UI Design for Language Translator Module in Swasthya Slate (m-Health Tool)

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Abstract*—Modern Information Technology is increasingly used in health-care with the goal to enhance medical services and reduce costs. Nowadays, Urban Areas rapidly adopt these advancements in technology to quickly reach out its services. But, the situation of patients in Rural Areas is entirely different from those in Urban Areas. Towards filling this gap, Government of India has started some appreciated initiatives to overcome problems in Rural Healthcare. In this paper, we propose a revision in the existing architecture to reduce the communication gap between patients and Public Health Workers in Rural Areas. The revision is proposed in the Language Translator Module in the existing architecture. This module helps in gathering details of ailments from patients in their regional language and get the prescription as soon as possible. This module incorporates the emerging techniques in Information Technology such as, Speech Recognition, Synthesis and Reproduction.

Keywords—m-Health tool; Language Translator; DECIDE framework; GOMS model.

I. INTRODUCTION

The proliferation in the healthcare industry has increased human life span. But, the services are mainly concentrated in the Urban Areas. In a developing nation like India, the health-care industry is considered to be developed, only when these services reach Rural Areas. Towards achieving this goal Government of India has started various initiatives such as Norway-India Partnership Initiative (NIPI) [1]. The initiative is implemented as an integral part of the National Rural Health Mission (NRHM) [1,2] of India. Its objective is to reduce maternal and neo-natal mortality rates. The Yojana has identified Accredited Social Health Activist (ASHA), as an effective link between the Government and the poor pregnant women across India. These ASHA workers, conduct various diagnostic tests via, Swasthya slate (m-Health tool)[3], a mobile device. This tool also supports Text-To-Speech (TTS) conversion module to partially reduce communication gap between the ASHA worker and the patient.

The objective of this paper is to propose a revised UI design for the existing Language Translator module to completely confiscate this communication gap. For the purpose, the module incorporates Speech-to-Text (STT) and Text-to-Text (TTT) modules along with the existing TTS module. To further enhance the efficiency of the ASHA worker Symptoms Log Module (SLM) has been included to accept the key terms for recognizing ailments.

The overall structure of the paper is as follows: Section 1 discusses the motivation, relevance and objective for selecting this topic; Section 2 covers the summary of the literature review carried out before designing the proposed UI; Section 3 details the revisions proposed in the existing System Architecture; Section 4 presents a high level description about how the system is organized and operates; Section 5 illustrates the UI design proposed for the Language Translator module; Section 6 briefs evaluation plan and the results of the evaluation process; Finally, Section 7 lists the findings and future scope.

II. LITERATURE REVIEW

A. NIPI

Fig.1 depicts the various programs initiated by NIPI [1] to improve the quality of health-care services offered in Rural Areas.

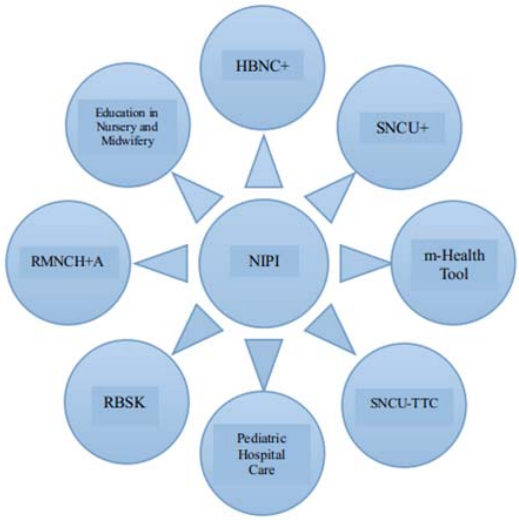

Fig. 1. Programs Initiated by NIPI.

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B. *Swasthya Slate (m-Health tool)*

Swasthya Slate[3] is a powerful application that allows Android Tablets and Phones to conduct 33 diagnostic tests on the mobile device. The Swasthya Slate includes specialized applications that help users to perform a variety of screening and health analysis. This device even stores, Electronic Medical Records (EMR) both locally on the phone/tablet and also push the data into the cloud.

C. *Speech Recognition System*

The four main steps involved in any Speech Recognition System [4,5] are:

1. Training Process defines the voice commands to be recognized by the System.
2. Library stores the trained voice commands.
3. Recognition: When a command is uttered, its fingerprint is compared with the fingerprints available in the Library. The best acceptable match above a threshold percentage is assigned as the recognized command.
4. Process: Executing the functionalities assigned to the recognized commands.

The various interdisciplinary subjects involved in the process of implementing a Speech Recognition [4,5] System are:

- Signal Processing, to analyze and synthesize sound signals.
- Pattern Recognition, to locate similar text / speech patterns recorded.
- Neural Computing, to train the System with a new set of sound signals captured from the user.
- Natural Language Processing (NLP), to convert the source language to target language.

The driving force towards designing a UI Module for Language Translator was the cost involved in integrating the existing Speech Recognition System. Even the trial versions for these Systems are available with limited functionality, less clarity & accuracy which decides the quality & acceptance of the System.

III. Proposed System Architecture

This section details the revised system architecture for the existing Swasthya Slate. The modules in the existing system are depicted using nine white blocks in Fig. 2. This paper redesigns the language translator module with four new modules added to reduce the communication gap as mentioned in the introduction. In Fig. 2, these four modules are represented in red blocks.

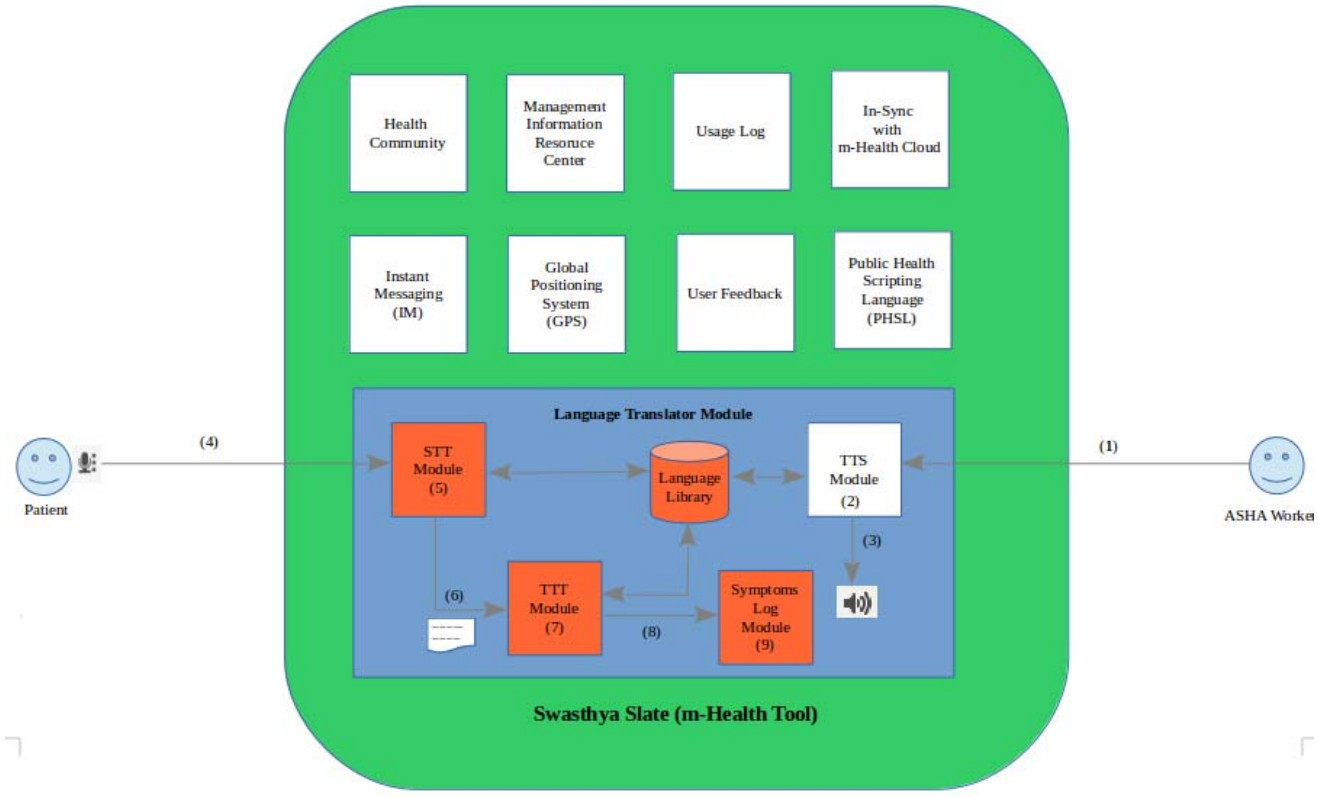


Fig. 2. Proposed System Architecture

The working of the Language Translator module is as follows: (1) ASHA worker types in the query into Text-to-Speech (TTS) module. (2) TTS module converts the typed text into the patients regional language. (3) TTS read out the query in his/her regional language. (4) In response to the query read-out, the patient describes the illness in his regional language which is given as input to the **Speech To Text (STT)module**. (5) STT module digitizes the analog signals and breaks the words in the text into phonemes. It then compares the phonemes to words by interacting with the **Language Library.** (6) The resulting text in regional language will be confirmed by the patient. (7) After getting the patient's confirmation the resultant text is fed into the **Text-to-Text (TTT)** module by the ASHA worker. The TTT module refers language library and translate the text in regional language to English. (8) ASHA worker extracts the keywords related to the ailment from the text output of TTT module and saves it into the **Symptoms Log Module (SLM)** along with patient id and timestamp.

IV. Conceptual Model

The Task Description of the proposed Language Translator module is explained using GOMS (Goals Operators Methods Selection) Model [6] as follows.

The ASHA worker initiates a new entry of the registered patient by tapping the select patient button on the main menu and he/she then scans the eSwasthya card to gather patient information. There arise three scenarios in the process of collecting information from the patients.

Scenario 1: ASHA worker is not conversant with the regional language. All four modules in the Language Translator module along with the language library is involved in the process.

Scenario 2: ASHA worker is familiar with the regional language. In this scenario STT and TTT modules along with the language library is required to convert the regional language text into English so that it can be saved in the symptoms log module.

Scenario 3: The patient proficient in English, then the symptoms can be directly extracted from the text generated by the STT module. Finally, these keywords are saved in the Symptoms Log Module for further reference.

GOAL: Collect the information from the patient via the language translator module.

1. Tap on the Language Translator icon.
2. Subgoal: Questioning the patient.
   (a) Scenario 1 : ASHA worker types the query in English and taps on the TTS module to read out the query in the patient's regional language.
   (b) Scenario 2 : ASHA worker questions the patient in his/her regional language.
   (c) Scenario 3 : ASHA worker questions the patient in English.
3. Subgoal: Receiving the response from the patient.

(a) ASHA worker taps on the STT module to capture the patient's response and converts it into text. The resultant text is then replayed for getting the patient's confirmation.

(b) For future reference, this text is converted to English.

4. Subgoal: Extracting and storing symptoms into SLM.

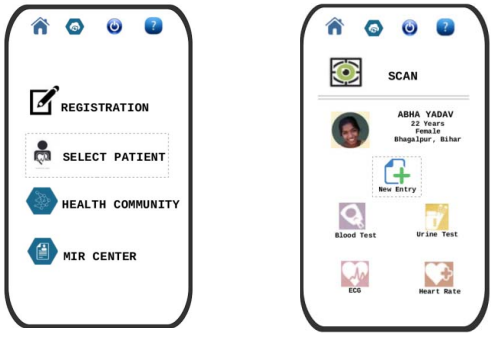
(a) Scenario 1 and Scenario 2: Text in regional language is converted to English via TTT module.

(b) Scenario 3: The confirmed text in English is used.

(c) In all the three scenarios the key terms are extracted by the ASHA worker and saved into the SLM. The structure of the log entry is (pid, timestamp, <keyterms>).

V. User Interface Design

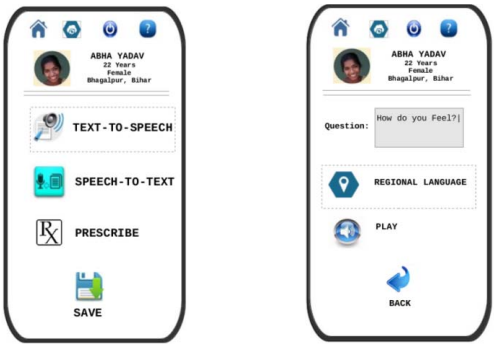
ASHA worker initiates the new entry of the registered patient by tapping the *SELECT PATIENT* button on the Main Menu as shown in Fig. 3 (a). He /She then scans the eSwasthya card to gather patient information. Then the patient details will be displayed on the screen as shown in Fig. 3 (b). ASHA worker taps the *New Entry* button, to begin a new prescription.



(a) (b)

Fig. 3. UI Design for (a) Main Menu (b) Scanning eSwasthya card.

In Scenario 1, **TTS module** is used to read out the query typed in English in their corresponding regional language. For this, *TEXT-TO-SPEECH* button is tapped, as shown in Fig. 4(a). After selecting the *TEXT-TO-SPEECH* button, the query is typed in English into the textbox in Fig. 4(b). ASHA worker then, taps the *REGIONAL LANGUAGE* to retrieve regional language via GPS. Behind the screen, **TTS module** consults the **Language Library,** to convert the text in English to regional language. Finally, the text in regional language is read out to the patient by tapping the *PLAY* button. But in Scenario 2 and Scenario 3, ASHA worker questions the patient directly.



(a) (b)

Fig. 4. UI Design for (a) Language Translator (b) Text-to-Speech

In all the three scenarios, the patient's response is recorded by tapping *SPEECH-TO-TEXT* button in Fig. 4(a). For this the ASHA worker taps the *MICROPHONE* button shown in Fig. 5(a). Here, the **STT module** converts the words uttered by the patient to text using **Language Library**. The resultant text is played by tapping the *PLAY* button to get the patient's confirmation. After getting the confirmation, text in regional language is converted to the English language by tapping *TEXT-TO-TEXT* button shown in Fig. 5(b) for Scenario 1 and Scenario 2. **TTT module** and **Language Library** are involved in this process.

(a) (b)

Fig. 5. UI Design for (a) Speech-to-Text (b) Text-to-Text

By tapping the *KEYWORD SELECTION* button in Fig. 5(b), ASHA worker selects the keywords from the response and saves it into the **System Log Module** (SLM) along with Patient ID and Timestamp. Medicines are then prescribed by the ASHA worker or they consult the respective Health Care Providers if the patient's condition is critical. The prescription is also saved in the Log module for future reference.

VI. Evaluation of UI Design

UI design for the Language Translator module was evaluated using DECIDE [7] Framework. According to this framework the following six steps are involved in planning the evaluation process.

1. Determine the goal.
   → High level goal: Design UI for Language Translator.
   → Users : ASHA workers
   → Purpose: Reduce the communication gap.
   → Actors: ASHA worker, Patient
   → Subgoals:
      ✓ Questioning the patient
      ✓ Recieving Patient's response
      ✓ Extracting and storing symptoms into SLM module for future reference.
2. Explore the questions.
   → Is the User Interface poor?
   → Is the System difficult to navigate?
   → Does the communication gap reduced?
   → Does the system improve the speed of data gathering?
   → Are the terminologies confusing?
   → Is the response time too slow?
   → Is the feedback confusing or insufficient?
3. Choose the evaluation approaches & methods.
   → Due to time limitation & issues in visiting the site, Usability Testing was preferred.
   → Evaluation Methods adopted:
      ✓ Observing Users.
      ✓ Asking Users.
4. Identify the practical issues.
   → Involving appropriate users, i.e, ASHA workers, ASHA Supervisors.
   → Evaluation was performed in a day with a group of 5.
   → The paper sketch prototype was used for the evaluation process.
5. Decide how to deal with ethical issues.
   → Explain clearly the goals of the study and expected outcome of the Testing process to the participants for boosting social morale.
   → Assure the participants that they are free to stop evaluation at any time.
   → Ensure the participants that their personal sensitive information will be retained confidential by using numbers or fictitious names to record and identify individuals.
   → Disclose a copy of the report to the participants before distribution.
6. Evaluate, Analyze, Interpret & Present the data.

During the evaluation process the following parameters were analyzed.

→ Reliability / Consistency was high with respect to the participants involved.

→ Validity is moderate, as usability testing does not completely assure it.

→ Biases were moderate, as the participants were not experts in the domain.

→ Scope of the product is high, that it can also be adopted by other initiatives of NIPI.

→ Low Ecological Validity as the results are unlikely to represent what happens in the real world.

As per the plan discussed above evaluation was performed and parameters were analyzed. The results summarized during the sixth step of the evaluation process clearly depicts that the design of the UI module for Language Translator is satisfactory.

VII. Conclusion

To start with, the existing system was thoroughly studied. The Language Transaltor in the existing system helps the ASHA worker as a language assistant while communicating with patients in rural areas. From the study it was clear that there is a need to completely confiscate the communication gap for reducing the delay in data capture and entry.

The paper starts with the revised system architecture which gives a bird's eye view of the revitalized Language Translator module. Then, using GOMS model task description associated with different scenarios is explained. The UI for the Language

Translator module was then elucidated for achieving the subgoals in GOMS for the respective scenarios.

During the UI evaluation different parameters were analyzed. Among them, reliability and scope of the system were found to be high and along with moderate validity and biases. From these results it can be concluded that UI designed for the Language Translator module is satisfactory.

The paper can be further extended by developing and Android application which integrates the existing system with Google APIs.

REFERENCES

[1] NIPI Website.(2014, December 14). [online].Available: http://www.nipi.org.in/

[2] PC Quest July 2012, Best IT Implementations of the year 2012 Finalist : United Nations Home based Post Natal Care Data Capture & Analysis Project with maximum Social Impact.

[3] Swasthya Slate (2014, December 14). [online].Available: http://www.swasthyaslate.org/

[4] Newman, Dan. Talk to Your Computer: Speech Recognition Made Easy, Berkely: Waveside Publishing, 2000.

[5] Wikipedia. .(2014, December 14).[online]. Avilable: http://en.wikipedia.org/wiki/Speech_recognition

[6] Alan Dix, Janet Finlay, Gregory D Abowd, Russell Beale, "Human Computer Interaction", Pearson Publication, 3rd Edition

[7] Yvonne Rogers, Jenny Preece, Helen Sharp, "Interaction Design : Beyond Human Computer Interaction", Wiley India Publication, 2nd Edition.