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Interactive ATM for Visually Challenged

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Abstract: In today's industrious world, the use of ATMs has become common. Visually challenged find it difficult to access ATM using magnetic cards and touch screen displays. The setup in existence uses an Ear phone facility to start transaction by inserting in the jack and plug out to stop the transaction. It is very difficult for them to identify and insert the earphone into the jack and also to locate the machine. To overcome these shortcomings, the ATM is provided with speaker guidance system to reach the ATM and with a handset arrangement for interaction. The initial level of security is the handprint biometric through which the person can access the door. The next level of security involves the voice code detection which verifies the person's voice password with that of pre-recorded code. If the authentication process succeeds, the person is accepted as a valid user. Through pre-recorded instructions received via handset, the visually challenged is able to withdraw or deposit money.

Keywords: Handset, Hand print biometric, Voice code detection, Voice biometric, Authentication

I. INTRODUCTION

People once made use of banking sectors to do their money transactions by filling the Chelan, Demand Draft or Cheque. Today, accessing and handling of money is supported by Automated Teller Machine (ATM). Generally, they find it easy to access the ATMs using the magnetic card and touch screen displays to do their transactions. Today, the number of ATM centers is gradually increasing and they are available in almost every place. As per Census 2011, there are 1.5 Crore visually challenged people in India which is 1.24% of the entire population [1]. However, the accessing of ATM by these people is difficult as they are unable to use the touch screen or the button system that is available in the ATM machine. Most importantly they find difficulty in inserting the ATM card into the card reader. Due to this process, they have to depend on a third person to handle their own transaction.

II. BACKGROUND

Over the years, many researchers have tried to implement an advanced model of ATM to aid the visually challenged persons. Then, Talking ATM [2] called T-ATM was implemented and it is a type of ATM which allows the visually challenged user to access the machine independently without depending on third person. This is done in such a way that the machine interacts with the user by giving instructions through an ear phone available in the machine. The ATMs are equipped with audio jack and deliver voice guidance through the user's earphone to prevent others from hearing the transaction.

A. T-ATM in USA:

United States installed the first T-ATM machine called Diebold on October 1, 1999 in San Francisco's City Hall by the Federal Credit Union [3]. It uses the pre-recorded .wav files as audio output. One or more .wav files were tied to a particular ATM screen, and when the screen appeared, the .wav file played. These files were recorded of real persons and bank employees. This is harder for banks to increase the functionality of T-ATMs or make routine changes to the audio program. Recognition of these problems and collaboration between the banks and vendors have resulted in the development of next-generation T-ATMs with text-to-speech software and speech synthesizers inside the machines in more sophisticated models.

B. T-ATM in India:

In India, thousands of T-ATMs are deployed across different parts of the nation. The first T-ATM in India was installed at the premises of the Blind People's Association (BPA) in Ahmadabad by the Union Bank of India (UBI) on June 6th, 2012 [4]. This was a bilingual T-ATM which operates in English and Hindi. The Union Bank of India (UBI) set up a benchmark in bringing such T-ATMs to the country. They were instrumental in bringing these machines to help the visually challenged person access the ATM independently.

The State Bank of India launched its first T-ATM in New Delhi, on October 4, 2012 in which 7000 out of 18,500 ATMs are voice enabled for visually challenged persons [5]. These voice enabled ATMs, customized with headphones

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and Braille keypads will offer services like funds transfer and downloading of account statements. All these ATMs are bilingual which means that they are available only in two languages namely English and Hindi.

C. Limitations of T-ATM [6]

- No proper guidance to locate the audio headset
- Inserting the headset into audio jack is a tedious task
- The use of magnetic cards is still a problem for persons without vision
- The presence of touch screen display and keypads can be still seen as a major flaw
- Though Braille keypads are available, every time the person has to press the buttons in the machine for transaction

III. PROPOSED MODEL

The Interactive ATM (I-ATM) was specially designed to aid the transaction process in the ATM for the visually impaired by overcoming the limitation of Talking ATM. The proposed I-ATM model will replace the card authentication by Hand print biometric and voice biometric systems. This system comprises of the speaker guidance system and handset arrangement to interact with the person. In order to increase the security of ATM, the automatic door lock system was also adopted. I-ATM model consists of five main blocks whose working is explained as follows. The Fig.1 shows the various blocks of I-ATM.

- **Hand print biometric-** Ensures security through automatic door lock system
- **Speaker Guidance -** Provides voice assistance to reach ATM machine
- **Handset arrangement -** Facilitates to interact with the ATM Machine
- **Voice code Detector -** Acts as the primary authentication process
- **Voice biometric -** Acts as the secondary authentication of the user

A. Blocks of I-ATM

I-ATM comprises of a handset arrangement to interact with the person. The model includes three authentication process (i) Hand print biometric (ii) voice code detection and (iii) voice biometric. As the person reaches the ATM, first he has to use the finger print biometric system which is outside the door of the ATM center. After the finger print verification the person can enter into the ATM center. The automatic door will close after the person has entered to the ATM center. The visually challenged person will not know the position of the ATM machine. He will be guided towards the ATM machine through a pre-recorded voice which will instruct the position of the ATM and the handset arrangement. The person will pick up the handset and the I-ATM will interact with the person through a pre-recorded voice. The person will have to register his unique voice code which is a voice password in the bank when new opens his new account. This will be matched with the original value of the bank's server. In the next process the voice of the person will be scanned and referred with his own stored voice in the bank's server. When both the conditions are satisfied in authentication, the process will come to an end. If the person has bad voice condition or the password mismatches, then the system will move to advanced security mode where the person needs to answer two private security questions of the user. From this authentication process, the transaction process will be working through voice assistance by choosing the account type and amount of cash, but through voice commands to the ATM. As the transaction comes to end the automatic door will open and the person can exit.

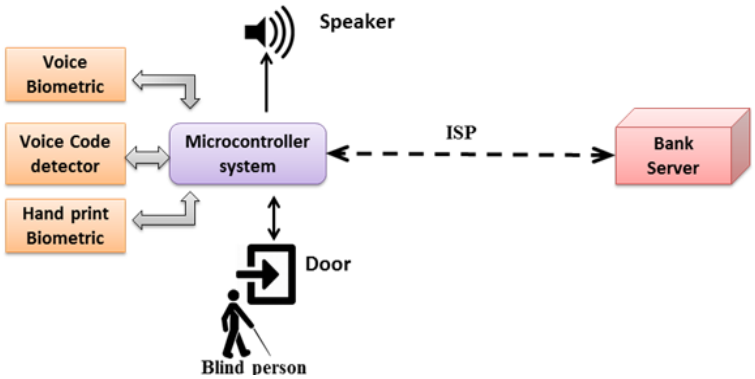

Fig.1. Various Blocks of I-ATM

B. Flowchart of I-ATM: The flow chart of I-ATM shows the sequence of execution of operations performed starting from the user enters the ATM Center till the user leaves it. The Fig.2 shows the flow chart of the I-ATM.
The sequence of execution of I-ATM is as follows,

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- Start of Process
- The hand print biometric at the ATM door gets turned ON and scans the hand print. If the scanned hand print matches with the pre-recorded data, then the person is permitted to further process or else he has to repeat the same authentication.
- If the condition is satisfied, then the beep sound will indicate the verification of the finger print.
- The automatic door will be opened and closed when the person has entered into the ATM center.
- The speaker guidance system helps to know the position and guides to reach the ATM machine inside the ATM center.
- Following this, next the voice recognition system will interact with the user through the handset arrangement. If the voice code matches with the user then the person is allowed to proceed to next authentication process, else the system will once again ask the user to register the voice code.
- The next is the Voice biometric process which does the voice matching authentication and if the voice password then the Transaction part will take place or else it will run to execute the advanced security question process in which the user has to answer to two personal questions that has been already registered by him in the bank's database.
- Once the transaction block gets executed the automatic door will open and the process will come to termination.

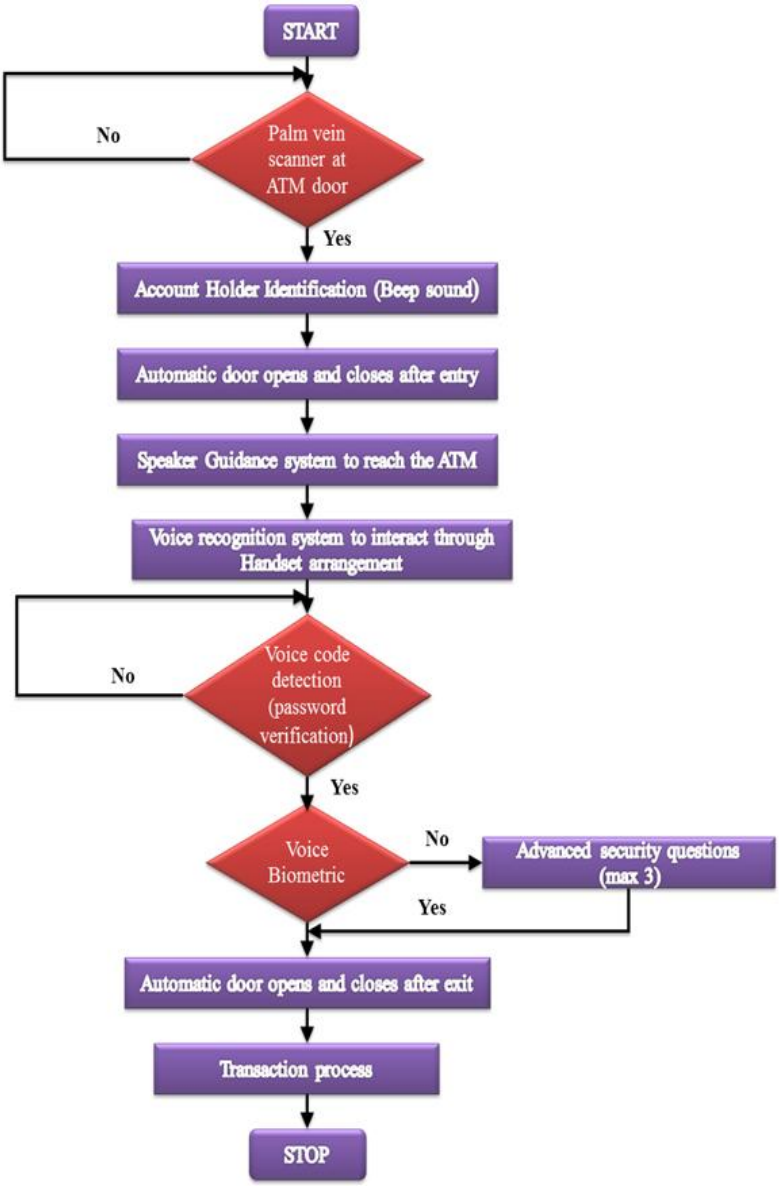

Fig.2. Flowchart of I-ATM

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IV. PROTOTYPE MODEL

The I-ATM is implemented as a prototype working model by choosing certain required hardware components and technologies as shown in Fig.3.The ultrasonic sensor, R305 finger print biometric module, micro SD card module and the Elechouse voice recognition module are the components used here. The LCD display is used here to display the execution of process. In addition to this a speaker is provided for the voice guidance and another speaker is placed inside the handset arrangement to provide voice interactions.

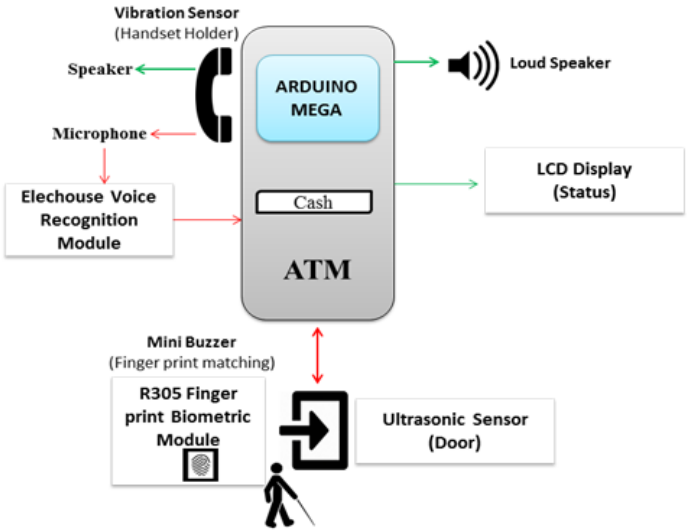

Fig.3. Block Diagram of Prototype I-ATM

The block diagram of the prototype I-ATM is shown in Fig.3.The entire system is integrated and controlled using the Arduino Mega controller. This controller functions to command and operate all the components i.e., the ultrasonic sensor, R305 finger print biometric module, micro SD card module and the Elechouse voice recognition module. The operation is carried out in a sequential manner such that the flow process begins from the ultrasonic sensor and proceeds till voice recognition system. The LCD display is provided in order to display the status of the ATM process.
The Fig.4 shows the circuit diagram of I-ATM**.** The connections of the modules with the Arduino mega micro controller are shown in the circuit diagram.

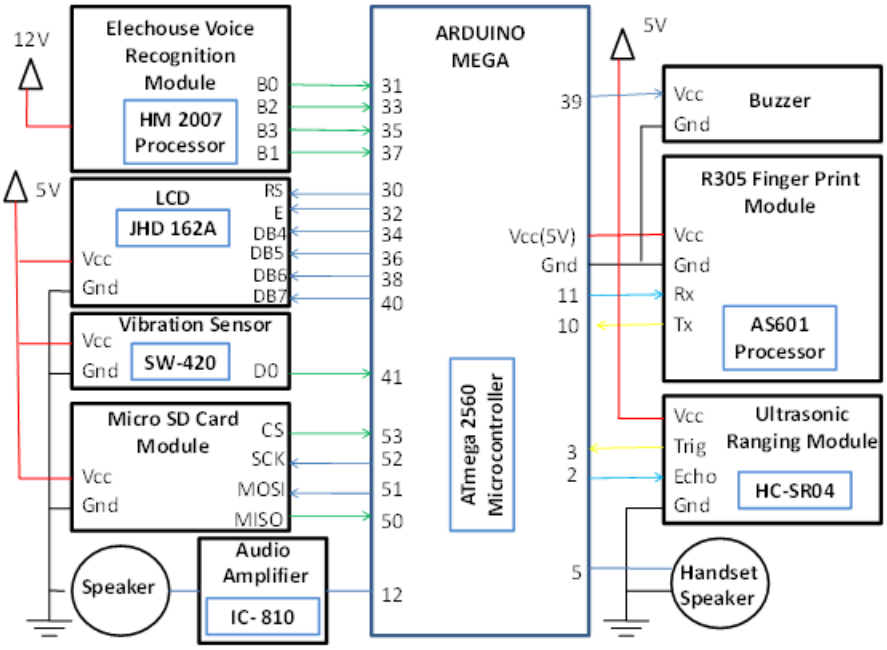

Fig.4 Circuit Diagram of I-ATM

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V. IMPLEMENTATION AND RESULTS

The Prototype of Interactive ATM consist of four major blocks namely, Automatic Door with Finger Print Biometric System, Speaker Guidance System, Personal Interaction through Handset arrangement and Voice Recognition System. The LCD setup is used to indicate the status of ATM. The mini buzzer is used to indicate the matching of finger print of the user.

A. Automatic door with finger print biometric system

The automatic door with finger print biometric system is shown in Fig.5. In prototype, the automatic door is replaced by Ultrasonic sensor. This sensor senses the presence of person near the door. The threshold distance is fixed as less than or equal to 30cm. So, that when the calculated distance reaches the threshold distance, then the controller identifies the person and display the status on the LCD as shown in Fig.6.

Fig.5 Automatic Door with Finger Print Biometric System

Fig.6 LCD displaying status of presence of person near the door

After sensing the presence of person at the door, the ATM goes for the finger print authentication process. The Interactive ATM instruct the user to scan the finger as shown in Fig.7. When the red light blinks, the Finger print of the user is taken as image and processed by R305 module. The obtained template is matched with the stored template and diplays the results using LCD.

Fig.7 LCD Displaying the instruction to done by the user

Fig.8 LCD displaying the results of Finger Print Authentication System

Once the finger print of the user gets matched, the mini buzzer will ring. This indicates that the door is open to enter into the ATM and the LCD displays the name of the user as shown in Fig.20

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B. Speaker guidance system

Once the process of authentication of user is completed, the speaker Guidance system helps the visually challenged person to reach the ATM machine. The Loud speaker will play the recorded audio stored in the MicroSD card. The Speaker guidance system interfacing with microcontroller system is shown in Fig.9.

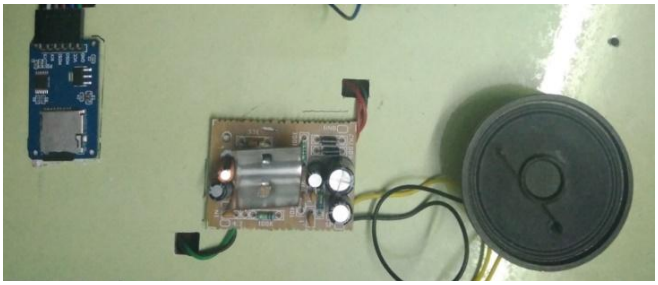

Fig.9 Speaker Guidance System

The status of the speaker guidance system is displayed using LCD as shown in Fig.10. After cmpleting the finger print authentication process, the Loudspeaker gets ON and plays the recorded .wav file stored in SD card.

Fig.10 LCD displaying the status of Speaker Guidance system

C. Personal interaction through handset arrangement

Using the speaker guidance system, the user reaches the ATM and instructed to pick up the handset placed over the holder. The vibration sensor is fixed on the Handset holder. Once the person picks the Handset, the vibration sensor senses the presence of person and Speaker Guidance system will OFF. Then, the ATM interacts personally through handset speaker. The status of Personal interaction through handset arrangement is shown in Fig.11.

Fig.11 LCD displaying the status of Personal Interaction process

D. Microcontroller system

Arduino Mega microcontroller is used in Interactive ATM. The Arduino mega is interfaced with various modules as shown in Fig.4. The board is supplied with a 9V battery. The Arduino mega on the mica board is shown in Fig.12.

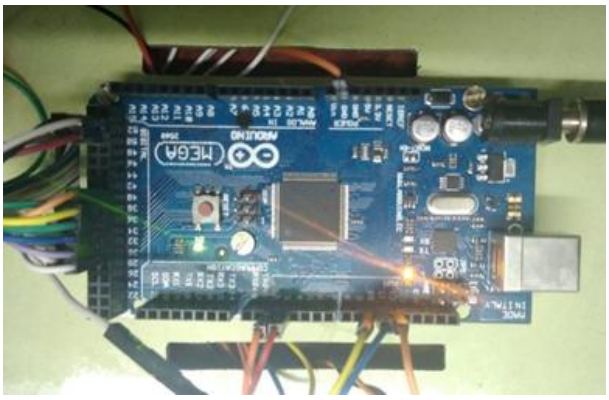

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Fig.12 Arduino Mega Microcontroller System

E. Voice recognition system

During the personal interaction process, the ATM asks for the voice password through the handset speaker. The voice password is given as input by the user to the Elechouse Voice recognition module through the microphone attached to it. If the voice password matches with the stored password, then the LCD display the status of voice recognition process as shown in Fig.13.

Fig.13 Voice Recognition process – LCD displaying the Password matching status

Once the password gets matched, the ATM asks for the amount that the user wants to withdraw. The user gives the input as the voice command to the voice recognition module through microphone. If the module recognizes the amount, then the amount gets displayed using LCD as shown in Fig.14

Fig.14 Voice Recognition process – LCD displaying the Amount withdraw status

VI. INTERACTIVE ATM

Finally, all these blocks are combined to form the Interactive ATM as shown in Fig.15. The Interactive ATM is implemented using the payphone with handset arrangement. The vibration sensor is attached to the handset holder. Remaining all these blocks are embedded on a single mica board as shown in Fig.15.

Fig.15 Prototype of Interactive ATM

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CONCLUSION

The Interactive ATM allows the visually challenged to utilize the ATM machine in a friendly manner as it replaces the ATM card authentication by voice authentication process and it also boosts up their confident level by accessing their money individually. The entire setup is quite simple and applicable, as this model could be compatible with the existing ATM model and so it is time and cost efficient. Finally, it provides security for their money from theft.

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