
Research article

Adoption of Voice Biometrics in the Kuwaiti Public Sector: A Study of User Perceptions and Acceptance Factors

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ABSTRACT

The research proposes a detailed study of government employees' perceptions regarding the introduction of biometric authentication, such as voice recognition, at their respective workplaces in the State of Kuwait. Studies were conducted among employees to identify factors that influence their adoption of new technology, thereby improving the adoption of voice recognition technology in other digital open government (DOG) applications. To obtain the required data for this study, a questionnaire was administered to managers, middle managers, and employees from four government organizations in the State of Kuwait to understand employees' perceptions of voice recognition. The study found a notable cultural and digital gap between the authentication solutions required by management and employees' technological knowledge. Due to the potential for misuse, a lack of trust in the newly introduced technology, and differing management intentions, managers feel more responsible for minimizing the prevalent gaps. In the context of biometric voice recognition implementation, it was essential to address employee resistance. It is highly recommended to have proper orientation and knowledge in biometrics, much before the introduction of the technology into the organization.

1. Introduction

The evolution of new dimensions is constant in our lives with every new technology that emerges. This helps create interactions between users and their respective governments through electronic services. Governments seek to use technology effectively and efficiently to deliver services to customers electronically with ease [1, 2]. Hence, electronic government has emerged as a vital application worldwide. For the functionality of digital open government applications, users need to submit their data to ensure effective, efficient, and safe technology, especially to provide reliable methods for users and secure data systems. With the introduction of a digital open government system, the government must address issues such as user authentication, privacy, and information security, for which biometrics would be an ideal solution [3, 4]. It provides proper identification of individuals, along with the ability to control and safeguard the integrity of sensitive, secure data stored in information systems [5, 6]. Thus, many governments have adopted biometric authentication systems to improve the efficient functioning and delivery of services. Simultaneously, this adoption of fingerprint biometrics into digital open government has become a vital element of political planning in several governments. User acceptance is considered vital for biometrics to be successfully implemented [2, 7, 8]. Users may directly influence the functioning of

biometric systems; hence, their requirements need to be carefully considered, regardless of how vague or rough they may be [9]. This research builds on a study conducted in the State of Kuwait examining government employees' perceptions of the implementation of biometric authentication in their workplaces. The objective is to understand the factors that affect employees' acceptance of the new biometric concept, and to explain to them how to implement voice recognition biometrics in digital open government applications. The study pattern of the paper first shows the review of the literature, followed by an explanation of the related empirical study, which has detailed interviews and surveys of managers, middle managers, and employees from four organizations

2. Digital open government challenges

The system of electronic government, or digital government, involves citizens in government activities, helping solve problems more effectively. The digital open government offers so many fine opportunities to improve and restructure the internal governmental processes, allow better service delivery, and create many chances for interactions amongst users and the government [10-12]. It suggests that information technology is being used by the government to enable better collaboration and service delivery provision to people, government organizations, and other businesses [10, 13]. It can be said that there are four particular groups of applications of digital open government and e-government: Government-to-Employee (G2E) [10, 13]; Government to Government (G2G); Government to Business (G2B), and Government to Citizen (G2C); that is a link mediated with technology prevalent amidst the people, and their respective governments, coming from the outlook of possible electronic negotiation over policy development, over a civic statement, and in democratic terms of a user will [14-16]. However, accessing government services in developing countries is neither simple nor convenient. The concerned services are police records, citizenship records, hospital services, pension schemes, ration card applications, agriculture services, and BPL services. Digital governance, the latest approach, is considered the solution to almost all problems. It is also referred to as digital government and online government. Digital governance offers several services beyond interactions and transactions among citizens, including all kinds of government business that use communication and information technology. The citizens of the country are involved in their government's activities, which helps solve issues more effectively. Though digitalization of government systems offers various opportunities and benefits to private and public institutions and citizens, there are many barriers and challenges that can hinder internal and external stakeholders from actually realizing the promises of IT initiatives. The complex and diverse applications of the government may give rise to varied challenges [17-20], which may be divided based on the literature review into social, organizational, financial, and technological barriers. The key barriers and challenges related to the study focus, as shown in Table 1, will be briefly introduced in this section.

Table 1: Digital Open Government Challenges

Technological	IT Infrastructure Security Availability Accessibility Website design
Human aspects	Lake of Awareness
social	Culture
Financial	Lake of budget/high cost

3. Identification and verification Technology

Biometrics refer to the automatic identification of users based on their behavioral or physiological traits [21-23]. A biometric system, which is a pattern recognition system, works by deriving an individual's biometric information, obtaining a feature set, and then comparing it with the template data already stored in the database.

Biometric systems operate in two modes: verification or identification, depending on the context. The verification mode is the method by which the system tests a person's identity by comparing their biometric data with the biometric template(s) stored in the system's database [24-27]. The verification process is a positive recognition intended to prevent situations in which multiple people may use the same identity. Identification mode, on the other hand, is a negative recognition that prevents a person from using multiple identities. The system identifies a particular individual by searching its database for templates of every user stored there to find a match. Positive recognition can be achieved with conventional techniques such as PINs, keys, passwords, and tokens; only through biometrics can negative recognition be ascertained. A sample of biometrics is shown in Figure 1, which has been used in verification or identification mode. The voice recognition biometric involved in this work is discussed in more detail in the following section. In this work, voice recognition, which is used as a biometric

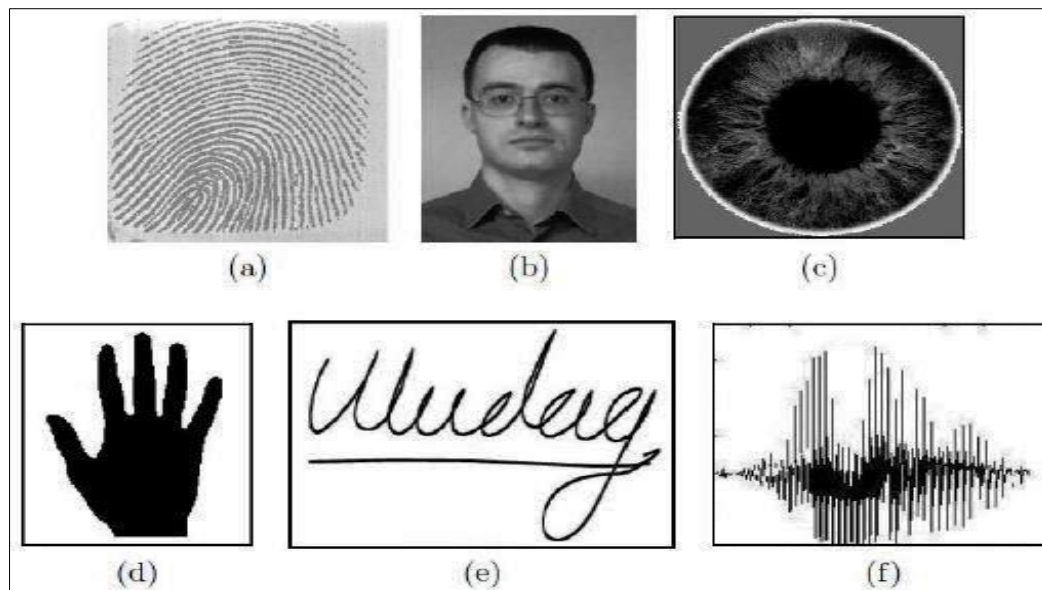


Fig. 3 Example biometric technologies: (a) Fingerprint, (b) Face, (c) Iris, (d) Hand Geometry, (e) Signature, and (f) Voice [28, 29]

4. Voice Recognition System

Voice recognition refers to the ability to mechanically identify a speaker by recognizing an unknown speaker among many other reference speakers using certain speaker-specific data, including speech waves [24]. Voice recognition aims to derive speaker-specific data, represent them, and later apply them for identification. Speaker recognition can be split into two: speaker verification and speaker identification. Speaker verification aims to confirm a person's identity from their voice using a machine [30-32]. Voice recognition contains two segments: the training phase and the testing phase. During the training phase, a speech sample is obtained from each user whose speaker model the handler constructs, and these samples are then deposited and used in the testing phase. In the testing phase, a user's speech sample is matched against the previously stored speaker models, which were structured during training, and the recognition decision is made. Voice recognition, generally, comprises feature extraction; classification, design matching, and decision-making process or modules, and speaker modeling.

5. Some of Biometric used in DOG Applications

Using voice recognition technology, digital open government and e-government aim to offer better services to their citizens by providing secure, efficient access to data, reliable individual identification, and the ability to protect and control the integrity of sensitive data systems. Scholars such as Ashbourn [33], Bonsor and Johnson [13], and Scott [2] argue that biometric technology can be widely used in digital open government and e-government schemes. Biometric technology is currently used in applications such as banking transactions, security access, and e-voting to ensure that voters do not vote more than once. With biometric technology, governments can minimize fraud in transactions and elections. Biometric-like voice recognition is now also used

to ensure accurate timekeeping and that only authorized individuals can access government resources and property. For example, banks regularly use biometric recognition systems, such as voice or facial recognition, to minimize the risk of theft or fraud. Even for commercial applications, there will be a need for digital certificates, full identification capabilities, multiple authentication devices, a human interface, and methods to ensure the safe and efficient operation of businesses. Before biometric technology was used, it was very easy to forge documents, sometimes altering them, allowing unauthorized people to misuse facilities and resources. Because of this, most nations have avoided mechanisms such as national identity card systems in the past. Biometric applications and effective digital open government help validate and recognize citizens, minimizing issues related to unlawful migration, access blockages in chaotic services, and the high cost of engaging security personnel. It is, however, true that biometrics offers strong authentication by recognizing people, yet it also has drawbacks. There is a chance that biometrics can be ineffective in many identification modes. For example, voice recognition performance degraded due to various challenges, such as background noise and reverberation, and also depended on the speaker's phonation, influenced by environmental factors (e.g., illness, whisper, speech under stress, aging, cold)[34]. Some facilities have the infrastructure for voice recognition, which requires more investment, making it quite tough for them to implement a worldwide system.

6. Research Methodology

A quantitative analysis approach using online questionnaire surveys was used in this report to gather primary data and fulfil the study objectives. A survey questionnaire was chosen because it is less time-consuming, less costly, it is possible to guarantee the privacy of respondents, and it has the potential to provide a data inflow from a large sample with a minimal degree of study bias[35]. The questionnaire was used to test managers' and employees' views on the challenges to adopting voice biometric-based digital open government services and the effect these challenges have on perceived security. Furthermore, from the service providers' perspective, the same issues have been discussed. The link to the online questionnaire was advertised to the research's targeted sample using multiple channels (such as social media groups and personal emails).

For the study, a survey questionnaire was also developed in English. Participation in the questionnaire was entirely voluntary, and informed consent was obtained by means of the first question on the cover information sheet, implying that the "yes" answer to the question is clear. By the end of that time, 50 responses were received. The sample of this study consists of two categories: managers and employees. 40 participants were employees from different government agencies in Kuwait. However, 10 employee responses were discarded due to incorrect or missing answers. As a consequence, a total of 50 responses were valid for the data analysis, enabling the identification of the extent to which digital open government challenges influence the acceptance of voice biometrics in the organization sector in Kuwait. The study was conducted based on the University of Salford's human research ethics.

6.1 Data Analysis and the Results

The following sections illustrate the main results and present survey-based indications for the response to the research query. In the first segment, an overview of the online survey questionnaire was given. Then, in the following three parts, an illustration of the study question's consequences was provided with more detail. Every acquired response was saved in SPSS and later used for analysis.

7. The Finding

In the past, in most Kuwaiti agencies, manual signatures were required to confirm employees' attendance. The procedure required the employee to sign and confirm his presence twice a day, at the start and end of the workday. This process, however, has drawbacks, such as employees being able to sign in for others and possibly failing to record the correct time of signing. Hence, it was realized that this procedure was not efficient or effective for recording attendance, which paved the way for introducing voice recognition technology. In this part, some survey questions are presented, focusing on identifying issues in the context and on finding solutions to minimize the cultural and digital gap.

7.1 Survey Finding

The survey was distributed to 60 employees working at a government organization, and the analysis, presented in

question-by-question format, is shown in this section. A Likert scale form containing questions ordered from 1 to 5 was used in this survey. Question 1 represents the lowest level of importance, and level 5 is the highest. Generally, it is expected to derive a preliminary analysis view from Likert responses.

- Using voice recognition technology in the government organisation is significant; do you think?
This question evaluates users' perspectives on the degree of prominence the organization assigns to employees based on the application of voice recognition technology. The following are the derived responses:
 - None of the concerned participants thought it was unimportant.
 - 28.6% consider it important.
 - 8.7% consider it quite important.
 - A minority (40.3%) of participants are unaware of the value of applying the system of voice recognition technology at their respective workplace.
- Do you think it is important that there must be an awareness of this technique before it's used?
The answers to this query focus on users' perspectives on the value of awareness before implementing biometric technology. The notion of awareness encompasses information, statements, and employee instructions. The respondents differentiated the degree of significance in the following way:
 - Only 3% of the participants felt there is no need to enhance the employees' alertness about the related biometric before its installation
 - 13.5% consider it important.
 - Most of the respondents (48.46%) have assumed that it is essential to have know-how before the usage of speaker recognition biometrics.
- Do you think that utilizing this biometric means that employers suspect employees?
The response to this question analyses the users' perspective on the employer's suspicion arising from the introduction and use of voice recognition technology. There is quite a difference between the responses of the employees, as shown below:
 - 32.6% of respondents declared that it does not indicate mistrust.
 - 9.7% consider it mistrust.
 - 19.9% are certain that it is mistrust.
 - 27.8% of participants are not sure if it is mistrust or not.

8. Discussion

The derived outcomes show that after the survey, 90% of the managers agreed that there is a cultural/digital gap resulting from employees' limited familiarity with technology and the organization's embrace of voice recognition biometrics. Organizations that plan to adopt voice recognition biometric technology need to communicate with their workers to gain a clear understanding of how the technology works and why it needs to be implemented. If this information is conveyed clearly and concisely, the organization will be able to successfully educate users about the project, thereby building their confidence in the technology's implementation. Another fact noted is the literature on the challenges of applying digital open government in the State of Kuwait. This can be summarized as the shortcomings resulting from a lack of cultural and social understanding of the ideals and claims of digital open government, the degree of computer illiteracy, and the lack of a curriculum in official education that portrays the information age. The outcome of this study, however, shows the need for more programs that apply digital open government. Only 45% of the questioned managers considered themselves responsible for minimizing the technical-cultural gap. This aligns with Ashbourn's [6] research, which found that managers require detailed training to understand the problems associated with the design and use of this biometric. It is particularly essential for fulfilling the roles related to user acceptance, application functionality, and understanding. Hence, this kind of training may help managers to lessen the practical cultural gap. From respondents' responses to various questions, it was evident that employee resistance is a significant challenge for organizations. Attempts have been made by many employees to prevent the use of technology in many ways. Giesing identified perception issues, user acceptance, and issues related to the use of modern technology as factors that could deter an organization from adopting or using voice recognition

biometric technology. The survey also yielded extensive responses on the social effects of voice recognition biometrics. As stated by 55% of participants, many positive impacts were observed through proper working hours and attendance regulation. Whereas 45% of other respondents stressed the negative effects of using this biometric, based on the findings of Coventry [36], who focused on the feebleness of cultural and social consciousness regarding the ideas and DOG applications. The author in [37] also noted that the acceptance and usability of biometric facilities may be influenced by the context of related social issues, such as perceived privacy risks and perceived benefits to users. The application relates to the seeming advantages, minimal obvious dangers, and may lead to wider insights into user possibilities and greater acceptance of views about voice recognition biometrics, more than in contexts with lesser obvious advantages and greater risks. A minority of employees (46.6%) were unaware of the value of voice recognition technology, which, again, could be associated with the lack of awareness required before using any new technology. This underscores the challenges in implementing digital open government in Kuwait, which indicate a lack of awareness classes on its application, inadequate curricula in official education to prepare for the information age, and citizens' illiteracy in computer knowledge. A relatively small number (53.55%) of respondents believed it is essential to understand the implications of introducing voice recognition technology through education and information programs before even commencing use. Change resistance could be an essential element here. This work finds that the users prefer using voice recognition technology instead of using others type of biometrics such as fingerprint which is the most technology used in Kuwait State that because of numerous persons said it increases the problem of radiation dangers that they think are related with utilizing these schemes, in addition to illness transmission via each member touching the similar place, that also exemplified in additional answers to the interviews. This worry decreases as the stages of consciousness rise and as normal behaviors persist after acclimation when the biometric is used. Moreover, voice/speaker recognition does not require any special or expensive equipment. 34.8% of the respondents of this survey are not sure if the arrival of this new technology denotes mistrust, while 23.6% of respondents are sure that using this technology surely indicates that employers lack trust in their employees, which could be due to factors like the absence of knowledge via consultation, information, notification, and the extent of computer literacy. Lack of programs associated with the application of digital open government and e-government could be the reason for these results. Since 32.8% of the respondents do not consider it a case of mistrust in employees, this may be associated with that percentage of the user population with greater levels of familiarity with technology, convenience, its adoption, and helpfulness, which must have been experienced elsewhere.

9. Conclusion

Research was conducted to understand government employees' perceptions of factors related to the adoption of voice recognition biometrics in the workplace. The objective was to understand the best way to achieve employees' acceptance of biometrics to successfully adopt voice biometrics in digital open government applications. Many results reinforced findings in the literature on user acceptance of voice recognition and the embrace of digital open government technology. Based on the analysis of the results, it is clear that an orientation and awareness program on voice recognition is needed before introducing this technology into the organisation. This point is clearly stated, as the entire top and middle management pointed out employees' resistance to installing the technology before it was even installed. The employees must be well aware of the new technology, its purpose, and its benefits. Most managers refused to see themselves as responsible for minimizing the cultural and digital gap in voice recognition technology, and it was suggested that managers be more aware of their respective responsibilities. They need to identify the presence of cultural and digital gaps in technological awareness and also serve as role models and leaders for their employees. It was also stressed that managers are responsible for successfully implementing voice recognition technology in their organizations to achieve proper awareness of the technology and an elementary understanding of Information Technology.

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