An Electronic Aid for Visually Impaired in Reading Printed Text

D. Sreenivasan, Dr. S. Poonguzhali
(Center for Medical Electronics, Department of Electronics and Communication Engineering, Anna University, Chennai, Tamil Nadu, India.
Email:sreenivasand@yahoo.co.in)
Email:poongs@annauniv.edu)

ABSTRACT

The visually impaired are the people who can have permanent or temporary loss of vision. Such people cannot see, read or write as the normal human beings. There are several substituting equipments and aid to help them lead a normal life. Similarly to read, Braille notations are being used. These Braille editions are not available for each text book. Thus to help them read the conventional text book, this paper describes a portable electronic reading aid. This electronic reading aid captures the printed text as the image and recognizes the character using the OCR system. The OCR system sends the ASCII representation of the character to the ARDUINO UNO board which correspondingly actuates the Braille display. When the visually impaired person touches the Braille display, they could understand the printed text.

Keywords -- **ASCII- American Standard Code for Information Interchange, OCR-Optical Character Recognition.**

I. INTRODUCTION

Braille is a tactile read/writing system for the visually impaired people. Braille characters are small rectangular blocks called cells that contain tiny palpable bumps called raised dots. The number and arrangement of these dots distinguish one character from another, but Braille characters are much larger than their printed equivalents, whereas not every book has its own Braille edition. Under such circumstances, the visually impaired people have to get support of other people. This paper presents an electronic aid to help the visually impaired people to read the conventional printed text by giving the corresponding Braille outputs at a refreshable Braille display.

Similarly there are many more supporting aids. One of them is a reading aid[1] with a lens system to form a 1.6 x magnified image on a 24 x 6 array of 10-mil diameter fibers. The fibers are bundled into a flexible cable, which transmits the image to the phototransistors and electronics, each fiber being connected to a corresponding phototransistor. This arrangement enables to build a probe small enough to be moved sufficiently close to the binding of most books to scan the complete line of print. The image is send to the phototransistors and electronics, each fiber being connected to a corresponding phototransistor. This arrangement enabled to build a probe small enough to be moved sufficiently close to the binding of most books to scan the complete line of print. It consists of a photo sensor whose aperture equal to or smaller than the line width of the letters for sampling the image. After recognition, the respective characters are given as the tactile output to the user. In this proposal, the scanning of text and recognition of the text was not efficient and they couldn't resolve the characters every time.

In another proposal[2], it describes an aid for the visually impaired people to read the hand printed documents. It follows a structural rule-based character recognition system using topological analysis of character's profile. This approach is to obtain the character's profile from boundaries of individual characters within the digitized image and thus character classification, which is difficult to identify the varying patterns of hand written documents. The four profile analysis not efficient to detect the character. After recognition, the text to speech conversion is also more difficult to imply as the need too large database.

Recently, an electronic pen[3] aiding visually impaired to read the text is proposed. They suggest for the use of a pen which consists of a camera, conversion software, word repository, text-to-audio converter This audio stream can be shared among peers by use of multicast or broadcast modes using wi-fi-protocols or unicast the message using ZigBee protocol. The text to audio conversion requires huge database. The system has to recognize the each character and thus the word then find the word's appropriate audio file from the huge database and then transmit them.

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To overcome all these effects, we can design an electronic reading aid with the help of OCR system, with Braille display than the text-to-speech conversion techniques. These text-to-speech conversion techniques require large database and high efficiency to map the text with the respective audio file. Moreover, these audio files are sometimes difficult to understand due to the variation in pronunciations between person to person and as region to region. The visually impaired people could find it more comfortable to read the Braille outputs instead. This could even overcome the background noise problems too.

When considering previous proposals, it is better to use the Braille display to give the Braille outputs enabling the user to understand the text efficiently. A proposal of refreshable Braille display[4] describes about designing and developing a system for controlling piezoelectric Braille cell by using Programmable Interface Controller (PIC) microcontroller. Piezoelectric Braille cells are used in many refreshable Braille display applications. The Braille displays using piezoelectric Braille cell are able to refresh the Braille character that are read by the visually impaired by touching the dots at Braille cell. Each piezoelectric Braille cell consists of six or eight movable pins or dots in rectangular array. The height of pins or dots in Braille cell is controlled by a piezoelectric bimorph. This will cause the pins or dots at piezoelectric Braille cell to rise or fall and therefore, create the Braille character or alphabet.

These piezoelectric Braille cells require 200V input for the actuation purpose. To provide such a large input is difficult in case of portable devices. So, in this paper we describe on a new Braille display which actuates by the dedicated magnetic coil and it needs 5V input for such actuation.

II. SYSTEM DESIGN

The proposed system includes the scanning module with guide, processing unit and the actuator. The processing unit recognizes the scanned character to be projected by the actuator. The system design is shown in the following figure1.

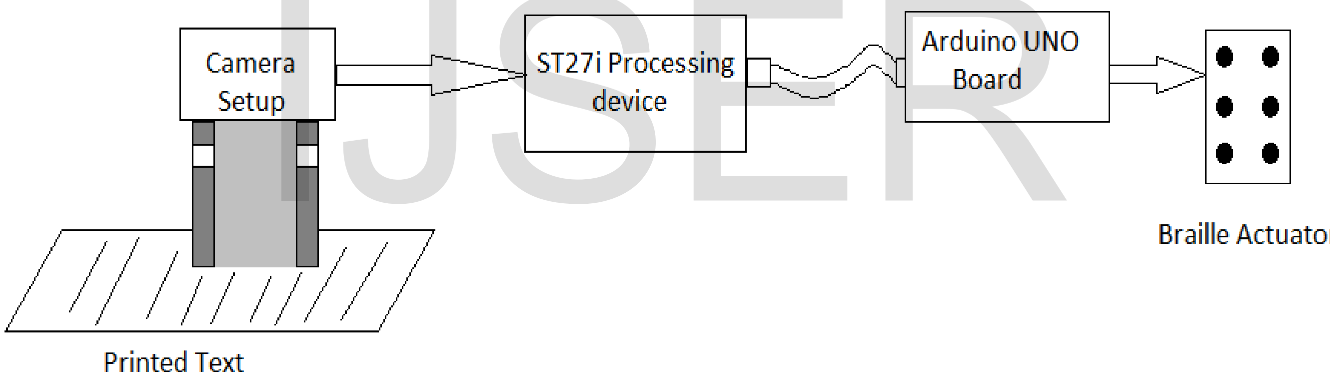

Fig.1 Block Diagram of the Electronic reading aid

The camera set up scans the printed text as the image and sends to the ST27i processing device where the character is recognized to its corresponding ASCII code. The data out from here is the processor is the serial data which is communicated via the USB cable to the Arduino UNO board. The Arduino board is programmed to detect the ASCII code and convert it as the Braille code. It produces the parallel output to actuate the Braille dots accordingly at the actuator.

The following figure 2 represents an example of the process being carried out in the proposed reading aid.

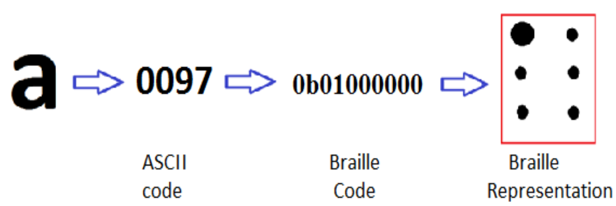

Fig. 2 Conversion representation

The character ‘a’ is scanned by the camera set up and sent to the ST27i processor which detects the image as the 0097 ASCII code using the OCR technique. The micro USB communicates the output to the Arduino UNO board where the Braille code 0b01000000 to be produced is determined and the Braille cell is actuated by parallel actuation.

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III. MODULES OF READING AID

3.1 Camera setup

The camera used here is the Sony mobile camera of 5 Mega Pixel. It is the CMOS camera powered by the on board battery in ST27i device.

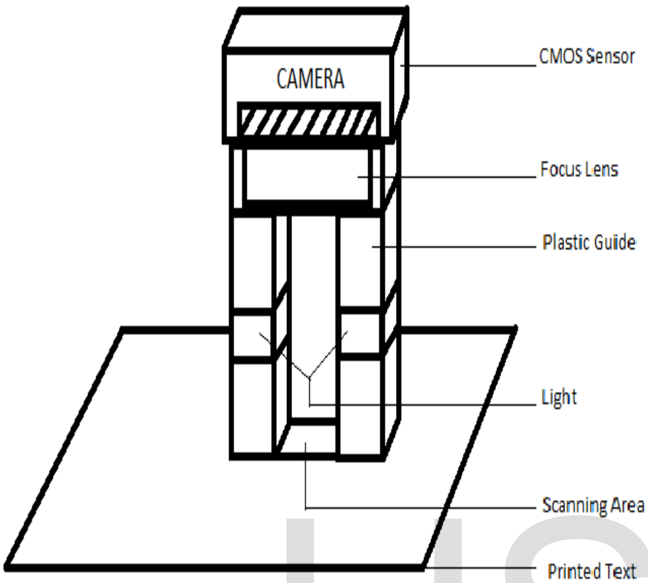

Fig. 3 Camera Setup

The visually impaired people cannot adjust the height of the camera to enable it scan the characters properly. To support proper scanning, a plastic guide is made surrounding the area to be scanned as shown in figure 3. The scanning area could accomplish a maximum font size of 28. Since, the guide covers the area at all the four sides, light is affected. So, a light set at the plastic guide itself. The space to be covered by the camera is focused with the help of the focusing lens. The set up is made such that one character

is scanned at a time. Even if there are more than one character at the scanning area due to fond variation, all those characters are scanned and the output is produced serially.

3.2. ST27i Processing Device

The Sony ST27i is used as the processing device. The output from the camera is processed to detect the ASCII code of the character. This processor is the combination of the hardware and software modules. The Sony ST27i consists of the Android V4.0.4 as the operating system and as kernel, the V3.0.8+ which is a build host.

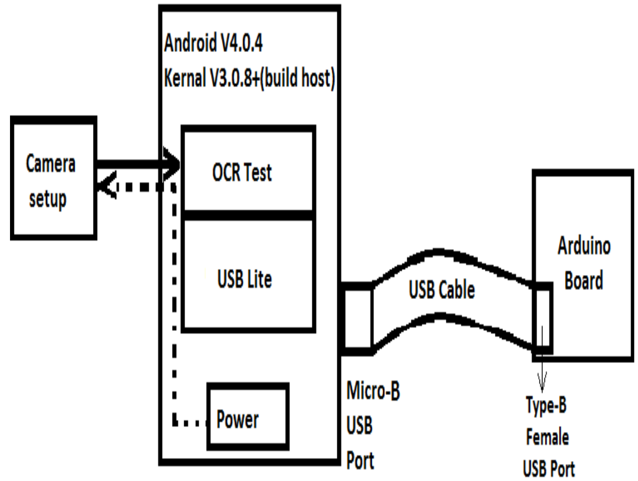

Fig. 4 ST27i module

As the hardware, it consists of serial communication ports, onboard Battery, RAM – 512MB, Flash – 8GB, 1GHz NovaThor U8500 Dual-core Cortex A9 processor. Along with these, the OCR test and USB serial Lite application software are included for the character recognition operation.

Since the kernel is a build host, it can act as the master for any number of slave devices connected to the Sony ST27i via the USB.

3.2.1 OCR Test

The OCR test is the module responsible for the character recognition system. An optical character recognition system can be viewed as a combination of several sub modules which extracts the features from the captured text images and recognises hat the character is.

4.2.2 USB serial Lite

The data communication is carried out via the USB micro port which is a serial port which transmits each bit serially to the Arduino UNO Board. At the Arduino UNO Board, the serial data is received at its female port. The ports are connected using the USB cable. These communications are administered by the USB serial Lite module. Once an Arduino UNO board is connected to the ST27i, the USB serial Lite recognises it and builds up the communication process

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4.2.3. Power Supply

The Sony ST27i consists of an onboard battery of 3.6V and 1500mA. This battery acts as the power source for our whole reading aid setup. The camera gets whole power supply from this and which includes the Arduino and the actuating systems too. They get the power via the USB connections. The USB provides data and power supply.

4.3 Arduino UNO Board

The Arduino UNO Board is the single board programming unit with ATmega 328P-PU. This is a high performance, low power AVR 8-bit microcontroller.

The Arduino UNO board receives the serial data from the ST27i at its type-B female port and processes them. The The Arduino UNO provides the 8-bit parallel output at its output port. The Braille actuator is connected to these ports. They require 5V to actuate the dots. These dots are thus actuated by the Arduino UNO ATmega 328P based on the Braille code.

4.3 Braille cell

The Braille Cell consists of 3X2 dots for representing the Braille projections of the scanned character. Each dot in the Braille cell consists of magnetic actuator which is coupled to the parallel output port of the Arduino UNO board.

There are totally 6 magnetic actuators, over them lies the dots. Each magnetic actuator requires 5V for actuation. The magnetic actuator gets actuated once they get the 5V power supply.

The Arduino UNO board accordingly gives the power supply to those actuators which corresponds the dots to be projected out.

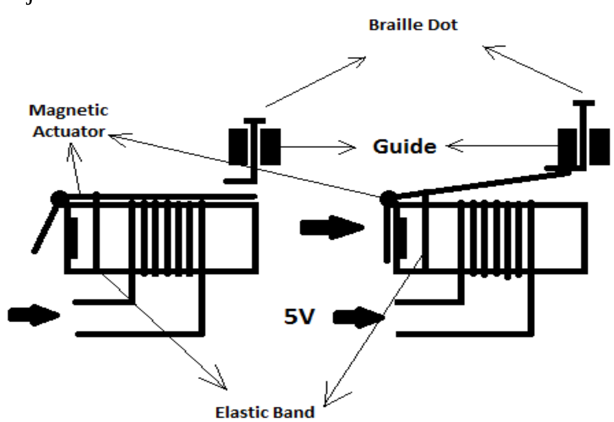

Fig.8 Braille cell representing actuation process

Each Braille dot lies on the magnetic actuator. As shown in the figure 8, when 5V is applied, the magnetic actuator lifts up and thus lifts up the Braille dot. The Braille dot is support by the guide thus they can project up to a height received data is the ASCII code generated for the scanned text. There is a look up table for each character. The ASCII code is compared with the look up table contents and the corresponding Braille code is acquired.

The following table 1 represents the ASCII code for each character along with their Braille code and Braille representation.

The ST27i consists of the look up table of each character and its ACSII code, where as the Arduino UNO board with ATmega328P IC consists of the look up table of each ASCII code of characters along with their corresponding Braille code and Braille representation.

of 1.5mm. The elastic band is added to provide retention to the actuators.

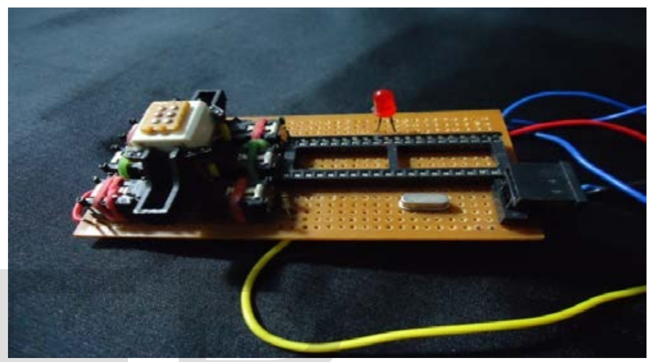

Fig.9 The Braille actuator

The above figure 9 shows the whole setup of the Braille display which have been actuated using the magnetic actuators. The elastic bands are to get the retentive power for the Braille dots to get back to the original position.

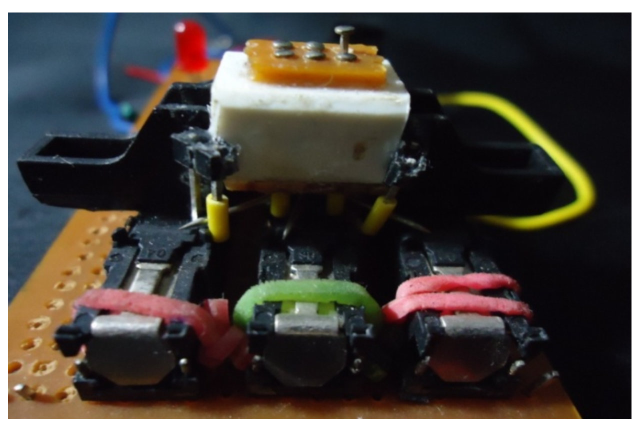

Fig. 10 Actuated Braille cell

Similarly, the figure 10 shows the actuated Braille dot which happens when 5V power is applied to the magnetic actuator which lies below each Braille dot.

This actuation takes place at a delay of 20ms. When a string is scanned, the characters are projected one after the other serially.

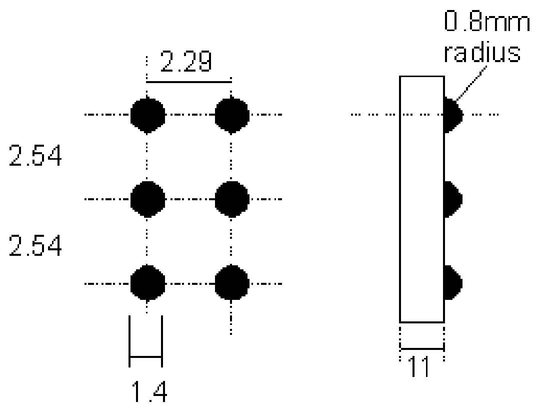

Fig .11 Dimensions of Braille Cell

The figure 11 shows the dimensions of the Braille cell. The Braille cell consists of 6 dots with 1.4mm diameter along with the column spacing of 2.29mm and row spacing of 2.54mm. The dots are provided with the guide of 11mm thickness.

The magnetic actuator used for the Braille cell is of high sensitivity and has 150mW nominal power consumption with 96mW pickup power. Thus the six actuators totally consume 900mW of power. The actuator is small in size which could fit in a cube of 10H x 7.5W x 12.5L mm.

The whole set up is powered by the single onboard battery of Sony ST27i.

When the visually impaired person touches this Braille cell, they can recognise which dot is projected and thus they can understand the printed text being scanned.

V. RESULTS AND DISCUSSION

The developed electronic reading aid can read the text up to the maximum font size of 28 and project one character at a time. In the case of smaller sized letters, it can read all the characters covered under the scanning region and produce the Braille projections of each letter as one after the other. It takes a total delay of 30 milliseconds between each projection. The device is compact and is a hand carried setup. The character recognitions are accurate and the projections are perfect without errors. The current design is for the English alphabets and numerical recognition along with some special character, latter it could be developed for denoting the images, tables and many more special characters and languages.

VI. CONCLUSION AND FUTURE WORK

The described electronic reading aid is a portable, low cost and efficient device which could make the visually impaired people understand the printed text with any scanning difficulty and recognition problems since they are much familiar with the Braille reading. The system can adopt to the maximum font size of 28 and can scan any text below this size. It can recognise the strings and project serially at the Braille display (cell). In future, the system can be examined for its real time performance and will be improved better for convenience based on the feedback from the visually impaired people.

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