Fingerprint-Based Smart Digital Life Certificate Using Mobile Technology

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A pension plan is a savings solution for pensioners that plays a vital role in pensioner's life after retirement. Different pension disbursing systems have been implemented which aim to support individual pensioners after retirement. This study highlights several critical issues for pensioners. Most of the pensioners are of old age, and it is difficult for them to move physically towards the concerned authority for life authentication in a periodic manner. This study proposes a model for pension disbursing based on the fingerprint scanner-enabled smartphone. The proposed model is designed for pensioners' bi-annual authentication and issuance of Digital Life Certificates (DLC) ubiquitously. The proposed model eliminates the physical presence and traveling expenses. The Hammer and Champy methodology are utilized to construct the model while the Delphi method is used for evaluating the proposed model. This study involves quantitative research to investigate the behavioural intention to accept fingerprint scanner-enabled smartphones for the pension-receiving process. The data was analysed by applying the goodness-of-fit Chi-square test to inspect the efficiency and impact of the adoption of a mobile-based biometric fingerprint system (MBFPS) for the pension disbursing system.

Keywords: Pension, Pensioner, Business Process Reengineering (BPR), Digital Life Certificate (DLC), Fingerprint scanner-enabled smartphone.

Introduction:

A pension serves as an alternative form of monthly payment for individuals after retirement. It promotes a culture of saving and provides a dependable and secure source of income during post-employment years [1], [2]. The pension amount is accumulated throughout employment and, upon retirement, is disbursed monthly to support the basic living needs of each pensioner. As people age, their ability to work diminishes, and they prefer to retire. After this transition, individuals often worry about covering monthly expenses to maintain their standard of living [3], [4]. The pension system is designed to ensure financial stability and a better quality of life for employees after their working years end. Pension schemes are flexible, cost-effective, tax-efficient, and portable options for retirement savings. Pensioners may choose to receive their benefits either as a lump sum or as regular monthly payments deposited directly into their bank accounts. These systems aim to provide financial assistance to those experiencing loss of income due to old age, disability, or the death of a family breadwinner [5]. A pension offers comprehensive protection from investment risks, health issues, and financial insecurity after retirement [6], [7].

Under the Employees' Pension Scheme, payments are made directly to the retired individual, while the Employees' Family Pension Scheme ensures benefits for eligible dependents in the event of the pensioner's death. Globally, pension systems are administered by state authorities [8], [9]. Pension frameworks are typically classified as either contributory or non-contributory systems, as shown in Figure 1. The contributory system plays a pivotal role in income support for retirees [10], employing either the funding or benefit method for disbursement.

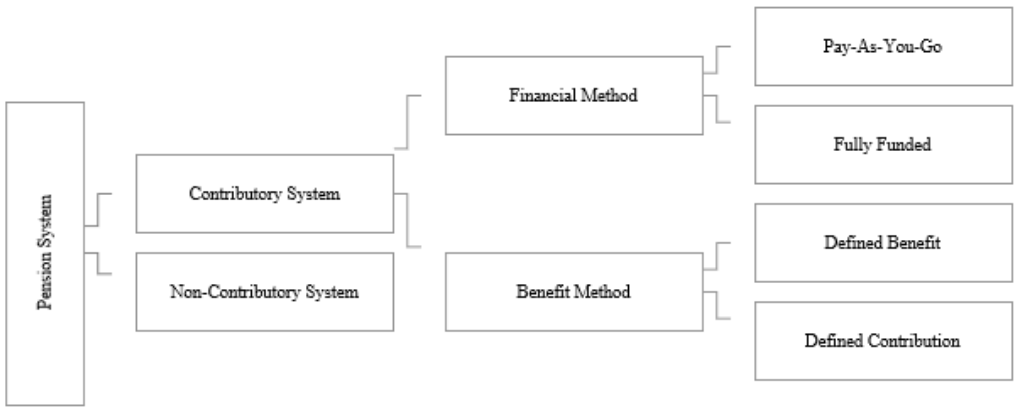

Figure 1. Pension System

A fully earnings-related model, which is a funding method within the contributory structure, ties pension benefits directly to the employee's salary and cumulative contributions during their career. Various financing mechanisms fall under this method (Figure 1). In a Pay-As-You-Go approach, current workers contribute based on earnings, and these funds are used to pay current retirees. In contrast, the fully funded scheme relies on individuals contributing to personal investment accounts.

The benefit method represents another approach within the contributory system. This employer-backed plan calculates pension amounts using a predetermined formula that incorporates factors such as income history and duration of service. Two main schemes fall under this category: the defined benefit and defined contribution plans. In the defined benefit plan, retirees receive a fixed annual amount based on past earnings and service years. It is the responsibility of the employer to ensure adequate investment to cover future payouts.

The defined contribution plan, also referred to as the money purchase scheme, involves contributions from both the pensioner and the employer to a personal retirement fund. The fund's final value depends on total contributions and the cost of annuity purchase at

retirement. Pensioners can opt to withdraw the entire amount as a lump sum or receive it in periodic instalments. This scheme permits a tax-free withdrawal of up to 25% of the total fund, with the remaining portion taxed as per annual income regulations. For individuals with insufficient income who cannot contribute regularly to a pension fund, the non-contributory system offers minimum guaranteed support. It targets those unable to afford the contributory option [10].

To enrol in a pension scheme, individuals must complete a registration form and submit identification documents, including biometric data and contact details. Upon successful registration, a unique 17-digit Pension Payment Order (PPO) number is issued. Confirmation of registration is sent via SMS and email to the pensioner's registered contact information. Bi-annual biometric verification is mandatory for life authentication. Over time, fingerprint quality deteriorates due to the natural aging process; skin loses elasticity, and ridge patterns become less distinct. The epidermis and dermis layers [11] are thin with age, complicating biometric scanning. Therefore, pensioners must undergo re-verification every six months to confirm their continued eligibility. Countries worldwide have implemented comprehensive systems to support their retirees. Elderly individuals often face physical and emotional challenges, such as isolation, fatigue, housing issues, diminished confidence, and unfamiliarity with technology. They may also suffer from health conditions, including hearing, vision, and memory loss [12], [13], [14].

In Pakistan, under the Direct Credit Scheme (D.C.S), pensioners receive their payments through the National Bank of Pakistan. Disbursement regulations are governed by Civil Service Rules (C.S.R) to prevent fraud and ensure transparency. Pensioners must submit an authority letter, an attested D.C.S. form, an indemnity bond on stamped paper, and their pension book to the Accountant General Pakistan Revenues (A.G.P.R). The A.G.P.R then issues the PPO for payment processing. Biometric re-verification every six months is again required in Pakistan for proof of life, as aging impacts fingerprint clarity. The gradual degradation of skin layers [11] makes verification a recurring necessity to maintain pension disbursements.

This study presents a comprehensive and integrated overview of pension systems with a particular focus on challenges faced in biometric verification by elderly people. This is an often-overlooked aspect of the current pension system in place in Pakistan. Previous researchers had focused on financial structures and policy frameworks only; however, this work uniquely highlights the intersection of aging-related biometric degeneration and digital authentication requirements. This research also explores the contributory and non-contributory pension mechanisms parallel to each other using Pakistan as a case study. This research is multifaceted as it focuses on technology, biological aspects, and procedural facets of the current pension system of Pakistan.

Family Pension:

Around the world, eligible pensioners are categorized based on specific terms and conditions. If a pension recipient fails to meet any of the required criteria, they will be deemed ineligible to receive the pension. Pension payments are received directly by the pensioner while they are alive. After the pensioner's death, these payments can be received indirectly by their family members through a family pension, which is provided to support the pensioner's family. A family pension may be caused due to the in-service death of an employee or due to the death of a pensioner. The direct pensioner is a pensioner who gets a pension itself. The indirect pensioner is a person who is legally allowed to receive a pension after the pensioner's death. After the death of a pensioner, the pension can be received by kids, the wife of a male pensioner, the husband of a female pensioner, or parents as per family pension rules shown in Table 1. At one time, only one individual can receive a pension under specific terms and conditions.

Table 1. Indirect Pensioner Characteristic

S. no	Indirect pensioners		Specific terms and conditions
1	Wife of a male pensioner		Forever
2	Husband of a female pensioner		Forever
3	Parents		Until 5 years
4	Kids	Child	Until the age of 18 years
5		Unmarried daughter	Until the age of 18 years
6		Divorced and widowed daughter	Until the second marriage
7		Disable child	Forever

Pensioner's Challenges:

Retirement is a period of relaxation for pensioners while financial or medical issues spoil relaxation dreams. After retirement, pensioners are interested in being comfortable in all parts of life [13], [11]. Pensioners often encounter numerous challenges when receiving their pension or submitting a life certificate. A lack of familiarity with smart technology and limited education further complicate the process for many retired individuals. In existing frameworks for disbursing pension, a retired person needs to wait in the specific pension queue to get a pension payment. Standing in queues for a long time is troublesome for pensioners in old age. Bi-annual verification for pensioner's life authentication is arranged according to governmental rules; the pensioner needs to visit the respective bank or organization admin officer/medical officer and provides the confirmation of life for proceeding monthly pension. A pensioner obtains the life certificate through manual verification, either from the concerned bank, the employees' organization's administrative officer, or a medical officer, and it is then attested by the Consulate General of Pakistan (C.G.P).

For the attestation of the life certificate, the pensioner has to be physically present at the consulate along with the original NIC and sign the document in the presence of the consular officer. Most pensioners are elderly and face various challenges such as traveling long distances alone, health problems, and waiting in long queues. Additionally, some pensioners relocate to different urban areas or even move abroad. Pensioners living abroad often wish to receive their monthly pension at their new location, but in many cases, there is no formal system in place to facilitate pension payments at their current residence. In some countries, the traditional manual system of accepting pension cheques has been replaced by plastic card-based payment methods [3], [15], [16]. These cards have different risks like physical damage, stealing and then misuse, leakage of password, credit not accessible, over credit limit, etc. If a plastic card is stolen, it can cause significant problems for the retired person. Physical damage [15] (bending of plastic cards might bend or break its circuit, magnetic material ruin the plastic card, scratches on the chip, dropping of plastic card in water, etc.) can make it useless. In this situation, a pensioner needs to re-apply for the issuance of a plastic card, which is a tedious procedure.

Related Work:

To provide retirement shelter to pensioners, state and local governments establish retirement plans. With the advancements in technology innovations, some creative frameworks are adopted in pension disbursing procedure which provides assistance to the pensioner smartly. Some of the systems have been described:

Existing pension systems of India:

Jeevan pramaan pension system:

Jeevan Pramaan is a pension disbursing framework offered by the Government of India [12], [16]. In this framework, an online digital life certificate is generated. It utilizes the Aadhaar stage for biometric confirmation of pensioners through a fingerprint. Jeevan Pramaan's framework eliminates the physical presence of pensioners for life authentication or

receiving life certificates. In the Jeevan Pramaan framework, the pensioner needs to install the desktop application of Jeevan Pramaan and configure a peripheral fingerprint scanner with the application. The desktop application of Jeevan Pramaan requires some information about contact number, Aadhaar number, and PPO number, then this framework generates a One-Time Password (OTP) code which is received at the pensioner's mobile device. After inserting an OTP code, the pensioner needs to provide a biometric fingerprint by using the peripheral fingerprint scanner. After authentication, an SMS is sent to the pensioner's mobile device for the acknowledgment of Jeevan Pramaan certificate ID then the system generates the pensioner's digital life certificate and stores it in its database which can be accessed by the pensioner or the pension disbursing agencies. The pensioner can also download a PDF copy of the digital life certificate for further use.

Biometric Smart Cards Pension System:

Plastic cards are the most widely used method for digital payments worldwide, and their usage continues to grow year after year. Biometric smart card is a sub-category of biometric payment card which is a credit or debit card that uses the cardholder's fingerprint to authenticate transactions. This type of card has a built-in biometric fingerprint chip for cardholders' authentication. Biometric smart card system used locally hired bank-appointed staff to biometrically authenticate the pensioner and make pension cash payments at the pensioner's doorstep. In this system, the pensioner provides biometric data (ten fingerprints) and a digital photo to create unique identification. Bank-appointed staff reaches the pensioner's doorstep along with a biometric reader machine and reads the pensioner's biometric smart card that has a chip with the thumb impression. The biometric reader machine spits out a slip just like an ATM, and then staff gives the pension payment to the pensioner at the doorstep. This payment inquiry registers at the bank's central server then the revenue department has captured the fingerprints and photo of the pensioner. In this system, pensioners may make a decision to get a full pension at once or an instalment.

Existing pension systems of Australia and Haryana:

Cashless debit card pension system:

The Australian Government introduced the Cashless Debit Card (CDC) program [17], [18] for pensioners, which is issued by Indue Limited. CDC is not only used for receiving pensions it is also used for paying expenditure bills that provide flexibility and financial freedom to a pensioner. The pensioner needs to activate the CDC with an online Personal Identification Number (PIN) that must be used for each transaction. A pensioner can use this CDC at shops or businesses that accept Cashless Debit to make purchases accept some restricted items. The CDC functions like a regular bank card; however, it does not allow pensioners to withdraw cash from ATMs or receive cash back when making purchases at store checkouts. A pensioner can check their balance and transaction history online or through a free mobile app. They can also turn the CDC on or off using a Card ON/OFF switch. When the card is turned off, it can't be used for any transactions. The CDC does not verify a pensioner's identity at the time of receiving a pension. If the card is lost or stolen, the pensioner can block it through their online account settings or by calling the customer service centre. A replacement card can be ordered free of charge [19], [20].

E- Pension System:

The Government of Haryana introduced an enabled e-pension system for pensioners to provide digital life certificates who are registered with the state treasuries. It includes pension processing at district-level treasury and it disburses pension payment through pensioner's bank account on the due date. The Treasury officer receives the PPO from the Accountant General (AG) office or enters the relevant data about the PPO in the e-pension system after the verification of the live pensioner from a peripheral biometric reader/ scanner machine and generates a life certificate online then forwards to the Pension Disbursement Cell

(PDC). The office of treasury releases the first pension to the pensioner's account. The data is recorded in the e-pension system and then forwarded to the Pension Disbursement Cell (PDC) for disbursement of pension for the next month onwards. Officers of the treasury office are authorized to update pensioner's PPO and alteration of data must be reported in the PDC. Pensioners can get a digital life certificate from any of the nearest Jeevan Pramaan Centres or treasury offices after the submission of life authentication without visiting the concerned treasury. This system uses Aadhar-based Bio-metric authentication for verification of pensioner's life so there is no chance of fake verification by treasury officers. In this system, pensioners do not need to visit the pension disbursing authority every year for the submission of life certificates. They can submit their Life Certificate at any nearby Jeevan Pramaan Centre. They also have the option to submit a Digital Life Certificate from home, which requires an internet connection and a biometric reader or scanner device. This system eliminates the physical traveling of pensioners but it requires a peripheral biometric reader/ scanner machine which creates hurdles for pensioners or treasury officers.

Existing Pension Systems Pakistan:

The Government of Pakistan has introduced policies and strategies to address pension disbursement issues. One key step is the use of biometric verification for pension payments [15], [21]. The following programs were launched by the Government of Pakistan to facilitate pensioners Employees Old-Age Benefits Institution (EOBI), ATM card (which is red), NADRA e-Sahulat, and Easypaisa.

Employees Old-Age Benefit Institution (EOBI) pension system:

Employees Old-Age Benefits Institution (EOBI) [22], [23] introduced the pension disbursing framework officially among its registered pensioners through ATM cards. EOBI joined hands with Bank Alfalah to implement the pension process for employees' contributions and pension disbursement. In this process, the pensioner needs to open an EOBI pension wallet account and receive a red ATM card. They visit any Alfalah Bank branch and present their CNIC and passbook for verification. After this, they complete biometric verification for profiling. A form is printed and signed by the pensioner and branch officer. The pensioner's wallet account is opened then the bank delivers an EOBI pension card to the pensioner to receive a monthly pension securely. Using this ATM card the pensioner can withdraw his pension from any ATM. On the 1st of every month, the pensioner's wallet account is credited with the pension amount, and an SMS is sent, the pensioner is able to withdraw the pension from the account by using Bank Alfalah ATMs across Pakistan. For the confirmation of the pensioner's life, bi-annual verification is required which is performed through a biometrics system at the nearest Telenor outlet location or any Bank Alfalah branch. In case of an error in the verification process or over a limit of bi-annual verification, the account of a pensioner is suspended. They receive an SMS for suspension of account before one month. The system will restore the pensioner's account whenever he/she provides biometric verification at the nearest Telenor outlet location or any Bank Alfalah branch.

Nadra-E-Sahulat Pension System:

NADRA e-Sahulat is an enhanced version of the ATM card to assist pensioners in receiving a pension. In collaboration with NADRA and the Employees Old-Age Benefits Institution (EOBI), a Smart National Identity Card (SNIC)-based system has been introduced to help EOBI pensioners receive their pensions. In this system, EOBI pensioner receives a pension through a chip-based SNIC with live biometric verification at NADRA e-Sahulat franchises across Pakistan. This system provides transparency in pension disbursement and pensioners can withdraw pension payments from the nearest NADRA e-Sahulat outlet, but this system does not create a digital life certificate for a pensioner.

Easy Paisa Pension System

Employees Old-Age Benefits Institution (EOBI) with the collaboration of Easypasia has designed a pension disbursing system to facilitate pensioners conveniently. Through this system, pensioner registers may register at the closest service centres or enterprises to receive a monthly pension. Pensioners need to visit the nearest Easypaisa service centre or enterprise along with a pension book and unique ID card to register and withdraw pension payments.
A summary of the existing pension disbursing system has been highlighted in Table 2 but some limitations may cause trouble for the pensioner in receiving a pension. Some of them are listed below:

- In the existing pension disbursing systems, a pension is transferred to a pensioner account but, an appropriate mechanism for pensioner account confirmation, and verification of the pensioner's life is not present.
- In Pakistan, bi-annual authentication of pensioners is required to authenticate pensioner's life. Bi-annual authentication is still performed by the peripheral fingerprint scanner.
- Pensioners need to visit banks or pension authorities to receive a life certificate, but traveling for a long distance and standing in queue is critical for pensioners due to health issues and old age.
- There is a need for a remote access mechanism that will replace the physical movement of pensioners either for receiving life certificates or bi-annual verification.
- The existing systems don't provide an online digital life certificate against pensioners which is mandatory for receiving pension payments except for Jeevan Pramaan.
- In India, Jeevan Pramaan provides a pension disbursing system to facilitate pensioners by providing an online digital life certificate using the peripheral biometric scanner for authentication. In this existing solution, the peripheral biometric scanner is a hurdle for a pensioner.
- In India, the existing solution of a pension disbursing system provides doorstep service to the pensioner. In such a system peripheral biometrics reader /scanner machine is required to read a pensioner biometric smart card that has a chip with the thumb impression. In this existing solution, the peripheral biometric reader /scanner machine is a hurdle for staff to authenticate the pensioners at the doorstep.
- In Pakistan, an existing solution of the pension disbursing system provides an ATM card which is red, NADRA e-Sahulat, Easypaisa, and EOBI announced a pension system to facilitate the pensioners. For all the above systems, it is mandatory for a pensioner to visit the concerned bank for registration, biannual verification, and receiving of the life certificate.

The existing systems have helped reduce some of the issues faced by pensioners, but certain problems remain. In the existing pension disbursing systems, there are tremendous issues that have been observed in the era of advanced technology. According to the literature review of the study, existing pension disbursing systems, it is mandatory for a pensioner to visit a relevant bank for registration, biannual verification, and receiving of a life certificate. Another major issue of the existing systems is that the pension disbursing process requires a peripheral biometrics reader/scanner for pensioner's authentication [16], [17] whenever technology is enhanced. In addition, there should be a separate peripheral biometrics scanner with each pensioner individually while providing a pension facility at their doorstep. These existing pension disbursing systems [18], [23] don't generate online digital life certificates except for Jeevan Pramaan. There is a need for a remote access mechanism for a pension disbursing system that will replace the physical movement of pensioners either for bi-annual verification or receiving life certificates.

Table 2. Existing Pension Disbursing Mechanism

S.no	Country	Pension system	Pension organization	Gov. level	Bio-metric platform	Discrete bio-metric scanner	Bio-metric smart card	Bio-metric Registration	Bio-metric verification	Issuance of Digital life certificate	Direct credit pension system	Door-to door Deployment
1	India	Jeevan Pramaan Digital life certificate	Jeevan pramaan	✓	Adhaar stage	✓	x	✓	✓	✓	x	X
		Bio-metric smart card	-	✓	-	✓	✓	✓	✓	x	x	✓
2	Haryana	E-pension	-	✓	Adhaar stage	✓	x	✓	✓	✓	x	X
3	Australia	CDC	-	✓	-	x	x	x	x	x	✓	X
4	Pakistan	Red ATM card	EOBI & Bank Alfalah	✓	-	✓	x	✓	✓	x	✓	X
		NADRA-e-sahulat	EOBI & NADRA-e-sahulat franchises	✓	-	✓	x	✓	✓	x	✓	X
		Easy Paisa pension system	EOBI & Easy Paisa	✓	-	x	x	x	x	x	✓	X

Table 3. Characteristics of the Practitioner's Panel

Category of Responder	*Gender*		*Age*	Academic Level			Technology User	Non-Technology User
	M	F		Under Graduation	Graduation	Master		
Pension Authority	8	6	30-50	-	9	3	Yes	-
IT Expert	12	8	26-35	-	6	4	Yes	-
Banker	8	7	35-40	-	3	2	Yes	-
Pensioner	11	6	55-70	3	3	0	Yes	Yes
Total	39	27	-	-	-	-	-	-

Re-Engineering of Pension Disbursing Process:

Analysis of existing pension disbursing processes concludes that there is a need to re-engineer the pension disbursing process. Business Process Reengineering (BPR) is an effective approach to re-engineering the present pension disbursing process. In the current world of technology, organizations need to change business processes according to market trends. BPR plays a vital role in generating flexibility in business processes for the adoption of coming challenges. BPR can create a modification in the structure and process of an organization [24], [25]. It is a process-oriented approach for transforming the AS-IS process into the TO-BE process in order to improve the performance of an organization. BPR methodologies have been used to accomplish different targets in business organization processes in order to enhance performance by decreasing expenses and time, providing speedier reaction to a customer, extending versatility and flexibility to change, strategizing against the changes in the economy and advancement in innovation and empowering new business improvement [24].

In this study, Hammer and Champy's methodology of BPR has been utilized for re-designing the pension disbursing process according to the pension disbursing problems. This strategy contains finished 6 stages for re-engineering any business procedure and planning entirely new systems to accommodate better performances [26]. The standard steps have been followed to construct the proposed model which has effectively re-organized pension disbursing processes. Fingerprint-based enrolment and verification solutions are applied in diverse fields such as disaster management, health services, money transfer, and lock/unlock smartphones to improve security [27]. On the application side Mint Bills app, Web Money app, PayPal fingerprint-based payment app, etc. have been used (Effortlessly Stay, 2019) Approximate 60 percent of smartphones (Apple, Samsung) are easily available with built-in fingerprint scanner chips which can be utilized for biometrics authentication 93 percent of smartphones have a built-in fingerprint scanner chip that runs on Android and 45 percent of smartphones have a built-in fingerprint scanner chip that runs on iPhones.

In the future, smartphones will arrive with a built-in fingerprint scanner chip at 100 percent 2018 is on end. To construct the TO-BE model of the pension disbursing system, a fingerprint scanner-enabled smartphone has been utilized to eliminate unnecessary steps from the pension disbursing process. By utilizing fingerprint scanner-enabled smartphones real-time enrolments, authentication, and verification of pensioners will become easy. Based on real-time authentication and verification of the pensioner's fingerprint impression, the pension authority can generate an online digital life certificate after credential checking of the pensioner's fingerprint with the national database authority. Fingerprint verification becomes a stronger alternative solution against traditional password verification. In this way, the TO-BE model of pension disbursing system would be re-engineered conveniently.

Objectives:

This study aims to propose a hypothetical biometric-based pension disbursement model using fingerprint scanner-enabled smartphones to streamline pension payments, ensure secure life authentication, eliminate manual verification and long queues, and facilitate pension access for elderly and overseas pensioners.

Proposed Model:

Due to increasing security threats, researchers have turned to biometric technology to address the challenges brought by technological advancements. Each individual has a unique fingerprint pattern which can be utilized as an identity. This study presents a hypothetical model that is able to overcome the existing issues of the pension disbursing system by using a built-in fingerprint scanner chip in smartphones. The proposed model has struggled to trim down the faced problems efficiently as compared to the running ones. Pensioner's fingerprint scanner-enabled smartphone has been utilized for receiving pension payments or life certificates. Biometrics technology has matured with smartphones. With the advancement in

mobile technology, fingerprint scanner-enabled smartphones are available to guarantee the pensioners' fingerprint for receiving a pension. The use of smartphone-enabled biometric technology has made the bi-annual re-verification process easier for pensioners, reducing the need for elderly individuals to travel. The proposed model uses a mobile-based fingerprint scanner for taking fingerprint impressions of a pensioner in real time to authenticate the pensioner's life. Due to the use of fingerprint scanner-enabled smartphones, enrolment, authentication, re-verification, and generation of online digital life certificates against pensioners' real-time fingerprints become easy. It will eliminate the involvement of more people. This technology removes the need for a separate biometric scanner used by bank staff for doorstep pension services and also eliminates long queues of pensioners at the banks. Figure 2 shows a hypothetical proposed model for the smart pension system to assist pensioners. Description of the model diagram discussed below:

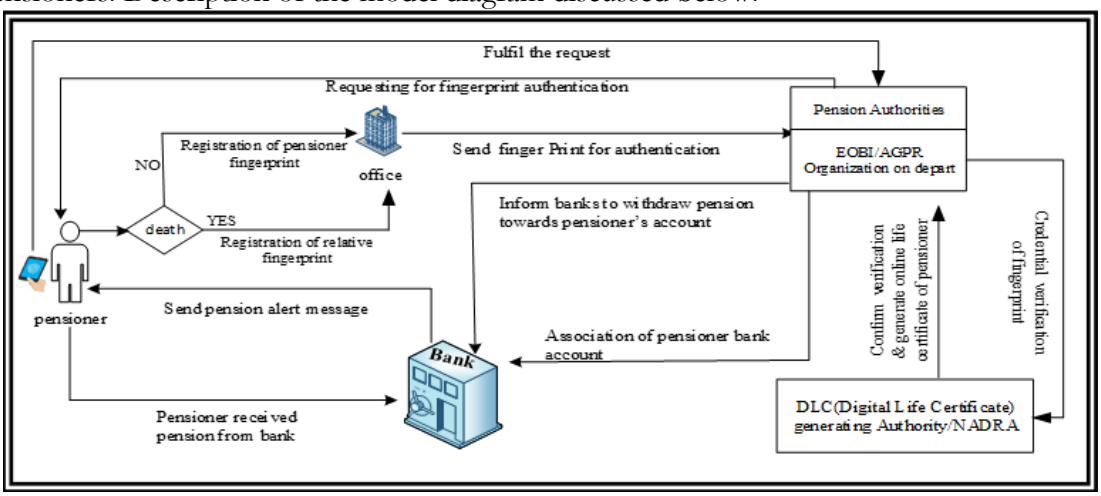

Figure 2. Proposed Model of Smart Pension System

Pensioners:

A pensioner is the core entity of the proposed model. The person who collects pension payments after retirement from an organization.

Pensioner Fingerprint Registration

A unique fingerprint of a retiree has been utilized for life authentication. Life authentication is the process of verifying the individual's life status. In the proposed model, the primary goal is to assist the recipient according to age demands. In the new era of technology, most of the verification is being replaced by biometric verification. In the proposed system, there is no need for a discrete peripheral biometrics scanner because fingerprint scanner-enabled smartphones are easily available. Retired individuals need to download the app insert relevant data for registration and generate an account. In proposed models, they should biometrically register remotely through their mobile app when the pension authority sends a request for taking a fingerprint from the mobile application. The pension authority connects users to the Digital Life Certificate (DLC) authority's server (similar to NADRA) to authenticate their fingerprints. When the identity is confirmed, the DLC authority system assigns the unique ID and generates the life certificate.

Pensioner Authorities:

Pension authorities are government and private organizations that provide pensions to retired individuals after their retirement. The pension authority has three major responsibilities: creation of the individual's bank account, fingerprint verification, and generation of the life certificate. A novelty of the proposed model is the remote verification of the beneficiary through the utilization of a fingerprint scanner-enabled smartphone. It relates to NADRA for the authentication of the person, generating online DLC, and forwarding this online DLC to the concerned pension authority and retiree for future use. As

a result, it will minimize the user's problems like physical appearance, extreme temperature (rain, cold), standing in a queue, etc.

Online Digital Life Certificate (DLC):

Bi-annual authentication of the recipient is compulsory. He/she needs to visit the respective bank and give the confirmation of life for proceeding monthly pension payment. In the proposed model, the national database authority is considered as the organization that authenticates the individual's life. The pension authority sends a request for authentication to the person's mobile device. The retiree provides a fingerprint through a mobile app on pension authority request. At this time, the pension authority connects the individual to the NADRA server for authentication of fingerprint. After credential verification of the submitted fingerprint, the national database authority generates online DLC against the retiree and sends a copy of online DLC to the pension authority and the individual's mobile app too. In this way, the system eliminates the physical presence of the recipient which is the core novelty of the proposed model.

Pensioner Bank Account:

Banking is a part of everyday life. Money handling is getting more and more complicated. A bank account allows a user to have wages, and pension and make withdrawals or deposits. These bank accounts eliminate the involvement of people who provide pensions door-to-door.

Mobile Application:

The proposed model utilizes the built-in fingerprint scanner chip of the user's smartphone for submitting real-time fingerprint impressions in bi-annual authentication and generation of online digital life certificates too. From a mobile app, an individual is able to register easily. At the time of bi-annual verification, retirees send fingerprints remotely from the mobile app when the individual receives a request from the pension authority to authenticate him/herself or generate a digital life certificate. After the generation of online DLC, the national database authority sends a copy of online DLC to the pension authority and the individual's mobile app too. When the pension authority confirms all parameters, pension payment credits to the person's bank account. Bank forwards SMS to the recipient's mobile device, now individuals can easily credit pension payments from an ATM. In the proposed system, life authentication of an abroad recipient becomes easy. Retirees living abroad can also provide fingerprints remotely via a mobile application for life authentication and re-new life certificates. The proposed system provides pension services easily to those who have moved abroad. Such individuals are interested in getting their monthly pension out of the country at their current location. The hypothetical-based proposed smart pension system is subdivided into two processes: the registration process and the pension-receiving process.

Pensioner's Registration Process:

Figure 3 shows the registration process of a hypothetical-based proposed model.

- At the time of retirement of the applicant, the concerned organization provides the person's context-based information (Name, NIC, D.O.B, Age, Organization, Post, Grade, and Contact) to the pension authority.
- Pension authority sends a request for taking a fingerprint on their mobile application and connects the retiree to the NADRA server for authentication of fingerprints.
- After credential verification of the fingerprint, NADRA generates online DLC against the user.
- NADRA sends online digital life certificates (DLC) of retirees to pension authorities and recipients too.
- Pension authority sends a confirmation SMS to the individual's mobile device after fingerprints & DLC endorsement.

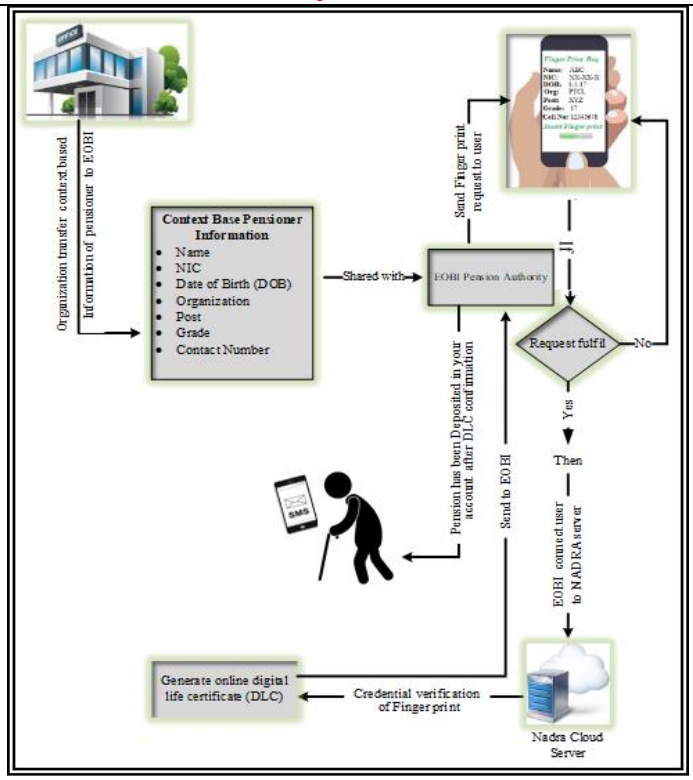

Figure 3. The registration process of a hypothetical-based proposed model.

Pension Reviving Process:

Figure 4 shows the pension reviving process.

- Life authentication is the confirmation of a pensioner's life. At the time of getting a pension, life certification is fundamental for the authentication of a pensioner's life, to check whether he/she is alive or not.
- For authentication of a pensioner's life, bi-annual fingerprint authentication is required as per governmental rule.
- At the time of pension credits, there are two possibilities of pensioner's DLC active or de-active. The pension authority must check the status of the pensioner's DLC. In an active case, when the pension authority confirms the status of the pensioner's DLC, the pension authority credits the pension to the pensioner's bank account. The pension authority sends an SMS to the pensioner's mobile device (the pension has been deposited in your account). Bank forwards SMS to pensioner's mobile device, now pensioners can easily debit pension from an ATM. In a de-active case, the pension authority sends a request for taking the pensioner's fingerprint via a mobile app for authentication and verifying it from the NADRA server. After credential verification of the pensioner's fingerprint, the pension authority credits the pension to the pensioner's bank account. The bank forwards the SMS to the pensioner's mobile device, now pensioners can easily credit pension from ATMs etc.

Statement of Limitation:

Every pensioner must have a biometric fingerprint chip-enabled smartphone. The fingerprint of some pensioners may be mismatched because of changes in the elderly unique fingerprint patterns with the progression of time, which may create a smidgen issue during capture and create the need for re-verification. A national database authority must be involved in fingerprint verification. In case of unavailability of the smartphone with pensioners, they will need a separate scanning device. For connectivity purposes, the internet is mandatory for pensioners which may create an economic affordability issue for them.

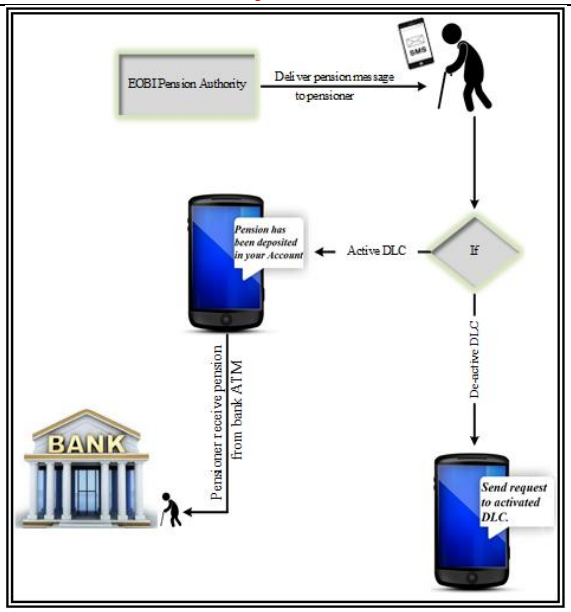

Figure 4. Pension receiving process

Delphi Method:

The Delphi method is a quantitative research methodology. It is a structured communication technique in which practitioner opinions are collected from a panel of practitioners [28]. There are several advantages of the Delphi method over all other quantitative methodologies inclusive of getting concrete expert knowledge, anonymity, quick response, etc [29], [30]. For the validation of the mobile-based biometric pension receiving model, the Delphi method has been used to collect practitioners' opinions from the practitioner's panel. A bunch of questionnaires were designed for the collection of practitioners' opinions and to evaluate them as statistical instruments to extract concluded results. This study applies the goodness of fit in the chi-square test for the evaluation to extract knowledge from the collected observation of the questionnaire. This test is based on a mathematical model which is used to test the hypothesis of the study. The objective of this test is to determine the approach to matching an observed frequency distribution with a theoretical frequency distribution.

Data Collection Methods:

A bunch of questionnaires containing nine questions were used to collect practitioners' opinions of the proposed pension system. The questionnaire was designed with the help of the System Usability Scale (SUS) [31]. Questionnaire for User Interface Satisfaction (QUIS) [32] and Computer System Usability Questionnaire (CSUQ) [33]. These refer to the analysis of usability based on the overall reaction to the system, screen factors, terminology and system feedback, learning factors, and system capabilities. The evaluation of the proposed model has two sessions:

- Mail invitation
- Call based conference.

In the case of mail invitations, a model diagram, description, and a bunch of questionnaires were designed to know the opinions of the practitioners' panel upon the proposed model which was sent via mail. In the call-based conference session, the practitioners were invited into a lab. In this session, firstly workflow of the existing pension disbursing models along with the description of the proposed pension disbursing model was explained in front of invited practitioners, and in the end, practitioners' opinions were collected by filling out the given questionnaire.

Sample Size:

For the validation and verification of the proposed pension disbursing model, around 66 practitioners were included having skills in pension authority, IT experts, Bankers, or retired persons. The practitioners involved in the practitioners' panel were 28 males and 38 females. Table 3 shows the characteristics of the practitioners. Here, practitioners' selection was based on experience level, knowledge, and professional accomplishments in pension disbursing management.

Hypotheses:

This study intended to inspect the worth and impact of the adoption of a mobile-based biometric fingerprint system (MBFPS) for pension disbursing system on the following listed hypotheses as shown in Table 4.

Table 4. Hypotheses Statement

Hypotheses	Statement
1	H_{01}: MBFP technology is not reliable for the pension disbursing system. H_{11}: MBFP technology is reliable for pension disbursing systems.
2	H_{02}: MBFPS is less secure than the traditional pension disbursing system. H_{12}: MBFPS is more secure than the traditional pension disbursing system.
3	H_{03}: Pensioners don't use MBFPS for the pension disbursing process ubiquitously (anywhere, anytime) H_{13}: Pensioner uses MBFPS for pension receiving process ubiquitously (anywhere, anytime)
4	H_{04}: Pensioner may not request to generate a Digital Life Certificate (DLC) through the proposed system. H_{14}: Pensioner may request to generate a Digital Life Certificate (DLC) through the proposed system.
5	H_{05}: MBFP does not save time and money for pensioners. H_{15}: MBFP saves time and money for pensioners.
6	H_{06}: MBFP does not save time and labor costs for pension authority. H_{16}: MBFP saves time and labor costs for pension authority
7	H_{07}: MBFPS does not overcome the migrated pensioner problem for disbursing pension. H_{17}: MBFPS overcomes migrated pensioner problem for disbursing pension.
8	H_{08}: MBFP for the proposed model is not economically expensive. H_{18}: MBFP for the proposed model is economically inexpensive.
9	H_{07}: Practitioners don't support the proposed system. H_{17}: Practitioners support the proposed system.

Data analysis & results:

This study involves quantitative research by using statistical tools (Statistical Package for Social Sciences (SPSS version 20)) for data analysis. The data was analyzed using descriptive statistics by applying the goodness of fit in the chi-square test to inspect the efficiency and impact of the adoption of a mobile-based biometric fingerprint system (MBFPS).

Analyzation Factors:

The results of this study present nine tested null hypotheses. These hypotheses are tested at a 0.05 level of significance using the goodness-of-fit (Chi-square) test. In this study, data analysis checks the efficiency and impact of the adopted feature in the proposed pension disbursing system on the following factors shown in Table 5.

Table 5. Observation Factors

S.no	Observation Factors
1	Reliability
2	Security
3	Ease-of-use
4	Ease-of-generating DLC (Digital Life Certificates)
5	Time reduction
6	Efficiency impact on labor cost
7	Efficiency impact on migrated pensioner
8	General case: • Economically expensive • Supportive for pensioner

Reliability:

The data was analysed in Table 6 against the first null hypothesis of the study, which states that "MBFP technology is reliable for pension disbursing system". About 14 practitioners disagreed with using mobile-based fingerprint technology for the pension system, while most practitioners supported its use.

10 practitioners were neutral, they neither agreed nor disagreed. The chi-square test statistics confirm that the number of practitioners who agreed is significantly higher than those who disagreed, $X^2(66, 4) = 21.424$, $p = .000$. Therefore, the first null hypothesis was rejected. This is concluded that the utilization of mobile-based fingerprint technology is reliable for the pension disbursing system**.**

Table 6. MBFP technology is reliable for the pension disbursing system

	Observed N	Expected N	Residual	Chi-Square	df	Asymp. Sig.
Strongly Agree	27	13.2	13.8	21.424[a]	4	.000
Agree	15	13.2	1.8			
Neutral	10	13.2	-3.2			
Disagree	8	13.2	-5.2			
Strongly Disagree	6	13.2	-7.2			
Total	66					

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 13.2.

Security:

Table 7 shows results against the second null hypothesis of the study to determine whether the MBFPS (Mobile Biometric Fingerprint System) is more secure than a traditional pension disbursing system. The result of the second hypothesis shows that 14 practitioners disagreed, while 41 practitioners agreed. There is a significant difference in the frequencies at 0.05 level of significance $X^2(66, 4) = 23.394$, $p = .000$. The result of perceived security shows significant differences. The result of this null hypothesis of the study concluded that mobile-based biometric technologies are more secure than traditional timekeeping methods in the pension disbursing process.

Table 7. Results against the second null hypothesis

	Observed N	Expected N	Residual	Chi-Square	df	Asymp. Sig.
Strongly Agree	28	13.2	14.8	23.394[a]	4	.000
Agree	13	13.2	-.2			
Neutral	11	13.2	-2.2			
Disagree	9	13.2	-4.2			
Strongly Disagree	5	13.2	-8.2			

Total	66					

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 13.2.

Ease-of-Use:

Table 8 shows the result against the third null hypothesis which states that "Pensioner uses MBFPS for pension receiving process ubiquitously (anywhere, anytime)". The majority of practitioners agreed on said hypothesis while 15 practitioners disagreed on a said hypothesis. The result of the applied test shows that there is a significant difference in the frequencies at a 0.05 level of significance. X^2 (66, 4) =33.848, p = .000. It is concluded that pensioners would be able to use the proposed system easily from anywhere and at any time to receive their pension, removing the need to visit a specific bank branch.

Table 8. Pensioner uses MBFPS for pension receiving process ubiquitously (anywhere, anytime)

	Observed N	Expected N	Residual	Chi-Square	df	Asymp. Sig.
Strongly Agree	30	13.2	16.8	33.848*	4	.000
Agree	17	13.2	3.8			
Neutral	4	13.2	-9.2			
Disagree	7	13.2	-6.2			
Strongly Disagree	8	13.2	-5.2			
Total	66					

*0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 13.2.

Ease-of-Generating DLC:

For the perceived efficiency impact of generating online digital life certificates, a chi-square test of goodness-of-fit was performed to determine whether the "Pensioner may request to generate Digital Life Certificate (DLC) through the proposed system". In Table 9, 15 practitioners disagreed that pensioners may not request to generate a Digital Life Certificate (DLC) through the proposed system. Additionally, it also shows that 25 practitioners were agreed while 20 practitioners were strongly agreed. There were 6 practitioners who neither agreed nor disagreed. Statistics of the chi-square test of goodness-of-fit show that the number of practitioners who agreed is significantly higher than those who disagreed in this case. X^2 (66, 4) = 22.939, p = .000. In this situation, the null hypothesis was rejected, so it is concluded that pensioners may request to generate a Digital Life Certificate (DLC) through the proposed system by submitting real-time fingerprints impression ubiquitously.

Table 9. Pensioners may request to generate a Digital Life Certificate (DLC) through the proposed system.

	Observed N	Expected N	Residual	Chi-Square	df	Asymp. Sig.
Strongly Agree	20	13.2	6.8	22.939*	4	.000
Agree	25	13.2	11.8			
Neutral	6	13.2	-7.2			
Disagree	7	13.2	-6.2			
Strongly Disagree	8	13.2	-5.2			
Total	66					

*0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 13.2.

Time Reduction:

Table 10 shows the statistical chi-square test of goodness-of-fit results against the fifth hypothesis which states that "MBFP saves time and money for pensioners". The result of this hypothesis shows that the majority of practitioners agreed on said hypothesis while

15 practitioners disagreed on the said hypothesis. There were 10 practitioners who neither agreed nor disagreed in this regard. There is a significant difference in the frequencies at a 0.05 level of significance. X^2 (66, 4) = 22.182, p = .000. The result of this null hypothesis of the study concluded that the implementation of mobile-based biometric technology in the pension disbursing process saves time and money for the pensioner.

Table 10. MBFP saves time and money for pensioners.

	Observed N	Expected N	Residual	Chi-Square	df	Asymp. Sig.
Strongly Agree	26	13.2	12.8	22.182*	4	.000
Agree	18	13.2	4.8			
Neutral	8	13.2	-5.2			
Disagree	8	13.2	-5.2			
Strongly Disagree	6	13.2	-7.2			
Total	66					

*0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 13.2.

Efficiency Impact on Labor Cost:

The data was analyzed in Table 11 against the sixth hypothesis of the study, which states that "MBFP saves time and labor cost for pension authority". 16 practitioners disagreed that the utilization of mobile-based fingerprint technology in the pension disbursing process is efficient whereas a majority of practitioners agreed on the utilization of mobile-based fingerprint technology in the pension disbursing process. There were 8 practitioners who neither agreed nor disagreed. The chi-square test of goodness-of-fit statistic confirms that the number of practitioners who agreed is significantly higher than those who disagreed, X^2(66, 4) =25.212, p = .000. Therefore, the sixth null hypothesis has been rejected. The conclusion is that using mobile-based fingerprint technology in pension disbursement saves time and reduces labor costs for the pension authority.

Table 11. MBFP saves time and labor costs for pension authority

	Observed N	Expected N	Residual	Chi-Square	df	Asymp. Sig.
Strongly Agree	13	13.2	-.2	25.212*	4	.000
Agree	29	13.2	15.8			
Neutral	8	13.2	-5.2			
Disagree	7	13.2	-6.2			
Strongly Disagree	9	13.2	-4.2			
Total	66					

*0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 13.2.

Efficiency Impact on Migrated Pensioner:

For the perceived efficiency impact on the migrated pensioner, a chi-square test of goodness-of-fit was performed to determine whether the "MBFPS overcomes migrated pensioner problem for disbursing pension". In Table 12, 14 practitioners have disagreed that MBFPS overcomes the migrated pensioners' problem for disbursing pensions. Additionally, it also shows that 22 practitioners agreed while 23 practitioners strongly agreed. There were 7 practitioners who neither agreed nor disagreed. The statistics of this test show that the number of practitioners who agreed is significantly higher than those who disagreed in this case. X^2 (66, 4) = 22.030, p = .000. Since the null hypothesis is rejected, it is concluded that mobile-based fingerprint technology (MBFPS) effectively solves the problem of migrated pensioners receiving their pension payments at their current location.

Table 12. MBFPS overcomes migrated pensioner problem for disbursing pension.

	Observed N	Expected N	Residual	Chi-Square	df	Asymp. Sig.
Strongly Agree	23	13.2	9.8	22.030*	4	.000
Agree	22	13.2	8.8			
Neutral	7	13.2	-6.2			
Disagree	8	13.2	-5.2			
Strongly Disagree	6	13.2	-7.2			
Total	66					

*0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 13.2.

Economically Expensive:

Table 13 shows the statistical chi-square test of goodness-of-fit results against the eighth hypothesis which states that "MBFPS for proposed model is economically inexpensive". The result of this hypothesis shows that the majority of practitioners agreed while 16 practitioners disagreed with the said hypothesis. There were 8 practitioners who neither agreed nor disagreed in this regard. There is a significant difference in the frequencies at a 0.05 level of significance. X^2 (66, 4) = 22.182, p = .000. The result of this null hypothesis of the study concluded that the proposed model is economically inexpensive because there is no need for extra hardware for implementation.

Table 13. MBFP for the proposed model is economically inexpensive.

	Observed N	Expected N	Residual	Chi-Square	df	Asymp. Sig.
Strongly Agree	30	13.2	16.8	28.242*	4	.000
Agree	12	13.2	-1.2			
Neutral	8	13.2	-5.2			
Disagree	6	13.2	-7.2			
Strongly Disagree	10	13.2	-3.2			
Total	66					

*0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 13.2.

Supportive For Pensioners:

For the perceived support for a pensioner, a chi-square test of goodness-of-fit was performed to determine whether the "Practitioner supports the proposed system". In Table 14, 14 practitioners disagreed with said hypothesis. Additionally, it also shows that 44 practitioners agreed. There were 8 practitioners who neither agreed nor disagreed. Statistics of the chi-square test of goodness-of-fit show that the number of practitioners who agreed is significantly higher than those who disagreed in this case. X^2 (66, 4) = 25.212, p = .000. In this situation, a null hypothesis is rejected, so it may be concluded that practitioners support the proposed system.

Table 14. Practitioners support the proposed system.

	Observed N	Expected N	Residual	Chi-Square	df	Asymp. Sig.
Strongly Agree	28	13.2	14.8	25.212*	4	.000
Agree	16	13.2	2.8			
Neutral	8	13.2	-5.2			
Disagree	6	13.2	-7.2			
Strongly Disagree	8	13.2	-5.2			
Total	66					

**0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 13.2.*

Discussion:

The following discussion interprets the results presented in Table 15, highlighting practitioners' strong agreement with the effectiveness and suitability of the proposed model for addressing key challenges faced by pensioners. Table 15 collects all variables of the null hypothesis and shows that the number of practitioners who agreed is significantly higher than those who disagreed with all hypotheses. It indicates that reliability and security have the highest weight of agreement from practitioners (M =2.2576, SD =1.35090) and (M =2.2424, SD =1.33659) respectively. The descriptive statistics table similarly shows that the proposed model would be more effective for pensioners due to ease-of-use (M =2.1818, SD =1.42407) and generating online DLC (Digital Life Certificates) ubiquitously (M =2.3636, SD =1.34320) have the highest mass of agreement from practitioners respectively. This table also shows that the proposed model has a greater efficiency impact on labor cost and migrated pensioner (M =2.5455, SD =1.30304) and (M =2.2727, SD =1.30732) separately. The descriptive statistics table also observed that the proposed model would be economically inexpensive (M =2.3030, SD =1.49841) because there is no need for extra hardware for implementation and support for pensioners (M =2.2424, SD =1.40396). After all, the proposed system overcomes many faced problems of a pensioner. This table displays a significant difference between means at a 0.05 level of significance. Thus, relative to all variables, there was a higher proportion of practitioners who agreed that the proposed model is suitable for the pensioners' community to resolve their issues during the pension payment and life certificate receiving process.

Table 15. Descriptive Statistics.

S.no	Variable	N	Mean	Std. Deviation
1	Reliability	66	2.2576	1.35090
2	Security	66	2.2424	1.33659
3	Ease-of-use	66	2.1818	1.42407
4	Ease-of-generating DLC (Digital Life Certificates)	66	2.3636	1.34320
5	Time reduction	66	2.2424	1.33659
6	Efficiency impact on labor cost	66	2.5455	1.30304
7	Efficiency impact on migrated pensioner	66	2.2727	1.30732
8	Economically expensive	66	2.3030	1.49841
9	Supportive for pensioner	66	2.2424	1.40396

Table 16 represents a summary of the results of all null hypotheses. This table shows that all null hypotheses are rejected at the 0.05 level of significance. Therefore, the parallel alternative hypothesis of all hypotheses builds the decision of the study.

These outcomes express a few assumptions. The more perceived usefulness the more perceived ease of use created the more behavioural intention to accept the fingerprint biometric system for the pension disbursing process. On the other hand, the positive effect is greater for fingerprint recognition regarding higher innovation and less experience for implementation, but privacy concerns and technology anxiety have some negative effects on the behavioural intention to accept. The introduction of the above proposed smartphone-based biometric system that can leverage the built-in fingerprint scanner can offer a promising solution to a longstanding challenge that the pension disbursement process faces. By enabling real-time enrolment, authentication, and digital life certificate generation, the method proposed in this paper can streamline the biannual verification process, reduce reliance on external devices, and minimize the need for elderly pensioners to visit the pension disbursement offices or banks and queue up to get verified. It also supports remote pensioners who are living in other countries. With the growing maturity of mobile biometric technology, this model can improve the efficiency of the pension system and reduce administrative burden.

Table 16. Hypotheses summary

Hypotheses	A	P-value	Decision	Conclusion
RQ-1	0.05	.000	Rejected	MBFP technology is reliable for pension disbursing systems.
RQ-2	0.05	.000	Rejected	MBFPS is more secure than the traditional pension disbursing system.
RQ-3	0.05	.000	Rejected	Pensioners utilized MBFPS for the pension disbursing process ubiquitously (anywhere, anytime).
RQ-4	0.05	.000	Rejected	Pensioner easily generates online digital life certificates through the proposed system.
RQ-5	0.05	.000	Rejected	MBFP for the proposed model saves time and money for the elderly.
RQ-6	0.05	.000	Rejected	MBFP for the proposed model saves time and labor costs for pension authority.
RQ-7	0.05	.000	Rejected	MBFPS overcome migrated pensioners' problem for disbursing pension
RQ-8	0.05	.000	Rejected	MBFPS for the proposed model is economically inexpensive.
RQ-9	0.05	.000	Rejected	Responders support the proposed system.

Conclusion:

This study highlights the pensioners' community problems and proposes a technological-based solution that will assist the pensioner in life authentication and generating of digital life certificate which is mandatory for receiving pension payment. The proposed model presents a hypothetical model that utilizes a fingerprint scanner-enabled smartphone to capture a thumbprint impression of a pensioner remotely by which authentication of the pensioner's life and generating an online digital life certificate becomes easy. The proposed model eliminates the physical presence and traveling expenses of pensioners. The proposed pension disbursing system would be more efficient, and well-organized, and will save time and money for local and abroad pensioners. To evaluate the proposed model, the Delphi method has been utilized to collect practitioners' opinions from the practitioner panel and evaluate the feedback of the practitioner's panel via the Likert scale in order to investigate the novelty of the proposed model and its limitations. The outcome of this analysis shows that a pensioner's fingerprint scanner-enabled smartphone is an effective and acceptable tool for pensioner's life verification and generating of an online digital life certificate after authentication. However, some technological risk factors should be improved to build up the users' trust.

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