A Literacy Learning Smart System for the Blind Children

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Abstract— **Computer as commonly known is usable for both Braille written initiation and Latin written conversion to Braille or vice versa. Through input device modification and special application of computer was applicable for the braille script to be read by those who blind category and for the low vision one as well. Application of this system is enough once for teacher/trainer to guide the participant to be self-assist learning due to the braille-button press rather than manually relying on the teacher/trainer guidance. The method of research used was the *Waterfall* with sequential linier model. The major finding of the research were application program providing for the blind children community through the braille-based literacy learning, besides for the low vision with a standard written modification, and the input device (keyboard) creation with a braille-based letters and numbers.**

Keywords— *braille, blind children, literacy learning, computer program*

I. INTRODUCTION

An education growth is inline with the modern human civilization. The instructional learning activity is inseparable from the education process, and its method is very much determine the education outcome. Human being has been continually improved the instructional method from the primitive media like stone, up to the latest media for the need of education process, like computer. In this case, in terms of computer, people who are totally blind are absolutely not able to interact with the computer without assistive technologies. In order to overcome this barrier, they mostly use software and Braille displays [6].

Multimedia as a computing subfield offers heterogenious media to be used simultaneously, such as text, still image, grafix, audio, video, and animation. In education context, it can be used for more attractive and interactive as an instructional media system. Special for blind children, this media increases the instructional activity, such as for letters and numbers identification. The instructional should be referred to : [11]
1. A tangible experience need
2. An integrating experience need
3. Doing and acting need in learning

Instructional media for the blind children is divided according to the level category. A braille written media is prepared for the total blind category, while Low Vision category with a modified standard written media (a written enlargement). So far, braille written category is taken manually with a teacher direction. While the smart system-based instructional is enough taken once direction by a teacher/trainer during the learning activity, because the system informable the blind participant any directions related to the braille systems and for the low vision as well.

The research has been implemented in terms of literacy learning development system for the blind children with the computer medium. Further, the target of research, were as follows :
1. Designing a special computer application program for the instructional media with a braille-based system.
2. Create a special computer application program for the Low Vision category with a modified standard written media (a written enlargement).
3. Create a special input device (keyboard) with a braille-based system.

A. Blindness

Blindness understanding is not only for those who sight loss, but included those who categorize visible. Thus, the children with mild vision or near-normal vision is part of visual impairment.

The children with visual impairment are recognized in the following condition : [10]
1. A person's vision strength is less than those who the normal one.
2. A trouble occurrence on the person's eye lens or because of there is a certain liquid.
3. Uncontrollable of eye location by the brain neural.
4. A trouble occurrence of the brain neural system related to the vision.

Referring to the above condition, commonly used as a standard whether a child categorized as a blind or not is based on the sight strength. To know the blindness, someone can use the Snellen Card test. A child could categorized blind if one's vision strength is less than 6/21. Means that, a child only readable on the radius 6 meters referring to the test, if compared with the normal one with only from radius 21meters.

A blind child can be categorized into two categories: [8]

A.1 Blind Category
Blind category of children is if they can not receive incoming light stimulus.

A.2 Low Vision category
A child can receive incoming light stimulus with its strength more than 6/21, or a child can only read newspaper headline.

B. Multimedia

Etymologically the multimedia word was derived from the utility of more than one media simultaneously. In 1978, Nicolas was a scientist from MITS Media Laboratory, explained that combination of radio broadcasting, printed media, and computer industry were a later media would influenced the communication technological continuity. Nowdays, it was factual, where personal computer today provides a various media that usable simultaneously.

Thus, generally can be conclude that multimedia is utility of more than one media for delivering message or information.[1]

Today, multimedia itself connected with many digital system. As Fluckiger (1995) says "digital multimedia is an integrating field of text, image, animation, sound, and other media that supported by computer, where each instruction can be represented, saved, transferred and processed digitally. [3]

C. Multimedia Interactivity

Multimedia can be linear and non-linear. It is said a linear when a user uncontrollable what is seen on the screen.[1] For instance, while someone sees advertisement on TV or movie.
Whereas a non-linear multimedia is a multimedia that commonly cited the interactive multimedia, where a user controlable what is seen on the computer screen. A user actively involves in controlling a computer operational process and searching a needed information. Thus, two-ways communication are occured between user and computer used through related application.

D. Braille Letter

Charles Barbier Dela Serre was a person who the first time introduced sonography to the institution of blind children, that was found by Valentin Hauy in 1784. Sonography is artilllery code which is combine with spot and line used for a war communication facility. In that institution there was a smart and talent child, that was Louis Braille. He was born in January, 4, 1809. Immediately he encountered some problems in Barbier system, that was never really used in the military because of it too complicated. Sonography uses 12 dots cell, that was not

only the finger top size, but it need a time and energy to write with needle. The weakness of sonography is not have punctuation, number, node mark, and has many abbreviation, since the cell simbolizing the voice not letter.

In 1824 Louis met its new alphabet. He met 63 ways to use the six dots cell. Many of his colleague were very anthusiasm to use the new letter. After passing through the long serious process, then in 1860 Braille written was acceptable as a formal written for blind school in the region of Europe.

Braille letters that Louis Braille discovered was consist of 6 dots, namely; left upper dot was dot one, middle left dot was two dots, lower left dot was dot three, upper right dot was dot four such for the next go. From all the dots were capable of making 64 combinations. The braille letter is read from the left to the right. The dot represented black was the spot dot, as seen on the figure 1 below, [12] :
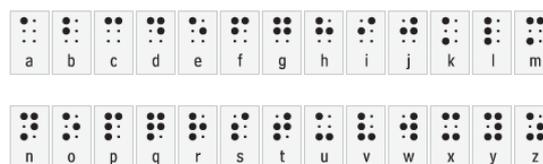

Figure 1: Braille Dot

Figure 2. Braille Alphabets

E. Research Method

Research method for designing system was System Development Life Cycle (SDLC) which consist of: analyzing, designing, coding, testing, and implementation. The SDLC method is commonly also called waterfall approach [5].

II. RESULT AND DISCUSSION

The research was based on the system development life cycle that was preceded by analysis for the software need. The activity was focused on understanding of program character being built, understanding the information domain, manners, performance, and the required interface. The types of activity, namely :

- Searching and reading resources or literatur of braille letter and its supporting tools.
- Collecting and designing the required data, such as: text, image, sound, video, and others.
- Taking interview about the proper system design for the blind community.

Design phase: researcher on this phase is taking activity that focused on the program four attribute, namely; **Data Structure, Software Architecture, Interface Representation, and Procedural Detail Algorithm.**

Translating design process of requirement/need into the software representation was predictable its quality before to be continued to the coding phase. Technical design that the researcher used was Data Flow Diagram. According to Pressman (1997) DFD is a graphical technical that describes information and transformation flow that applicable when the data changed from input into output.[4]
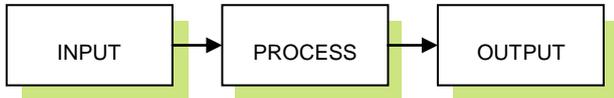
INPUT → PROCESS → OUTPUT

Figure 3. Changing data

The next phase is coding, where in this phase the researcher translating design phase into the machine language form which readable by both software programming and software authoring (multimedia establishment).

Testing; on this phase the researcher takes the focused exam that directing on the software internal logic, to make sure that all statement have been tested on the external functional, namely focusing the test for fault finding. Besides, to make sure that the limited input will produce the actual and proper of needed result. And the system would be implemented when the testing was not satisfying the user.

System implementation phase was the application phase of system that was in CD setting for the distribution easiness. System operation Windows XP minimally needed to run this system, and hardware specification at least Pentium IV generation. The system was designed in file format with executable and autorun so that it can directly be run without a prior installation.

System Designing

The created system was based on the data structure referring to Finite Automata (FA) theory as a language recognition device. Working principle of finite automata are as follows: [7]
- Accepting input such as a string
- FA has a limited control and state
- FA reads the early alphabet with control located in the early state.
- Through the control and reading state early alphabet change into the new state (early state absorbs the sub string)
- Keeping the process up to string absorption out.
- If state out and at last located in the last definite gathering state, thus, the string accepted by FA.

There are two kinds of FA, namely; DFA (Deterministic Finite Automata) dan NDFA (Non Deterministic Finite Automata). NDFA must be created earlier before DFA, but the researcher in this case directly present DFA. DFA taken from letter arrangement module is:[7]

α   : {a,b,c,d,e,f,g,h,i,j,k,l,m,n,o,p,q,r,s,t,u,v,w,x,y,z)
K   : { A,B,C,D,E,F,G,H,I,J,K,L,M,N,O,P }
Initial state   : A
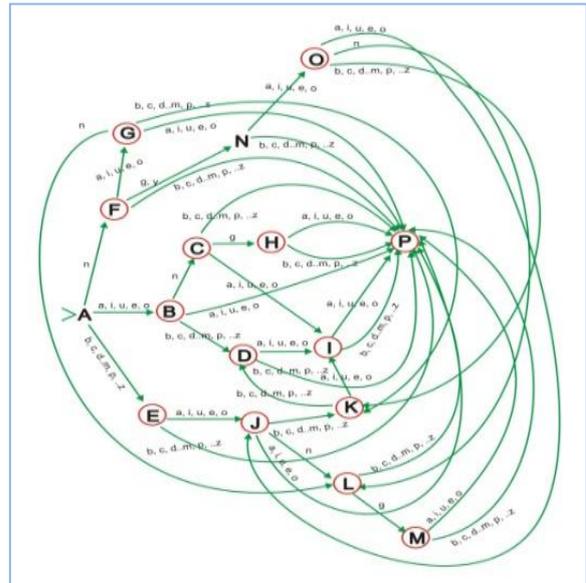Final State   : { B,C,D,E,F,G,H,I,J,K,L,M,O,P }

Figure 4 . DFA to arrange letters

based on the DFA description, it can be created a context free grammars (CFG) regular. :
- Alphabet α that consist of :
  - Terminal set T $\neq \Phi$
  - Non terminal set N $\neq \Phi$
  - With α = T U N and T ∩ N = Φ
  - Early symbol S Є N
- Production rules of R that is limited set in N x T *(N U $^{\wedge}$)

CFG of the DFA were as follows :
R = { A ⟶ a,i,u,e,oB| b,c,d...m,p,..zE| nF, B ⟶ nC| b,c,d...m,p,..zD,

C ⟶ gH| a,i,u,e,oI, D ⟶ a,i,u,e,oI, E ⟶ a,i,u,e,oJ, F ⟶ g,yN|a,i,u,e,oE,

G ⟶ nL|b,c,d,f...zK, J ⟶ b,c,d,f...zK|nL, K ⟶ a,i,u,e,oI|b,c,d,f...zD,

L ⟶ gM, N ⟶ a,i,u,e,oO, O ⟶ a,i,u,e,oJ|nL|b,c,d...m,p..zK }

As the example of production rule "R" above for the word "mama" can be search from state
A ⟶ E ⟶ J ⟶ K ⟶ I

Figure 5. Alphabets Menu System

Figure 6. Numbers Menu System

The braille letters and numbers recognition system gives response by sound to the user who presses the keyboard. But, for the user of low vision status the system would response by sound and present animation (on screen) according to the button pressed of keyboard. The annimation type presented for the low vision status by showing the letters /numbers looked bigger and smaller (on screen). Whereas, the sound of letters/numbers give priority for the blind category only.

III. CONCLUSION AND SUGGESTION

A. Conclusion
The research gives the out put, were as follows:
1. The built database related to braille letters and number (including form, type and reading system aspects).
2. The built database of audio letters and numbers (through audio recording process in proper format used for the application system).
3. Smart system as a media for the literacy learning (letter and number of braille reading).
4. Sustainable for accelerating the braille literacy learning (letters and numbers braille reading).

B. Suggestion
All parties were needed to support the implementation system, such as government, in this case Dinas DIKPORA (Departement of Education District Youth and Sport), Blind School, Community, and STMIK Bumigora that institutionally as a propose institution. Therefore, all parties cooperation were needed for this program goals. Infrastructure readiness became the main factor for the smoothness program.

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