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Biometric Attendance Management System and Administration: An Overview

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Abstract:

The implementation of a biometric attendance maintenance system is one method to address the management of employees to confirm attendance and ensure the effective delivery of services. With rise of globalization, it is becoming essential to find the easier and more effective system to help an organization to improve their employee productivity and efficiency. Employee attendance management system is an easy way to keep track on attendance of staff within organization. Among all the biometric techniques, fingerprint-based identification is the oldest method which has been successfully used in numerous applications. Everyone is known to have unique, immutable finger prints. A finger print is made of a series of ridges and furrows on the surface of the finger. As the level of security breaches and transaction fraud increases, the need for highly secure identification and personal verification technologies is becoming apparent. Biometrics has long been touched as a powerful tool for solving identification. In addition to growing needs for fast, accurate and dependable security biometrics technology has recently begun to enter into public consciousness. The empirical literature review indicates the attitudes of the faculties towards biometric attendance systems which are influenced by subjective norms, perceptions of usefulness and ease of use, and concerns related to privacy and technical issues. While faculty members recognize the advantages of these systems in streamlining attendance management, there are concerns about data privacy and potential errors in recognition. The findings of the study provide a foundation for the future study.

Keywords: *Biometric, Finger Print, Verification, Identification, Template and Hand Geometry.*

Introduction:

Biometric attendance systems have gained significant attention in management and administration due to their potential to streamline attendance management processes and minimize fraudulent attendance practices. These systems utilize unique physiological or behavioural characteristics such as finger prints, facial recognition, or iris scans to accurately record and verify student attendance. While the adoption of biometric attendance systems offers several advantages, the acceptance and cooperation of the faculty members play a critical role in their successful implementation and effectiveness.

Biometric technology as a means of identifying and verifying an individual`s characteristic is widely used in many aspects of peoples` lives now a days. In this regard, public organizations use this technology to provide a more comprehensive system in monitoring employee attendance and also to ensure organisation’s quality of service and productivity.

The implementation of a biometric attendance maintenance system is one method to address the management of employees to confirm attendance and ensure the effective delivery of services. With rise of globalization, it is becoming essential to find the easier and more effective system to help an organization to improve their employee productivity and efficiency. Employee attendance management system is an easy way to keep track on attendance of staff within organization.

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Aims and Objectives of the Study:

The main purpose of the present study is to provide a proper context for implementation of biometric technology based on the previous research works done by other researchers. The present researcher has studied research papers, journals and online documents related to biometric technologies, reports and Ph. D thesis reports. The literature review process will guide the managers and administrators to gain insight on the biometric system and its functioning. The literature review will be also be helpful to explore various contours for further research.

Methodology:

The present study is an analytical study which addresses relevant conceptual issues, theoretical framework and conceptual and empirical review related to the topic. It includes attitudes, perceptions of the employees towards biometric attendance system and its impact on employee`s performance and challenges of biometric machine by focusing on previous research in this area and review of literature relevant to this study. Literature review is the starting phase to learn the current state of research in implementation of biometric technology. The literature review has been helpful to explore and solve different ambiguities in researcher's mind related to survey work flow, interview methods and procedures for biometric technology deployment.

Theoretical Literature Review:

There is a diffuse body of literature on biometrics in India and abroad covering a wide variety of topics. These include general studies and regional studies at the micro and macro-levels which are the outgrowth of the research works. These studies have covered both theoretical, as well as empirical parts. A brief review of studies on biometrics is presented here.

Davis (1995)[1] built the Technology Acceptance Model (TAM) on the Theory of Reasoned Action. TAM is an information system theory that simulates how technology adoption and usage occurs among people. It refers to how much a person thinks using a given system will be effortless. By analysing and examining aspects impacting the acceptance of specific information technology, this model aims to explain and forecast the acceptability of information technology. Perceived usefulness (PU) and perceived ease of use (PEOU) are two criteria that can influence attitude, according to TAM. TAM claims that behavioural intention has a significant and positive impact on actual behaviour. The model reveals that there was a large and positive correlation between how often employees used the software and how valuable they thought it was.[2]

The theory, therefore, is directly related to the study under investigation since the study is about the challenges of biometric attendance systems implementation in public sectors in Tanzania, a case of the National Housing Corporation (NHC). The study seeks to know how the biometric attendance system

application has an effect on the performance of public institutions. Thus, through this theory, the researcher becomes able to achieve the main objective of the study and come up with recommendations.

Biometric attendance system will replace the old method used which is the manual attendance monitoring system. The use of BARS in the workplace creates diverse perception of its effect to work performance specifically and productivity in general. The development of biometric time and attendance system has seen drastic advancement recently during which the technology has moved from a single method (fingerprint) to more than ten prudent methods [3].

Fingerprint authentication is one of the well-known and publicized biometric technologies. Everyone is known to have unique, immutable fingerprints. A fingerprint is made of a series of ridges and furrows on the surface of the finger. The uniqueness of a fingerprint can be determined by the pattern of ridges and furrows. As the level of security breaches and transaction fraud increases, the need for highly secure identification and personal verification technologies is increasing.[4]

Biometrics has long been used as a powerful tool for solving identification. It involves measuring one or more psychological characteristics. In addition to growing needs for fast, accurate and dependable security, biometrics technology has recently begun to enter into public consciousness. Government have made it mandatory to install biometrics machine for their offices in some countries.[5]

Acceptance of biometric security services may be affected by the context of use, with two important contextual factors being the perceived benefit to the user and the discerned privacy risks. Application context with obvious, apparent benefits and lows risks may lead to eminent perception of usability and higher acceptance opinion of biometrics than contexts where there are little apparent benefits and high risks.[6]

Time and attendance system are in place to record when employees start and stop work, in addition to the department where the work is performed. However, for some organization it is also common to track meals and breaks, the type of work performed, and the number of items produced, when employee are not working as a part of their workforce management strategy. These records can be kept manually with pen and paper or they can be automated. Modern day automated time and attendance system are largely used with biometric technology, where an employee provides their credentials to log in or log out of the system.[7]

Staff biometric attendance system provides the administrator with easy access to staff attendance information as well as easy monitoring of monthly attendance summary. This will improve the productivity of institution or any organization and performance of the employees. If the system is reliable, secure, efficient, and capable of replacing the traditional manual and unreliable method of attendance management, it ensure security of staff`s records, eradicate fake attendance records, saves time as well as reducing the amount of work done by the administrator in gathering staff attendance records. The system can be improved through the integration of multimodal biometric technologies to provide more security for the staff attendance management system.[8]

Fingerprint scan convert people`s fingerprints into digital codes or numerical data that can be recorded in a database. Fingerprint scanning matches an individual`s code against an existing database of codes in order to confirm the identity of the individual. The conversion of fingerprints into digital data is a privacy protection measure. Before scanning the fingerprint everyone has to fill the registration form. The form has basic details of personal information.[9]

The biometric time and attendance system has more advantage than its disadvantages. Unlike the manual attendance register, biometric devices can assist with the positive identification of individuals and act without any discrimination. The verification standards are applicable to all people who scan their finger for attendance in which impression is impossible.[10] Biometric system function eliminated administrative tasks and the time for roll call. The development of biometric technology grants access to a variety of employee

attendance reports which saves time and energy and money and the improving performance. The 'in' and 'out' clocking data are captured in real time with no reason to compromise clocking times. The biometric time and attendance system operate as a stand-alone device during power failure. Alike manual time keeping, a biometric time and attendance system operating with electricity requires back-up batteries during power failure.[11]

Moreover, the accuracy of biometric technology can decrease the confidence of users. It is because electronic equipment can malfunction and the possibility of small failure during a breakdown can have fatal results. It is difficult to maintain and repair it. The probe into the benefits and risks of both the manual and biometric time and attendance systems prompted an operational discovery of biometric systems.[12] A time and time attendance system that meets organization`s needs and integrates with human resource and payroll system can lead to a strong return on employee investment and a positive effect on overall business results. Employees are empowered when they have access to their own information through technology like employee self-service. Engaged employees are enthusiastic, contribute ideas, are optimistic about the company and its future, are rarely absent from work, typically stay with the organization longer, and are ambassador for the organization. Plus, a highly valued company culture is a major contributor to attracting and retaining top talent employees.[13]

When it`s time to run pay roll at the end of a pay period, if one uses a manual process the collection of time cards, re-entry of data into payroll solution, and time necessary to process payroll for the entire organization can be tedious and laborious. It is not uncommon for organization with a manual timekeeping and payroll process to spend upward of five hours or more running payroll at the end of each pay period.[14]

The possibilities of using biometrics for employee authentication are endless in workforce management. Workforce Management experts believe that biometric time and attendance is likely to be used more in the future since it virtually eliminates the ability for employees to swap, share, steal credential to duplicate biometric characteristics of an employee which preventsthe possibility of buddy punching and time theft. Biometrics improves the ease-of-use, efficiency, and accuracy of time keeping system while saving payroll costs and increasing productivity. Biometrics technologies are becoming the foundation of an extensive array of highly secure identification and personal verification solution. Today, biometric is being spot lighted as the authentication method because of the need for reliable security.[15] Biometrics have offered a scalable solution to business owners who are now empowered to circumvent issues like undocumented access, ID swapping, mutual symbol check, credential replacement and more. There have been many developments in the field of biometrics, which means things are getting more reliable and costs are becoming down.[16]

According to Roa and Satoa (2013)[17] the retrieval of data from the server can only take place with the coded templates of the fingerprint data on the clocking device. Coded fingerprint templates are saved on the biometric device and assist in the event of a connection failure due to power surge or during a switch over to auxiliary power. Registered employees place their fingers on the scanner to obtain a split second response in reporting "on" or "of" duty or allow access to buildings through the same device. When a fingerprint match is found, within a fingerprint database, it will provide a response of clocking "on" or "of" duty depending on option assigned like green (on duty) or a yellow (of duty) button chosen before the scan. While employees are reporting "on" or "off" duty, the scanning device will cross reference the employees scanned imprint against the templates of the translated true minutia points of fingerprints database. The fingerprint on the scanning device is coded and then compared against already stored templates the where captured an employee's name during registration.[18]

Attitude is termed as a hypothetical construct that represents an individual's like or dislike for any behavior (Monday, Porter, and Steers, 1982) as cited in Ahmad et al, (2010).[19] A simpler definition of attitude is a mindset or a tendency to act in a particular way due to both an individual's experience and temperament.

How people behave at a work often depends on how they feel about being there. Therefore, making sense of how people behave depends on understanding their work attitude.[20]

Employees are regarded as committed to an organization and devote considerable effort to achieve organizational goals. The high level of effort exerted by employees with high level of organizational commitment would lead to higher level of performance and effectiveness that an individual and at the organizational level.[21]The study conducted by Rodenberry and Moberg (2007)[22] indicated that better attitude towards work resulted in enhanced performance.

Moreover, Suleiman (2013)[23] pointed out that poor performance of workers is attributed to factors like ineffective supervision, poor attendance to the office, lateness and motivation among other things. However, the impact off biometric attendance on the performance of employees was not studied widely and presents a research gap since the use of biometric system is a recent phenomenon.

Review of Empirical Literature

Several empirical studies have been conducted in various corners in the field of biometric attendance which tried to investigate the attitudes of the employees as well as the employers, impact of biometric attendance on employee`s performance.

Marijana (2004)[24] carried out a critical review of the extent to which biometric technology has assisted in controlling illegal entry of travellers in to specific country through the integration of biometric passport. The researcher concludes that the problems associated with biometric technologies such as error rates, spoofing attacks, non-universality and interoperability can be reduced through an overall security process that involves people, technology and procedures. But, his study did not consider the employee's perceptions rather focused on problems associated with using this technology.

Trabelsi and Shuaib (2011)[25] studied the implementation of a biometrics-based student attendance system. The study aimed to discuss the design, implementation and evaluation of biometrics in recording the attendance of students by using both fingerprint and iris readers. The findings revealed that the e-attendance system helped to drop the absenteeism rate among the students, and in addition, the system has provided a reliable solution to prevent any student impersonation resulting from fake attendance.

According to Yonazi (2012)[26], problems in implementing biometric attendance in Tanzania included risks to data, equipment, networks, and people, as well as the corresponding measures meant to mitigate them. The biometric system becomes even more crucial as Tanzania experiences an increase in ICT breakthroughs and advancements. Tanzania's technology infrastructure is still insufficient for the nation to have appropriate cyber security. This is due to how long ago the technological infrastructure was created compared to computer technology. The system was developed to support the conventional attendance-based workplace. For all types of biometric applications, security and timeliness were important concerns. This issue was made worse in developing nations like Tanzania by inadequate and outdated ICT systems.

In addition, Ahmad et al. (2012)[27] documented some challenges of the biometric attendance system, including some of the fingerprints of staff working in the laboratory, are affected; age also affecting the use of voice in the biometric system, and some diseases also affect the eyes of the individual which affect the biometric attendance system implementation. The study found that the implementation of the biometric attendance system requires a high cost with a high cost in the maintenance of the system itself.

Iqbal and Qadir (2012)[28] conducted a study on biometrics technology with the main aim of exploring and clarifying influencing factors and attitudes concerning biometrics security technology. The study employed the use of informal interviews by gathering expert opinions and using web-based surveys. The findings

revealed that people have trust in the biometrics system, and as the users, they have accepted the system and are ready to adopt the implementation of the biometric system.

Rao, S., & Satoa, K. J. (2013)[29] proposed employee or student attendance maintenance system with an intention to make the system simple, fast, accurate and very efficient. The study was conducted based on the quantitative method of data collection concerning fingerprint matching technologies.

Verma and Khan (2015)[30] conducted a study on determining the biometric attendance identifier that can be used to enhance traditional staff attendance system which presently affects the productivity of the organization. The study was conducted using a qualitative (exploratory) approach, it is purely an explorative study, where detailed knowledge of biometrics, biometrics attendance system and its usage in human resource practices has been shared. The study indicated that the biometric technology system is the best system that can sustainably solve the lingering problem of staff attendance in the organization as it eliminates buddy punching and increase staff productivity. However, the study did not show the perception towards biometric attendance system and did not measure or see the performance of employee`s at work before and after attendance system is implemented in their sample studies.

Morrison (2016)[31] conducted a research on the advantages and disadvantages of biometric travel systems. The study found a number of potential, including identity management, more convenience, and improved human resource management, that biometric technology present to the travel sector. However, the study also found that some user acceptance issues with biometric attendance systems included concerns about privacy, the risk of injury from system use, and overall user anxiety.

Another study by Sanchita S. and Swin S. (2016)[32] has tried to identify the impacts of biometric attendance system in higher educational institutes of India. The paper considered two educational institutes of Ranchi (India) who have already introduced Biometric Attendance System (BAS), to assess the projected impact of new technology in increasing organization's productivity and efficiency. On the basis of findings of the study, it has inferred from the perspectives of the students and employees that BAS will have positive impact on the performance of HEIs. The respondents perceive that BAS will make attendance system discipline with reducing payroll disputes for employees as well as reducing barring issues from appearing in exam for students. BAS will play vital role in removing favouritism and making the local leaders as well as faculty members more punctual and make the functioning of the system smoother and better.

By gauging the timeliness of the staff at the educational institutions, Kirmani (2017)[33] examined the effects of the biometric attendance system on the educational system. The study's conclusions showed that, despite some flaws in the biometric attendance system, biometric modalities are generally reliable and secure. Some of these issues included the stakeholders' lower acceptability of the biometric acceptance system and an insufficient electrical power supply to meet the system's consumption needs, which interfered with its efficient operation.[34]

According to Dey & Barman (2014)[35], the use of ineffective technology made it difficult to embrace biometric systems since many smaller rural Internet Service Providers (ISPs) lack the expertise and technical know-how required to implement the most effective technologies. For instance, a straight forward billing method was crucial. An ISP with technological capability could implement Open Source Software (OSS) to successfully carry out this task. Without these abilities, an ISP was forced to use more expensive proprietary software, raising expenditures and operating expenses. Some ISPs did not implement technology, like bandwidth management systems, to optimise the use of their resources. As a result, the network becomes congested, forcing the ISP to buy more bandwidth. Once more, customers bore the additional costs rather than merely using the limited resources more wisely.

Chaudhary and Dua (2018)[36] investigated the implementation of biometric attendance systems in Indian colleges and found that the majority of faculty members perceived these systems as efficient and reliable. However, there were concerns related to privacy, system reliability, and technical issues.

Faculty attitudes towards biometric attendance systems can be influenced by various factors. Sharma et al. (2018)[37] highlighted the role of subjective norms, perceived usefulness, and perceived ease of use in determining the acceptance of biometric attendance systems among faculty members. They found that positive attitudes were associated with higher levels of perceived usefulness and ease of use.

Ali et al. (2018)[38] studied the relationship between the biometric attendance system with teachers' performance at Hazara University. The study contacted 150 employees who were selected through stratified random sampling. The results showed a positive employee attitude towards the installation of a biometric attendance system. In addition, the findings revealed that biometrics ensure teachers' attendance on time, and hence it influences the employees' performance.

Villaroman *et al.* (2018)[39] carried out a study to assess the use of biometric attendance recording system and its impact on the work performance of Cabanatuan City Government employees. The result of the study states that the use of biometric attendance system has a positive impact on the work performance of the employees of selected government organization. It also states that although there are minor issues and concerns, it can be easily be addressed by the authorities. It appears that majority of the respondents believed that it has a significant effect on the level of performance using descriptive analysis but they did not include explanatory variables of biometric attendance on employee`s performance.

The literature reveals both perceived advantages and disadvantages of implementing biometric attendance systems. Kaur and Kaur (2019)[40] identified advantages such as automated attendance management, reduction in proxy attendance, and time-saving benefits. However, concerns were raised about privacy invasion, potential errors in recognition, and technical issues.

To enhance faculty acceptance and cooperation towards biometric attendance systems, certain strategies can be employed. Goyal et al. (2020)[41] proposed training programs to familiarize faculty members with the technical aspects of these systems, thereby addressing resistance arising from lack of understanding. They also recommended ensuring transparency in the data management and addressing privacy concerns to foster trust among faculty members.

Discussion and Analysis:

The above literature review has explored various contours about the implementation of biometric attendance system in administration and management. It is revealed that a sense of consensus prevailed among all experts pointing to the shortcomings of traditional attendance management systems where impersonation and buddy punching was echoed as their overarching weaknesses.

Recent literature has shown that while biometric authentication systems promise cost savings and higher levels of security for businesses, they are not a panacea. Many different factors affect how well or how poorly biometric authentication controls will perform in any given organizational environment. Included among these factors are the users, the administration, the environment, the infrastructure, the budget, the communication system, and the existing security needs. While many biometric technologies are capable of operating as stand-alone systems, in reality their accuracy and performance levels would be greatly improved by combining them with more conventional authentication methods such as passwords and keys.

In selecting a biometric authentication system and preparing for its implementation, organizations should focus closely on the user-technology interface and the conditions in the organizational environment that may influence the technology's performance. It is important that organizations consider not only the practical

impediments to effective implementation but also the potential psychological impediments such as user fears about the technology. Ethically, the organization also has the obligation to consider carefully the extent to which the implementation of biometric authentication compromises the privacy rights of users. In making this assessment, management must take into account the possibility that the organization may be compelled to release employees' biometric-related information to government authorities.

A review of the recent literature on the adoption of biometric technologies in organizations revealed almost no research regarding the factors influencing the decision to implement biometric access technologies. Research into this area could help explain why organizations are reluctant to implement biometric authentication controls. It could also help IT and security decision makers to determine what aspects of biometric security technologies are of concern to them and accordingly recommend appropriate security solutions for their organizations. Security technology companies can also benefit from this research by knowing what is important to their customer base while introducing new IT security products and/or technologies. Although there is a dearth of scholarly research regarding the factors influencing the decision to recommend or not recommend biometrics, there is a solid foundation of theories and previous studies on technology adoption in general.

Although not directly studied as part of this research effort, a review of the literature would be remiss if it did not include a discussion of organizational decision making because ultimately the IT/IA manager's decision to recommend or not to recommend biometric security technologies impacts any organizational decision regarding the adoption biometrics. Unfortunately, the literature focusing on organizational decision making has not yet fully arrived at any definitive theory agreeable to the majority of researchers and theorists in the organizational studies space. Some researchers have emphasized that organizational decisions are based on the notions of rationality and optimality, while others argue that decision making processes in organizations are haphazard, uncertain, and full of ambiguity. The extensive stream of research on organizational decision making indicates a diversity of research disciplines used in the study of decision making. It is commonly acknowledged that scholars and practitioners involved in decision making differ significantly in their concepts, approaches, methods, and applications.

There is little cross-referencing in the research literature among researchers of behavioral decision making, human problem-solving, and organizational decision making. This lack of integration is not surprising because the research fields differ in methodology, levels of analysis, and epistemology. The proliferation of labels in the field of decision making (e.g., behavioral decision making, decision theory, human information processing, judgement theory) is testimony of the growing divergence and complexity of decision making research.

The literature on theories of decision making can be divided into the following two distinct fields: (a) behavioral decision theory and (b) organizational decision theory. these Two fields of decision making are different, yet they have a history of conspicuous cross-pollination. Some of the early work in organizational decision theory was, in a very general way, an effort to represent decision making in organizations as intentionally rational and subject to rather severe cognitive constraints. These studies of decision making regarding new technologies are essentially examinations of the extent to which individuals treat preferences, expectations, and perceptions.

Some of the early work in behavioral decision theory was affected by speculation about organizations. In fact, researchers and observers of decision making move back and forth rather easily from discussions of individual decision making to discussions of organizational decision making and use many of the same concepts for both. Rational models see decisions as being made by the evaluation of alternatives in terms of their future consequences for prior preferences. A large portion of the literature discussing the theoretical developments in the analysis of decision response – both at the individual and the organizational levels – is some form of elaboration of that underlying vision of wilful human action. In studies of both individuals and

organizations, there is a persistent fascination with the extent to which decision making reflects processes and produces outcomes familiar to the modern decision scientists.

Conclusion:

In conclusion, it can be said without a doubt, the literature review has almost indicated no negatives about the biometrics' usefulness in the area of people verification, identification and authentication. It has indicated that the fear factor which de-accelerates decision making as being pro-implementation of the biometric attendance management tool. Succumbing to fear raises the question of cost effectiveness in decisions made by institutions where technologies that have greater potential, if well utilised, of bringing value to organisations are allowed to operate far below their value realisation levels. The empirical literature review indicates the attitudes of the faculties towards biometric attendance systems which are influenced by subjective norms, perceptions of usefulness and ease of use, and concerns related to privacy and technical issues. While faculty members recognize the advantages of these systems in streamlining attendance management, there are concerns about data privacy and potential errors in recognition.

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