

Biometrics Student Information Management System Using Voice Authentication

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Abstract: *Improving the students' management level by means of biometrics technology has a far-reaching significance to increase overall campus efficiencies for the university. This paper presents a smart campus solution that enables secured and seamless information flow across different user groups at Yangon Technological University (YTU) through a new, integrated, multi-channel solution. The proposed system is based on Interactive Voice Response (IVR) technology to provide speech-enabled responsive system to improve access control, reduce resource usage and prevent identity theft. For preventing unauthorized access to sensitive information and services of the university, voice biometric based user authentication technology is applied.*

Keywords: Student Information Management System (SIMS), Interactive Voice Response (IVR), Voice Biometric, Smart Campus

1. Introduction

Managing and maintaining information of students/ staff/ faculty of a university manually need much resources of human and time and getting accessing to information from that on-paper work is time consuming. Nowadays, with the rapid development of ICT capabilities, information management becomes a lot more convenience and supports users to get required information easily and quickly. The mobile Internet is becoming a familiar presence in people's daily lives of developing countries and the number of mobile Internet users becomes higher day by day. People use various devices such as laptop, PC, and smartphone to access the information whenever they need.

Biometric systems have a lot of benefits over the traditional systems. Firstly it is impossible to share and very hard to reproduce an individual biometric feature. Biometric systems also eliminate the need to remember and memorize long and random passwords or pins thereby enhancing user convenience. Biometrics systems also provide the same level of security to all users unlike passwords/pins and are repellent to brute force attacks. Moreover, biometrics is one of the few techniques that can be used to determine whether an individual is pretending to be someone else [5].

The Agile methodology was adopted to achieve the design of this application within the specified time limits and constraints. In this sequential design process, inspect-and-adapt approach is used by dividing the system requirements into logical sprints. All system and user requirements are made by interviews and on-site surveys in university before the system design activity proceeds to get the detailed data about the system.

1.1. Agile methodology

Agile methodology is a set of planning and management techniques derived from software development and based on the iterative and incremental execution of activities, where the requirements and solutions evolve according to the needs of the project.

Like the beginning of any project, at the beginning of an agile methodology sprint a meeting is held during which the sprint itself is planned. The customer and project team discuss the work that needs to be completed during the sprint. It is down to the project team to determine how much time they will need to complete certain amounts of work and up to the customer on the type of work that needs to be completed.

The Inspect and Adapt (I&A) is a significant event, held at the end of each Program Increment (PI), where the current state of the Solution is demonstrated and evaluated by the train.

1.2. Speaker Recognition and Biometric Authentication

Speaker recognition system is used to identify and verify the voice sample of a person. The computer system which spontaneously identifies and verifies the sample of person's voice taken from any source like microphone is known as speaker recognition. The term of biometric technology is voice recognition. Authentication is supplied to any system on the basis of his/her acoustic features of voice with the help of biometric technology. Identification and verification system use the behavioural aspects of persons voice [6].

Like a fingerprint, every human voice has a unique signature which can help machines to identify people. For callers trying to reach contact centers, voice-based authentication is one of the easiest ways to create a robust security mechanism. IVR allows customers to interact with the organization's host system via a telephone keypad or by speech recognition, after which they can service their own inquiries by following the IVR dialogue. Most IVR systems deployed in the network are sized to be able to handle large call volumes.

In addition, speech-based user authentication, known as, voice biometrics authentication becomes popular for providing secure access to resources. Biometrics information can be used to authenticate a person's identity and control access to a restricted area or electronic system, based on the physical characteristics that can be used to uniquely identify individuals [2, 4]. All security systems that use user-based

authorization require users to be accurately identified to ensure that the correct access privileges are granted. Biometrics as an authentication tool is very powerful because unlike other techniques currently used to authenticate people, such as passwords or access control badges, it cannot be easily taken away, lost, counterfeited, or forgotten. There are several categories of biometrics: fingerprints, hand geometry, retina, iris, face, handwriting, and voice. Voice biometrics is an effective method to protect sensitive information. Unlike other biometrics methods that require fingerprint sensors or cameras, voice biometrics work with any customer phone.

1.3. Organization of the paper

The rest of the paper is organized as follows: Section II discusses overall system design and Section III presents the architecture of the proposed system. Detailed implementation workflows of the proposed system are presented in Section IV. Some implemented results are shown in Section V. And finally Section VI concludes the paper.

2. Overall System Design

In this paper, a secured and speech-enabled responsive Student Information Management System (SIMS) is proposed using voice biometrics authentication and IVR technology. The proposed system provides three different user interfaces such as IVR, web portal and Mobile App to manage information of different user groups and to provide secure access to required information and features from SIMS. For IVR interface and voice biometrics authentication, Uniphore's core technology [1] on speech recognition and voice biometrics is applied in the IVR interface and user authentication process of the proposed system.

Fig. 1 illustrates the overall system of the proposed SIMS. Based on the analysis of current situation of Yangon Technological University, there are four main user groups in SIMS: (i) Students (ii) Staff (iii) Parents/Guardians and (iv) Administrators. Users can have access to features of SIMS, which are student attendance, examination results, class schedule, complaints, suggestions and reports based on their roles.

Accessing these features is provided through multi-channel solution that works across IVR, smartphones, feature phones, and web to offer users with not only anytime, anywhere access, but also speech-enable interface to SIMS.

For user authentication, Uniphore's speech platform for voice biometrics is applied. Students have to register their voice biometric during their enrollment process, which is utilized as the student's identity for providing secure access to limited features. Accessing features of SIMS via IVR channel is done through GSM/PSTN line. University provides four PSTN lines for this project, which will be extended in the future.

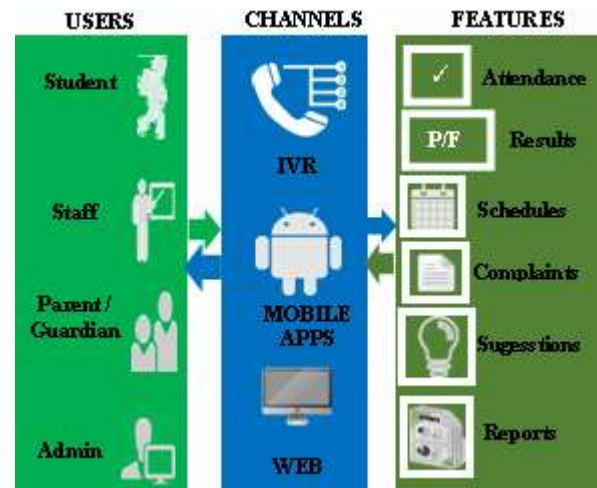


Figure 1: System Overview of SIMS

3. System Architecture of SIMS

The Detailed architecture of the proposed Student Information Management System is presented in Fig.2. Accessing features of SIMS is done via IVR, web portal or mobile app. GSM/PSTN communication links are utilized for IVR channel and TCP/IP communication link is applied for both web portal and mobile app channels.

Proposed SIMS uses Uniphore's speech platform for enabling Interactive Voice Response (IVR) and for secure user authentication purpose. IVR system includes speech recognition technology that is the ability of a program to understand and carry out spoken commands and enables natural, human-like conversations and satisfying interactions. In our project, more than 200-recorded voices in both Myanmar and English language are used as training data for automatic speech recognition with Natural Language Understanding. These voice records are trained as voiceprints stored in voiceprints repository server.

For user authentication, students have to register their voice biometric data during their enrollment process, which is utilized as the students' identity for providing secure access to limited features. Whenever users would like to access or login the proposed system, users have to input voice biometrics data as the password to access the system. Voice biometrics data is inputted directly using telephone or microphone or smart devices. Then, the identity of user is authenticated using Uniphore's speech platform on voice biometrics authentication. After successful authentication, users have access to features of SIMS depending on their roles. Detailed implementation process and privilege on accessing features of SIMS are discussed in the following section.

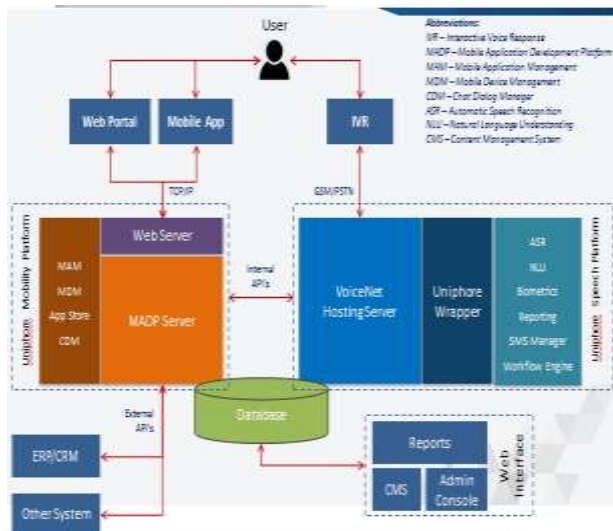


Figure 2: System Architecture of SIMS

4. System Implementation Processes

In this section, detailed implementation workflow of the proposed SIMS is presented. Three main processes: (i) Registration Process from web portal, (ii) Features Creating Process over web portal and IVR Application Process, and (iii) privilege on accessing features of SIMS are described in the following subsections.

4.1 Registration Process

Fig. 3 illustrates the workflow diagram of student registration. Students visit the registration office of university to provide necessary information and enroll voice biometrics data and their telephone number at the time of registration process. Admin fills and saves their information on SIMS web portal and enrolls their voice biometrics on voiceNet hosting server via web API.

The detailed processes are shown in Fig. 4.

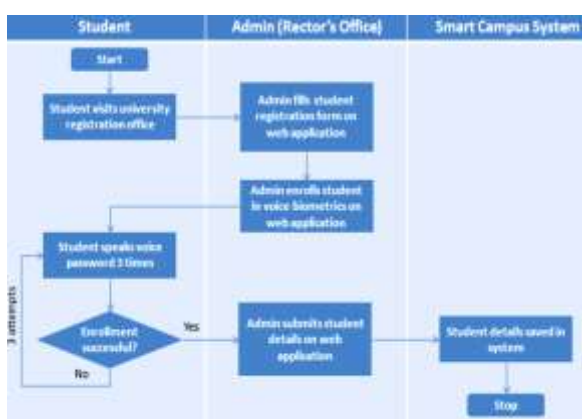


Figure 3: Workflow Diagram of Student Registration

Enrollment is performed using three consecutive renderings of the selected passphrase. After successfully finished the data filling process, admin submits their detailed data to the Smart Campus System.

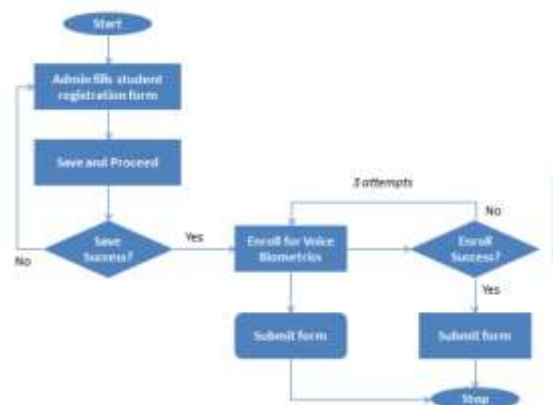


Figure 4: Student Registration and Voice Biometrics Enrollment Process

4.2. Features Creation Process

SIMS includes many features such as timetable, attendance, exam schedule, complaints, suggestions, exam results and reports. The process workflow of some feature is presented in this section. The detail of Student Attendance Submission Process is shown in Fig. 5.



Figure 5: Student Attendance Submission Process

According to university's rules, admin at student affairs office creates timetable for each department and submits it to be approved with each department. After admin revised timetable it is saved in system and published for students and staff.

Staff or faculty marks daily attendance for each student and uploads it to system from mobile device or web application. Admin generates monthly attendance report and publishes this report to students and staffs.

Schedule publishing process and Results publishing process are exposed in Fig. 6. Students can track their exam results via IVR system. As well, mobile app is provided for Students to track their exam results, to view timetable, to track attendance and to register or view suggestions.

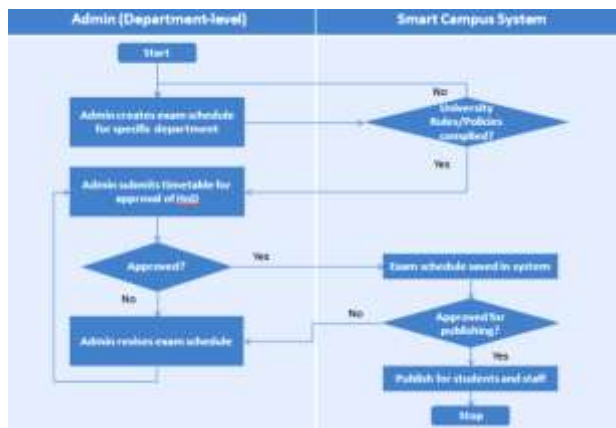


Figure 6: Schedule Publishing Process

4.3. IVR Application Process

In IVR application, registered person, students and their parents/guardians, can track the exam results and register complaints. When students or their parents/guardians call the IVR system via their mobile phones the system checks the incoming call number whether it is registered or not in the system.

If it is registered, the calling application generates the prompt as in the verification process. The speaker speaks the voice password phrase to verify the authentication, and the system verifies the speaker by comparing the speaker's voice sample to the voiceprint stored in the system's voiceprint repository. The verification phrase is provided by the system to the application in real time based on a predefined verification dictionary. If verification process is successful, students can choose to listen exam result or register complaint.

If the system cannot recognize the incoming call number, the system asks the students or parents/guardians to express their registered phone number. When the system recognizes their pronounced phone number, the system communicates the students to speak the voice password for tracking the exam results or registering complaints. Students can attempt three times for entering the system using their voice password. If their voice passwords are authenticated, the system asks the users for choosing complaint or results. According to the user choice, the system saves his complaint voice record in the server or the system fetches his exam result from the server.

The following Fig. 8 shows how to solve the registered complaint or suggestion between students and two types of admin. Admin can update the resolution details in system for complaints.

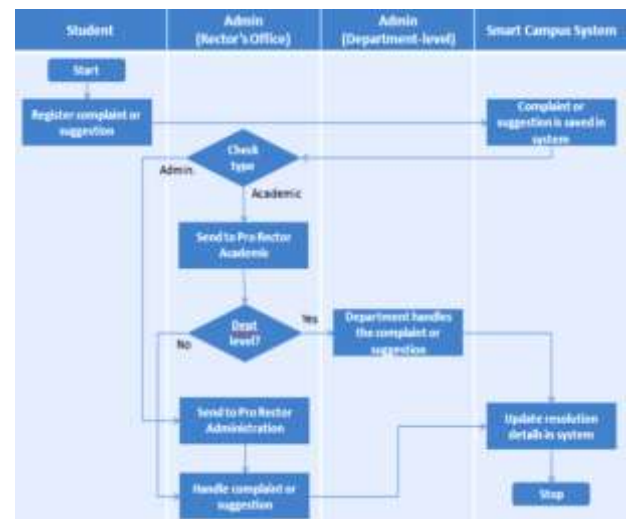


Figure 8: Complaints and Suggestions

4.4. Privileges on Accessing Features of SIMS

SIMS comprises five roles for accessing system features. Access privileges chart is shown in Fig 9.

	Role →	Student	Parent / Guardian	Staff / Faculty	Dept.	Admin Student Affairs	Rector's Office	Superadmin
#	Module	Privilege						
1	Access Control	-	-	-	-	-	-	Yes
2	Student Info	Read			Yes	Yes	Yes	Yes
		Write				Yes	Yes	Yes
3	Staff / Faculty Info	Read		Yes	Yes		Yes	Yes
		Write		Yes	Yes		Yes	Yes
4	Timetable	Read	Yes		Yes	Yes	Yes	Yes
		Write				Yes		Yes
		Publish				Yes		Yes
5	Attendance	Read	Yes	Yes	Yes	Yes	Yes	Yes
		Write		Yes	Yes	Yes		Yes
		Publish				Yes		Yes
6	Schedule	Read	Yes		Yes	Yes	Yes	Yes
		Write			Yes			Yes
		Publish						Yes
7	Complaints	Read	Yes		Yes	Yes	Yes	Yes
		Write	Yes	Yes				Yes
		Resolve			Yes	Yes	Yes	Yes
8	Suggestions	Read	Yes		Yes	Yes	Yes	Yes
		Write	Yes					Yes
		Resolve			Yes	Yes	Yes	Yes
9	Results	Read	Yes	Yes	Yes	Yes	Yes	Yes
		Write				Yes		Yes
		Publish				Yes		Yes
10	Reports	Read		Yes	Yes	Yes	Yes	Yes
		Write				Yes	Yes	Yes
		Publish				Yes	Yes	Yes

Figure 9: Access Privileges Chart

5. Implementation of the System

In this section, some implemented results of SIMS are presented. Fig. 11 and Fig. 12 show the student registration page for filling student information and capturing his voice.



The screenshot shows the Telegram Technology University website. The header is blue with the university name and navigation links. The main content area has a white background. There are two main sections: 'Study Grammarly' and 'Phonograph'. Each section has a list of features and a 'Learn More' button. The 'Study Grammarly' section includes a microphone icon and a '25%' discount badge. The 'Phonograph' section includes a microphone icon and a 'New! Free Trial' badge.

Figure 12: Student Registration Page for Capturing Voice


6. Conclusion

In this paper, the concept of voice as biometric authentication is used to enhance the access control and to improve effectiveness of the student management system. This system will be used in Yangon Technological University where each student's voice is recognized from its vocals. Extraction of voice features for recognition is the main step in this system. We present a voice password based secure smart campus system for retrieving student information. Four types of user can use this system over various channels: IVR, mobile app and web portal according to their roles. University administrator can perform new student enrolment, timetable management, attendance management via web portal easily. Staff can view timetable and manage attendance 24/7 via Mobile App. Students can view timetable and attendance using Mobile App and can listen exam results and register a complaint via IVR system. We have briefed the system with Privileges on Accessing Features of SIMS. The advantages of this voice-based authentication biometrics are significant as it is much more difficult to replicate and present fraudulent identity and users, in essence, cannot forget, lose or have


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