger's edges, an autoencoder is applied to photographs of a victim's fingerprint. The use of an autoencoder reduces the data's dimensionality while also denoising the input data. The distinctive features needed for victim identification are extracted from a preprocessed image

using an ELM. To improve the precision of victim recognition, an efficient optimal cost region matcher (OCRM) using deep learning techniques is implemented. With the help of this app, "the man in the street" can tell a victim's family of their whereabouts. Additionally, the system's ability to identify and manage blood types helps to reduce risk during initial treatment (Vidyasree et al., 2018).

The number of victims, the methods used to destroy the bodies, the degree of body fragmentation, the rate of DNA deterioration, the accessibility of the bodies for sample collection, and the type of DNA reference samples that are available are just a few of the numerous interrelated circumstances and factors that may pose a challenge to the ultimate DNA identification goal. In this article, we look at the various DNA identification analysis steps (DNA sampling, DNA analysis and technology, DNA database searching, and concordance and kinship analysis) while reviewing the "lessons learned" and scientific advancements made in some mass disaster cases reported in the scientific literature. We will place particular emphasis on the insightful scientific feedback that the genetic forensic community has received from the cooperative efforts of several public and private USA forensic laboratories in aiding with the more crucial aspects of the World Trade Center (WTC) mass fatality of September 11, 2001. We'll also discuss the primary difficulties in locating the victims of the latest South Asian tsunami, which resulted in the steepest increase in the number of fatalities ever. Additionally, we give information from two recent mass death incidents involving Spanish victims: the Yakolev-42 airplane crash in Trabzon, Turkey, on May 26, 2003, and the March 11, 2004, Madrid terrorist attack.

The proposed system “Automated Fingerprint Identification System" that improves on the current fingerprint biometric method of victim identification. The two key participants in this system are the transport officer and the law enforcement officer (FRSC/Police). Every one of these actors has a role to play. Every victim using the system is required to register. During registration, the transport officer collects data on the bus and the passengers, including their fingerprints, passports, next of kin names, and contact phone numbers. This data is subsequently transferred to the cloud and kept in a database that is shared by the company and law enforcement agencies. In the event of an issue, onlookers will dial the emergency numbers (112 or 122) of the relevant law enforcement agencies to inform the officer of the location of the incident. When the officer in charge gets to the scene of the incident, they check the victims' identification using the system linked to the fingerprint reader. The system compares the fresh fingerprint input to the previously obtained biometric template as part of the procedure. If a match is found, the technology identifies the victim and displays the victim's information. The officer then creates and sends an SMS to the specified victims' family members telling them of the victim's location in the hospital (Iyawa, et al., 2019).

Traffic accidents are one of the major factors that cause fatality. An important factor affecting the survival rates after an accident is the time between the accident and the dispatch of emergency medical personnel to the scene. If there is no delay between when an accident occurs and when first responders show up, mortality rates decrease by 6%. One strategy for reducing the time between an accident's occurrence and the dispatch of first responders is to use in-vehicle automatic accident detection and notification systems, which detect when traffic accidents occur and promptly inform emergency services. It is costly to install these in-car technology in older automobiles, and not all vehicles come equipped with them. This paper describes how smartphones, such as those produced by Apple and Google, can automatically identify traffic accidents using accelerometers and acoustic data, instantly notify a central emergency dispatch server after an accident, and provide situational awareness through pictures, GPS coordinates, VOIP communication channels, and accident data recording. This study adds the following to the body of knowledge on smartphone-based traffic accident detection: (1) We introduce a formal model for accident detection that combines sensors and context data, (2) We show how smartphone sensors, network connections, and web services can be used to provide first responders with situational awareness, and (3) We present empirical results highlighting the efficacy of various approaches used by smartphone accident detection systems to prevent false positives (Vidyasree, et al, 2018).

METHODOLOGY

The conceptual framework of the study shows the input needs for developing the system. This also comprises the order in which each step of the planning, designing, data collection and development, research, data synthesis, testing, and deployment of the system to be created for the project application system is completed.

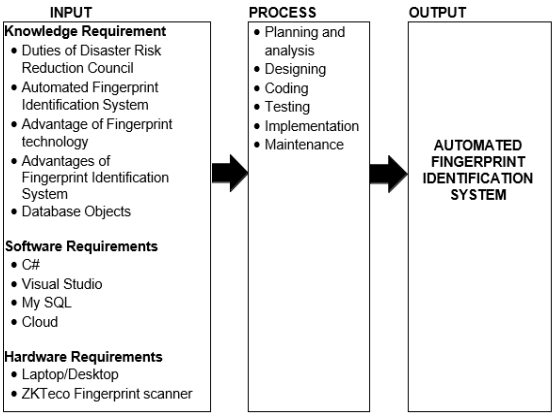

Figure 1. Conceptual Model

The study's objective is to develop a system to identify one's identity if the victim got into an accident. This study will help rescuers such as MDRRMO, health workers, or even fire fighters to do their tasks easier. This study needs to gather everyone's information such as name, age, address, birthdate, person to contact, and fingerprint. The information gathered will be stored in the database. All ages can register in the system and for the children ages 5 and below their parents should be present during their registration.

Using fingerprint technology for this study will be a significant advancement in authenticating a person's identity in any incidence where the victim is unidentified and without carrying an identity card. The rescuer will scan the victim's fingerprint to determine his or her identity; if the scanner does not find anything about the victim's details, the victim has either not been registered with his or her barangay or is an outsider. This study, "Automated Fingerprint Identification System" was limited to give an automated incident victim identification system for DRRMC of Occidental Mindoro on how they identify the victims of accidents.

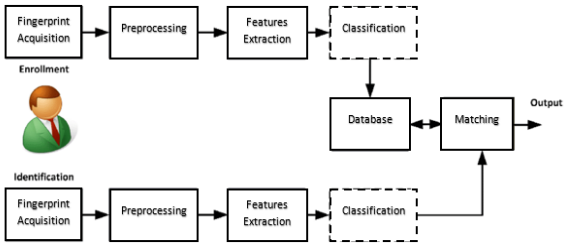

Fig. 2. System Flowchart

The AFIS system flowchart is designed to be efficient, accurate, and secure, allowing for the rapid identification of individuals during emergencies and disasters

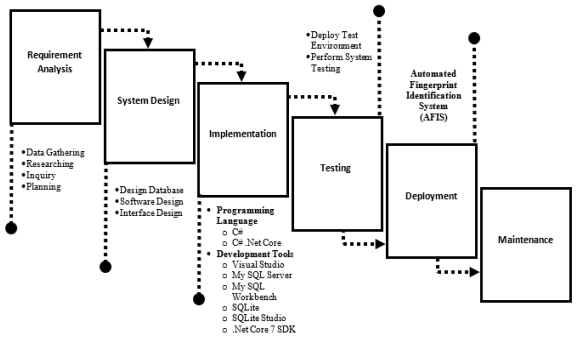

Fig. 3. Software development lifecycle Waterfall Model

Requirements Gathering Phase: In this phase, The system's requirements are compiled and evaluated. This entails identifying the system's end users—the Barangay, PDRRMO, and MDRRMO—understanding their needs, and figuring out both the functional and non-functional requirements.

Design Phase: In this phase, the requirements acquired from the previous phase are used to design the system. This involves building the system flowchart shown in figure 2, defining the database structure, and figuring out the necessary hardware and software.

Implementation Phase: In this phase, the actual coding of the system takes place using C# Windows form for desktop user registration and fingerprint scan, and C# .Net Core for web API's. This includes developing the user interface using visual studio community edition, implementing the database schema such as; My SQL Server for online server database, My SQL Workbench for management and designing server database tables, SQLite for offline local database, SQLite Studio for management and designing local

database tables, and integrating the hardware and software components such as; .Net Core SDK for open-source developer platform to build the system, laptop or desktop, and ZKTeco for the fingerprint scanner.

Testing Phase: In this phase, the system is rigorously tested to make sure it adheres to specifications and is free from glitches and mistakes. Functional testing, performance testing, and security testing are all included in this.

Deployment Phase: In this phase, the system is deployed to the end user which is the PDRRMO. This includes installing the hardware and software components, configuring the system, and conducting user training.

Maintenance Phase: In this phase, the is supported and maintained. Bugs and errors must be fixed, and the system must be updated to reflect any changes in requirements. and to provide technical support to users.

RESULTS AND DISCUSSIONS

This part of the study shows Context Diagram and Design of Automated Fingerprint Identification System.

Below is the Context Diagram Level 0 of Automated Fingerprint Identification System Using Biometrics.

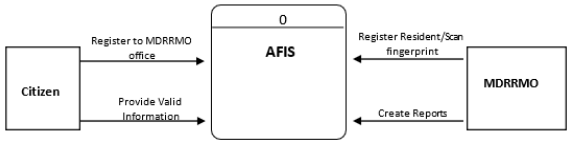

Fig. 4. Context Diagram Level 0.

Figure 4 Context Diagram of Automated Fingerprint Identification System level 0. The admin/user can register the resident personal data, scan the victim fingerprint, and has full access to the system.

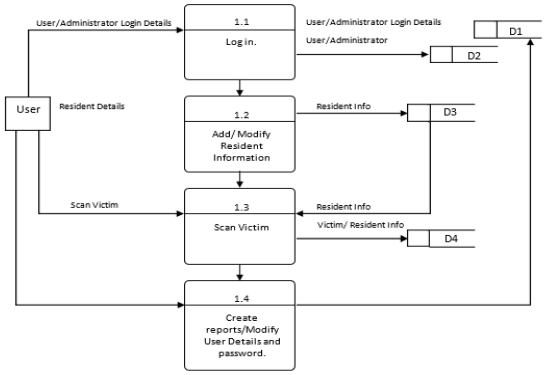

Fig. 5. Context Diagram level 1.

Figure 5 Context Diagram of Victim Identification System level 1. represents the flow of the system and how the user manipulates all functions of the system by adding resident information, scanning the victim fingerprint, and creating reports etc.

Fig. 5. Login form of Automated Fingerprint Identification System Using Biometrics.

Figure 5 shows the system log-in window. This form is a secure access point that allows authorized personnel to access the system's features and data. The AFIS login form typically requires users to enter their login credentials, which may include a username, password.

Fig. 6. Main form of Automated Fingerprint Identification System Using Biometrics.

Figure 6 shows the main form of an Automated Fingerprint Identification System (AFIS) using biometrics is the central interface that enables authorized users to access and utilize the features and data of the system. This form typically includes a variety of tools and functions for performing tasks such as identifying victims, victim history, resident records, and user logs.

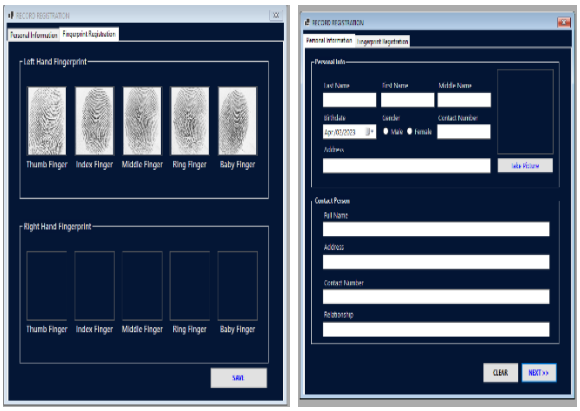

Fig. 7. Registration of the Resident Information of Automated Fingerprint Identification System Using Biometrics.

Figure 7 shows the registration process for the Resident Information of an Automated Fingerprint Identification System (AFIS) using biometrics is the initial step in creating a record of a resident's personal and biometric data. This process typically involves collecting and entering the resident's personal information including name, address, birthdate, and contact details, as well as biometric information like fingerprint images.

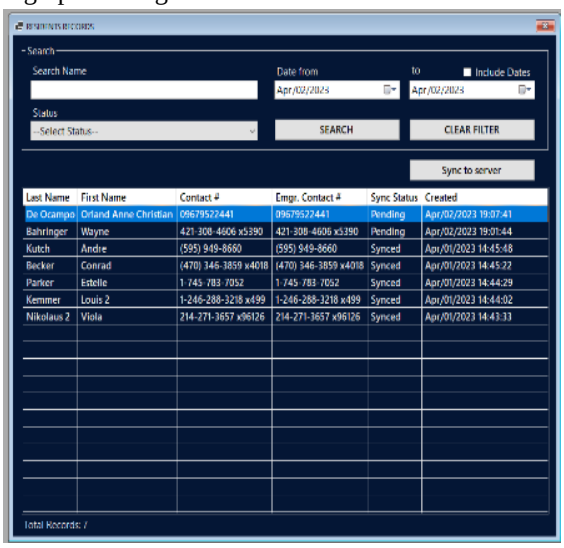

Fig. 8. Search victim records of Automated Fingerprint Identification System Using Biometrics.

Figure 8 shows The List of Resident Information Form for an Automated Fingerprint Identification System (AFIS) using biometrics is a document designed to collect and record information from residents that is necessary for biometric identification purposes. Personal details including name, address, date of birth, and contact details are often included on this form.

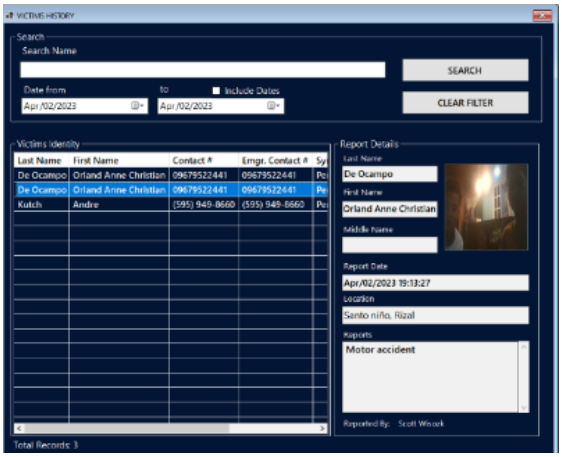

Fig. 9. Victim history record of Automated Fingerprint Identification System Using Biometrics.

Figure 9 shows the list of Victim history of Automated Fingerprint Identification System (AFIS) using biometrics can be utilized in managing victim information during calamities and accidents. The system can maintain a list of victim history that includes personal information such as name, age, gender, and contact information. This list can facilitate communication and contact with the victims' families or next of kin, to provide support and assistance, also to aid in the recovery and identification of victims.

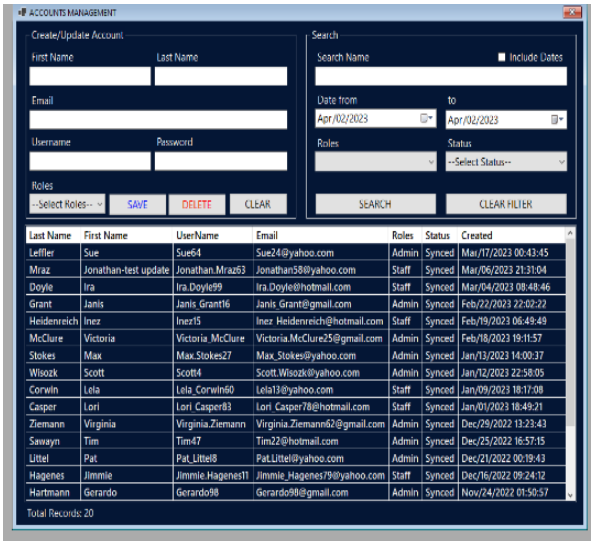

Fig. 10. Account Management Form of Automated Fingerprint Identification System Using Biometrics.

Figure 10 shows the Account Management Form for Automated Fingerprint Identification System (AFIS) using Biometrics is a critical component of the system's security infrastructure. It enables authorized personnel to create, manage, and update user accounts for accessing the system.

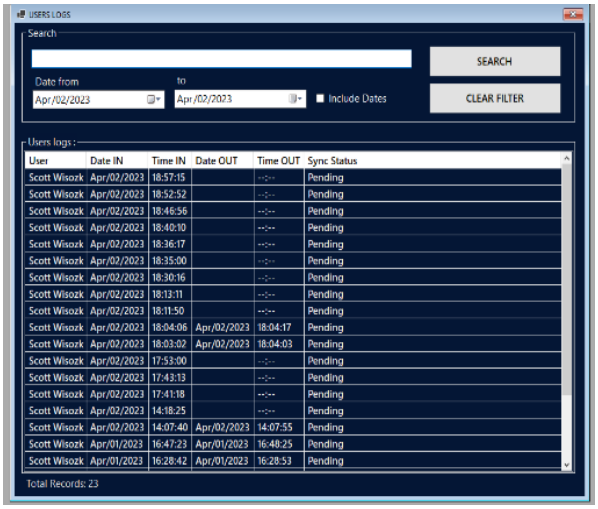

Fig. 11. User logs of Automated Fingerprint Identification System Using Biometrics.

Figure 11 shows the User Logs feature of the Automated Fingerprint Identification System (AFIS) using Biometrics is an important tool for monitoring and reviewing system activity. It captures a record of all user interactions with the system, including logins, date in, time in, and time out.

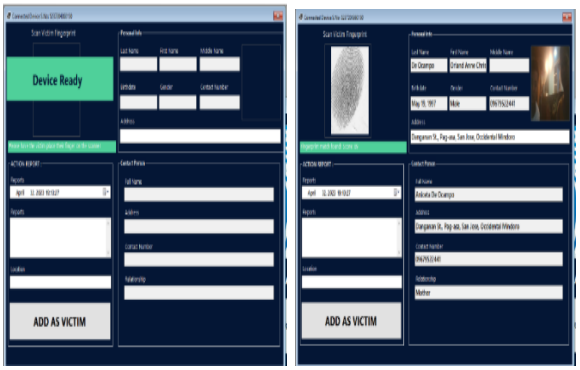

Fig. 12. Adding victim on list of Automated Fingerprint Identification System Using Biometrics.

Figure 12 shows the form to Add a Victim for Automated Fingerprint Identification System (AFIS) using Biometrics, it is a critical component of the system's database management infrastructure. It enables authorized personnel to enter and store victim information, such as name, age, gender, and contact details, into the system. To protect the privacy and security of victim information and preserve public confidence in the justice system, it is crucial to make sure that victim information is gathered and stored in accordance with pertinent legal and ethical guidelines and that access to the data is restricted to authorized personnel only.

CONCLUSIONS

Automated Fingerprint Identification Systems (AFIS) are effective tools that can be used to help identify people in disasters and accidents. These technologies can assist various governments and emergency response teams in promptly identifying victims and survivors, allowing them to get in touch with their loved ones and offer them the support they need.

In conclusion, the Automated Fingerprint Identification System (AFIS) has proven to be a successful tool in attaining its goals when used to manage victim information during disasters and accidents. The system facilitates the identification and recovery of victims by keeping track of victim history, personal information, and biometric data. It also gives contact information with the victims' relatives or next of kin.

The AFIS provides precise and trustworthy biometric data for identification purposes, aiding in the investigation and prosecution of offenses connected to the disaster or accident. The security infrastructure of the system, which includes Account Management and User Logs, also aids in protecting the security and privacy of victim information and preventing unwanted access to the system.

In managing victim information during disasters and accidents, as well as guaranteeing the safety and security of communities, the AFIS using biometrics is a useful resource for NDRRMO.

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