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Developing an Inscript Keyboard with Autocorrection and Text Prediction For Visually Impared

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***Abstract*— There are about 285 million people who are visually impaired worldwide of which 39 million are blind and 246 million have low vision (severe or moderate visual impairment). With 7.8 million blind people in India, India accounts for 20 per cent of the 39 million blind population across the globe, and this is a big number. Versions after versions of popular typing applications have come, and yet no application yet has addressed the difficulty that smaller user groups such as visually impaired people have while entering input.The intention is to enable blind students be independent of scribes (writers) to write their exams. We want to develop a typing model for Android using the Inscript keyboard layout. This tutor aims to help blindstudents to get familiar with Keyboard in their own native language. And finally made an attempt of reducing typing efforts by predictive texts and language detection using n-gram algorithm.**

***Index Terms*— Text To Speech(TTS), Text Classification, Supervised Learning, NLP, n-gram, autocomplete, autocorrect, visually impaired**

1.1 INTRODUCTION

With 7.8 million blind people in India, India accounts for 20 per cent of the 39 million blind population across the globe, and this is a big number. The reports narrate the sad stories of the quality of life of most of these people. The only solution to improve the quality of life of visually impaired people is education using technology. As per the pilot study conducted, there are no well researched training models to impart training to visually impaired people, which takes in to account the cognition process and learning styles of visually impaired people. The intention is to enable blind students be independent of scribes (writers) to write their exams. To achieve this vision, the aim is to develop an application which initially trains student to type and operate basic text navigation functions on the Android device. Text editors are in abundance in present times. However, most text editors fail to help in a very important aspect i.e. typing. In the era of touch-screens and voice commands, most text editors require typing out entire words on our old keyboards and laptops. While most people are used to this mechanical approach, novice users and senior citizens often have a hard time trying to locate alphabets on their keyboards. People with physical disabilities are unable to use such conventional systems. Also, often people in non-English speaking countries are unfamiliar with exact spellings of English words. Work in the text prediction domain has been going on since a long time. One of the oldest algorithms is HWYE or Hear What You Expect algorithm which works by building a large language model based on frequencies of usage of words and other predictive cues. Sonal R. Pampattiwar, Prof. Anil Z Chhangani in ”Smartphone Accessibility Application for visually impaired” has proposed an Android Smart Phone application for the visually challenged. Through this application the visually challenged user can always be connected with the world around. Akshay Bhatia in “Predicitive and Corrective text input for desktop editor using ngrams and suffix trees” used a method for text prediction first all the words in the dictionary are scanned to build a suffix tree a.k.a trie. This tree is traversed with respect to frequency to suggest the top words. A method of text classification is used in which each class is presented by an exemplar vector called codebook. The codebook vectors are placed in the feature space in a way that decision boundaries are approximated by the nearest neighbor rule. It presents the results of automated classifying Farsi text documents using tri-gram, quad-gram, and word frequency statistics methods. It use the Bayesian approach for Persian documents and they improve it by using the word collocation.

While the implementation of such a system is not unprecedented, the existing systems have drawbacks. This paper aims to address these and propose implementation of innovative features to develop a more comprehensive system.

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1.2 PRESENT VS PROPOSED SYSTEM

The project sets itself apart by harnessing the powers of both machine learning and human voice based as well as Text-To-Speech based interaction. The paper proposes a system, to develop a typing model for Android using the Inscript keyboard layout. Inscript keyboard layout is a Government of India approved keyboard layout that allows to type in Indic languages. The project aims to help blind students to get familiar with Keyboard in their own native language through human voice based as well as Text-To-Speech based interaction. a community run forum that is used to populate the database where the questions are dynamically scored on difficulty and discretion.

Implementing the afore mentioned model meets the goal of developing a program that aims to help blind students to get familiar with QWERTY keyboard in their own native language. This program relies on the human recorded voice assistance and on partial use of native Text-To-Speech(TTS) service. In script support for Hardware keyboards. Its is compatible with android tablets and smart phones. Auto correction and text prediction to reduce typing efforts.

The proposed system can be broadly divided into two phases:

a) Teaching Inscript keyboard
b) Auto correction and text prediction

The following model has been adopted to eradicate few loopholes of the existing systems. The reason for using Android operating system based mobile phones is that Android is an upcoming open source technology and is affordable.Using accessibility only to navigate and search for the respective application.Relies on Human recorded voice assistance for all other purposes.In all existing systems hardware is a major concern. It costs a lot to develop, prototype, test, refine, and eventually release any computer system, especially a highly customized one like note-takers use.

The model aims to fulfill the following aims -

- Aims to help blind students to get familiar with QWERTY keyboard in their own native language.
- Relies on Human recorded voice assistance
- Relies on partial use of Native Text-To-Speech(TTS) service
- Inscript support for Hardware keyboards
- Compatible with Android tablets and smart phones

1.2.1 Phase 1: Teaching Model

First phase focuses on building the basic learning application for the visually impaired to teach them how to type using the inscript keyboard. App will be developed as a native app and not a hybrid app with minimum supported Android version of 4.2.2 and maximum supported Android version as the latest available.

The application will have a login/signup page where the user can register as a new user using the signup option and can login into his account using the login option. Sign-up form and login form will be submitted on press of enter key.

SignUp - A new user account will be created with entered information. Once signed-up, on availability of Internet user data will be uploaded to web application. Sign-up details will be saved in a separate text file on device storage. This is to be catered to so that once app is uninstalled and re-installed, app should allow restoring of user data.

Login - Once signed-up, a user will start with login form where he will be able to login using a 4 digit numeric pin. This pin will be unique within the device. That is the Pin may repeat across devices. This login form will direct user appropriately to sign-up or forgot pin pages if need arises.

Once the user has logged in he can start taking lesson or resume his previously going lessons. The lessons will be designed into three categories :-
Acquaintance lesson - This lesson will be available only at initial phases. This lesson comes prefixed to the lessons where a new keyboard row is introduced.An Acquaintance lesson is played to teach student finger positioning and correct use of a finger to type corresponding keys.

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Keyboard Orientation

- Both the keyboard layouts - with and without numpad will be explained to start with.
- User will be made to explore the keyboard keys in a sequential manner row by row and not random.
- This lesson ensures that only a single row is activated at a time for interaction. After user explores a minimum of 12 keys in the given row, he will be able to press the keys from the next row that gets activated for interaction. In this scenario, if user presses a key belonging to any other inactive row, a buzz sound is played to convey an invalid key press.
- Once all keys have been explored, that is once last sixth row is explored, all the rows will be unlocked to allow user to explore any additional keys at random. A lesson would end once user presses the spacebar key twice.

Navigation lesson - Menu navigation lesson will be covered after the orientation lessons.

- A lesson will be added after Home Row character practice for teaching left & right arrows, Backspace, delete. In this, first that follows is navigation characters lesson and second is the editing character lesson.
- Word navigation will be taught when sentence exercises will start.
- Line navigation will be taught after sentence lessons just before entering the certificate test.

Practice - This lesson covers practice of a given lesson. Lessons are of different types :-

1) Characters-only,
2) Words
3) Sentences

- During practice, a student has to perform a given task configured number of times. The feedback is provided right at the time of character typing. That is if a typed character goes wrong, that isn't allowed to show up in the text box. Corrections are suggested immediately.
- Character lessons will have an additional Dictation audio playback other than Lesson instruction or task instruction. These lessons will have a character dictation where each character in expected output is dictated individually.
- Tasks under word practice must have facility to get spelt word so that user can understand apt use of vowels and consonants.

User can jump to Practice mode of any lesson from within any and every lesson. Test Mode

- Test mode for a practice lesson will be run right after the corresponding Navigation Lesson.
- Test lessons will appear in an independent Test Lesson List. As per practice, test lessons get unlocked and will be attempted.
- There is one-to-one mapping between Practice lessons and Test Lessons i.e. character practice will have character tests that are unlocked once user has attempted character practice lessons and learnt to navigate characters.
- User will be able to jump to test mode of any lesson from within any and every lesson.
- For Test mode of words and sentences, minimum 50% of words and sentences will be different than the practice mode.

Evaluation Mechanism

There will be 2 types of evaluations both in Practice mode and Test Mode:

- Activity level evaluation – It will be done as user starts typing and it will evaluate every correct/wrong character that gets typed. It will be applied mostly to tasks carried out under character lessons.
- Task level/Summary level evaluation – This will

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be done on completion of the task. If a task is correctly done, user will score 1 point. If task is incorrectly completed, user will score 0.

Scoring Rules

For every correct hit, the user would score 1 and for every wrong one he would get minus 0.25. The negative scoring applies only for 4 wrong attempts. After 4 wrong attempts, user will be guided to take human help without any further negative marking. Once, practice lesson is over, user will see his score. Based on his evaluated accuracy user will be guided in following manner.

- If practice is scored between Low and High level bracket, then the user is evaluated as "OK" performing. In such case, user is provided with 2 choices.Restart the practice lessonContinue to next lesson.
- If practice score goes below Low level, then the user performance is evaluated to be bad. In such case, the practice lesson is restarted automatically.
- If practice lesson is evaluated above High level, then it is considered to be good. In such case, corresponding test lesson is started automatically.

Certification

Every lesson will have a possible maximum score depending on the cumulative no of characters in all the tasks in that lesson.

So sum of actual scores of all the lessons against the possible maximum score will decide the grade/class of an end user.

The certificate will show 2 separate grades for accuracy and speed respectively.

- Generating certificate will be simply to inspire user and holds no significance in terms of authenticity of user.
- A certificate generated will be available from storage in form of PDF document.

There will be an option to logout which will save the user activity automatically and display the login page again so that a new user can login into his account.Different account for each student will help in assesing the students properly.

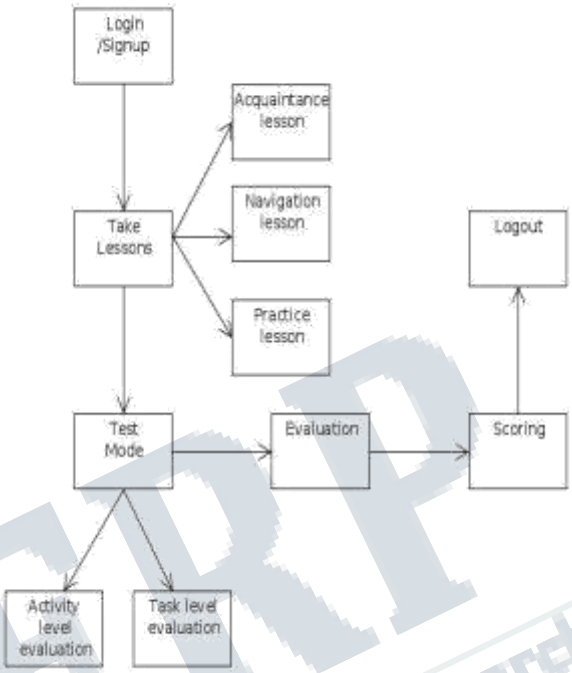

Figure 1.1: Functioning of Teaching Model

1.2.2 Phase 2: Prediction and Autocorrection Model

The second phase of the project invloves building the autocorrection and text prediction engine to reduce the typing effort of the visually impaired. This phase has various modules that work dependently.The proposed editor has multiple modules as shown in Figure 1.

The editor accepts input from the user, passes it on to the text extraction unit which further branches out in the autocorrect and autocomplete engines which are responsible for correction and prediction respectively. Extracted text is also sent to an analysis unit which extracts keywords from the text. The suggestion unit is responsible for providing real time suggestions ordered by ranks in the user interface. Each module is explained in detail below.

1) Text Extraction Module:

The text extraction module primarily serves as an interface between the user and the system and extracts each individual character typed by the user on his keyboard and passes it on to the engines. In the event of insertion of a complete word (known or unknown) by the user, this unit

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passes on the word for further analysis to the analysis unit.

2) Autocorrect Engine:

The Autocorrect Engine is responsible for verifying the correctness of a typed word. It builds a set of close words to the mistaken word and searches these words in the dictionary for an exact match.
The set of proximate words is determined as shown in Figure 2. All proximate words to the typed word are formed using operations such as substitution, deletion, insertion and transposition. This algorithm doesn't require any dictionary pre-processing or additional memory. Time complexity is dependent on number of errors k and alphabet size |A|.

3) Autocomplete Engine:

This engine is responsible for predicting the remaining part of an incompletely typed word and for guessing which word is likely to continue a given initial text fragment. This module is further divided into two submodules explained as follows:
a) Current word prediction:

Initially, all the words in the dictionary are scanned to build a suffix tree a.k.a. trie.[1] This tree is traversed with respect to frequency to suggest the top words. The structure and traversal of the suffix tree.

b) Next word prediction:

Next word predictions are carried out by implementing n-gram language models described by Adam Pauls and Dan Klein in 2011. N-grams are implemented by adding additional nodes to the existing suffix tree and sorting them with respect to their frequencies. N-grams can be implemented on multiple levels such as unigram, bigram, trigram and so on. N-grams are developed in two phases. In the first phase, the predictions are made on the basis of the statistical model. This statistical model consists of default frequencies of words in the dictionary. In the second phase, these frequencies are modified with each iteration according to the user's style of typing.

4) Dictionary:

Dictionary is the main database used in the system. Initially, a linear list of words is taken. The words are stored in an ascending order alphabetically and corresponding frequencies of the words are also maintained. The dictionary is then developed by using this list to form a tree structure. The tree structure is used in order to make searches faster. Multiple dictionaries are designed in order to make the system faster. Once created, the dictionary can be adapted to the user's vocabulary. The user is given the choice of adding a new word whenever the system encounters an unknown word.

5) Text Analysis and Keyword Extraction Unit:

This unit accepts the entire text entered by a user and extracts keywords from it. These keywords are analyzed, and words semantically related to these extracted keywords are then suggested to the user.

6) Suggestion Unit:

This unit compiles suggestions from all individual engines and displays top suggestions by ranking them. Machine learning algorithm n-gram and tri data structure will be used to find the next word and for auto completion.This proposed editor can become a very handy tool for text input and as shown earlier, can perform significantly better than most widespread editors in some aspects. Adding facilities like better context based suggestions will improve the usability of the editor.

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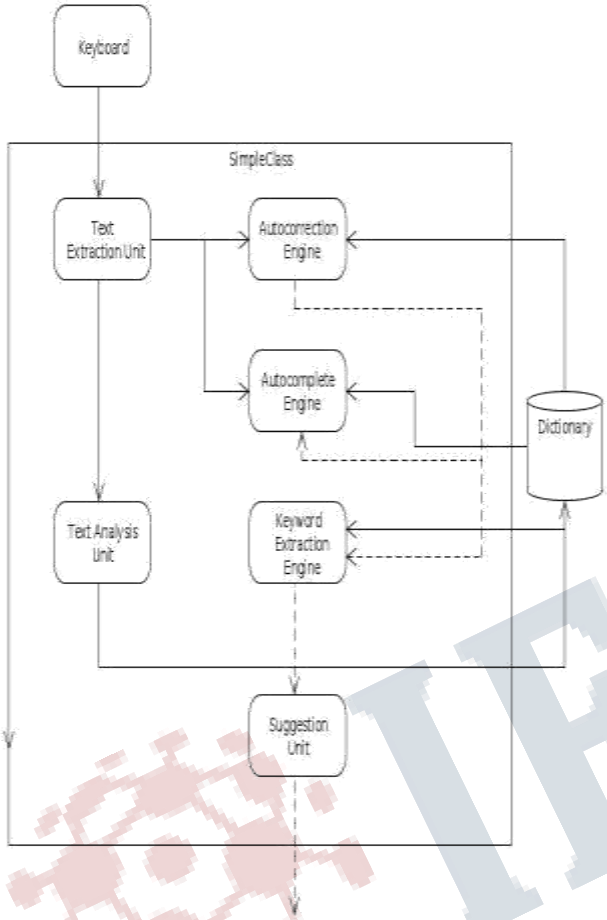

Figure 1.2: Functioning of Prediction and Autocorrection model

1.3. SUMMARY / CONCLUSION

In this paper we looked at the changes taking place in the assistive technology products which used to impart training for the visually impaired and various suggestion mechanism used in various text editor. We looked at a major drawback of the currently implemented systems and discussed possible solution. We also took a dive into the proposed system and discussed the major modules that overcome the afore mentioned drawbacks.

The first contribution of this system is to develop a typing program called Swalekhan for Android using the Inscript keyboard layout. This tutor aims to help blind students to get familiar with Keyboardin their own native language through human voice based as well as Text-To-Speech based interaction. The second contribution is the text editor which is an attempt to notably improve the accuracy of documents. The total number of keystrokes required to type a single word can be significantly reduced thereby improving overall typing speed.

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