Braiile Calculator

Bhavesh Bhatt, Chirag Gudkha, Avinash Khedekar and Prashant Mistry.

***Abstract*---This paper describes a novel Braille calculator system developed in a single low cost unit. 15 million blind out of 37 million population around the globe can make use of its special feature of producing output in Braille, Audio as well as in LCD display. Calculators with smooth input keys and LCD outputs which are available in market are useless for blind person. With the implementation of Braille keys and Braille output along with a speaker, it becomes a boon to blind person for computation purpose. Due to presence of such a calculator and affordability of this one, it will boost the calculation capability of visually impaired people. The system performance has been evaluated and shown encouraging results.**

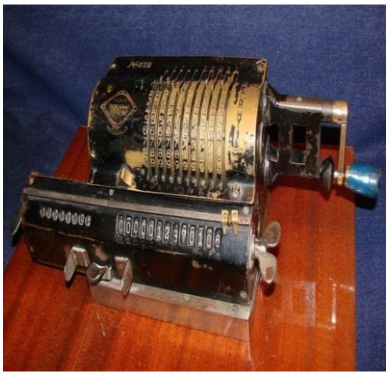
***Keywords*---**Braille, Braille literature survey, Braille system design, embossing of keypad, future enhancement.

1. INTRODUCTION

Technology has removed barriers to educate and employ people with visual impairment. Now these people can also compete with the normal people with the advanced technology. Calculators are one of the most common required tool at home, school, and work. However, people with various disabilities cannot use standard calculators. But For blinds, we have the Braille calculator coming up. Various statics have shown that the blind people often have hearing problems as well. So , to deal with those , we even have solution for this in form of audio output. The Braille system is a method that is widely used by blind people to read and write. The basic idea is to rotate stepper motor according to the answer, whose shaft will hold wheels on which Braille characters (0 to 9) would have been embossed. The keys of keypads will also be embossed in Braille language. The idea was inspired from old mechanical calculators as shown in fig. These devices were motor-driven, and had movable carriages where results of calculations were displayed by dials.

This paper deals with the technology used to Device the Braille calculator, From the Braille language, Braille literature survey, the block diagram and working, the components used to the applications and future enhancements.

Bhavesh Bhatt, Chirag Gudkha, Avinash Khedekar and Prashant Mistry are with Electronics, PVPPCOE (Padmabhushan vasantdada paristhan Patil College of engineering), Mumbai, India, Email: Email ID-chirag.gudkha@yahoo.com



Old Mechanical Calculator:

2. BRAILLE

Braille is a tactile writing system by the blind and the visually impaired, and found in books, on menus, signs, elevator buttons, and currency. Braille-users can read computer screens and other electronic supports thanks to refreshable Braille displays. They can write Braille with a slate and stylus or type it on a Braille writer, such as a portable Braille note-taker, or on a computer that prints with a Braille embosser.

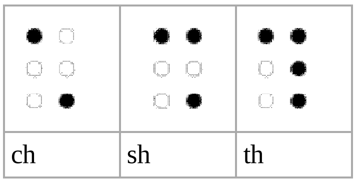
Braille characters are small rectangular blocks called *cells* that contain tiny palpable bumps called *raised dots*. The number and arrangement of these dots distinguish one character from another. Since the various Braille alphabets originated as transcription codes of printed writing systems, the mappings (sets of character designations) vary from language to language. Furthermore, in English Braille there are three levels of encoding: Grade 1, a letter-by-letter transcription used for basic literacy; Grade 2, an addition of abbreviations and contractions; and Grade 3, various non-standardized personal short hands.

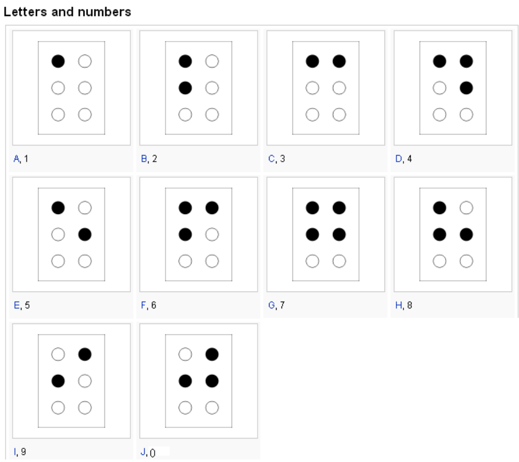
Braille can be seen as the world's first binary encoding scheme for representing the characters of a writing system. The system as devised by Braille consists of two parts. A character encoding for mapping characters of the French alphabet to tuples of six bits or *dots.* A way of physically representing six-bit characters as raised dots in a Braille cell.

Braille may be produced by hand using a slate and stylus in which each dot is created from the back of the page, writing in mirror image, or it may be produced on a braille typewriter or Perkins Brailler. Because braille letters cannot be effectively erased and written over if an error is made, an error is overwritten with all six dots. *Interposing* refers to braille printing that is offset, so that the paper can be embossed on both sides, with the dots on one side appearing between the divots that form the dots on the other (see the photo in the box at the top of this article for an example). Braille may also be produced using a computer with braille translation software and a braille embosser or a refreshable braille display.

Braille has been extended to an 8-dot code, particularly for use with braille embossers and refreshable braille displays. In 8-dot braille the additional dots are added at the bottom of the cell, giving matrix 4 dots high by 2 dots wide. The additional dots are given the numbers 7 (for the lower-left dot) and 8 (for the lower-right dot). Eight-dot braille has the advantages that the case of an individual letter is directly coded in the cell containing the letter and that all the printable ASCII characters can be represented in a single cell. All 256 (2^8) possible combinations of 8 dots are encoded by the Unicode standard. Braille with six dots is frequently stored as braille ASCII.

The first 25 braille letters, up through the first half of the 3rd decade, transcribe *a–z* (skipping *w*). In English Braille, the rest of that decade is rounded out with the ligatures *and, for, of, the,* and *with*. Omitting dot 3 from these forms the 4th decade, the ligatures *ch, gh, sh, th, wh, ed, er, ou, ow* and the letter *w*.





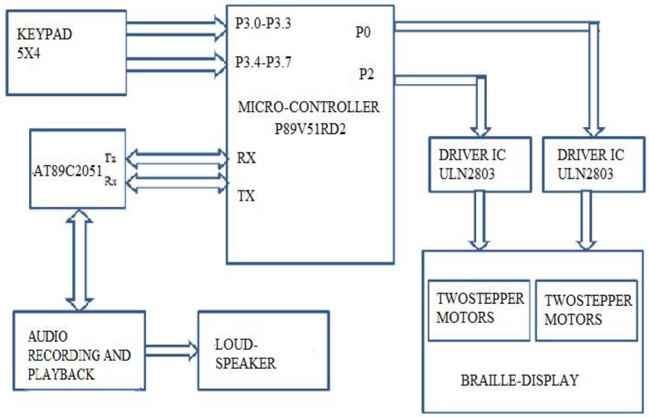
Letters and Numbers in Braille

3. BRAILLE CALULATOR SYSTEM DESIGN

3.1. BLOCK DIAGRAM

DESCRIPTION

As shown in figure, 5*4 matrix will act as a input of the calculator which will have Braille embossing on it . user will give the input as number and operation viz. addition , subtraction , multiplication, division to be performed using keypad. Micro-controller P89V51RD2 will carry out the particular operation on user entered numbers and will give the result for further processing.. Micro-controller P89V51RD2 will process the answer of the calculator to rotate the wheels of the braille display to produce the output in terms of the braille.These wheels will be rotated with the help of stepper motor which will be driven through the driver ULN-2803. The result will also be serially communicated to the micro-controller AT89C2051 which will operate audio-processing and playback IC APR6016 to announce the answer of the calculator on the loudspeaker



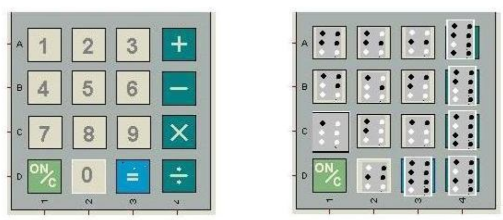
WORKING

The project will serve as calculator for blind people. The user will input a number through keyboard. The number will be stored in microcontroller . When the user will press any operation key such as '+','-','*','\', the microcontroller will ask for another number as input from user. On pressing'=' key, the microcontroller will calculate the result and will display the result on Braille display unit. The four stepper motor in display unit will rotate according to result. After rotation of each stepper motor through one step angle, the corresponding memory location in Serial Memory (24C64) is incremented and stored. As this memory is non-volatile, in case of power failure or when reset button is pressed, the display will rotate back to (0000) position. We are also serially sending the answer to AT89C2051 and communicating with APR6016 to announce the result on loud speaker

3.2 COMPONENTS

3.2.1 MATRIX KEYPAD

This is nothing but push-button keys arranged in matrix manner. User will input the numbers to be manipulated and corresponding manipulations to the system. These keys will be attached with the Braille embossed digits and arithmetic signs as shown in figure 4. It will have symbols for letters from 0 to 9 and signs for +,-,\,*,=. The keyboard will be as shown in figure below. Keyboards are organized as a matrix of rows and columns; two side of this matrix are connected to Vcc through resistors while the third side is connected to the microcontroller port and configured as an output; and the last side is connected to the microcontroller port and configured as an input as shown in figure



3.2.2MICROCONTROLER 89S52RD2

The P89V51RD2 is an 80C51 microcontroller with 64 kB Flash and 1024 bytes of Data RAM.A key feature of the P89V51RD2 is its X2 mode option. The design engineer can choose to run the application with the conventional 80C51 clock rate (12 clocks per machine cycle) or select the X2 mode (6 clocks per machine cycle) to achieve twice the throughput at the same clock frequency. Another way to benefit from this feature is to keep the same performance by reducing the clock frequency by half, thus dramatically reducing the EMI. The Flash program memory supports both parallel programming and in serial In-System Programming (ISP). In-System Programming is performed without removing the microcontroller from the system. The In-System Programming facility consists of a series of internal hardware resources coupled with internal firmware to facilitate remote programming of the P89V51RD2 through the serial port. This firmware is provided by Philips and embedded within each P89V51RD2 device. The Philips In-System Programming facility has made in-circuit programming in an embedded application possible with a minimum of additional expense in components and circuit board area. The ISP function uses five pins (VDD,VSS, TxD, RxD, and RST). Only a small connector needs to be available to interface your application to an external circuit in order to use this feature

3.2.3. DRIVER ULN2803

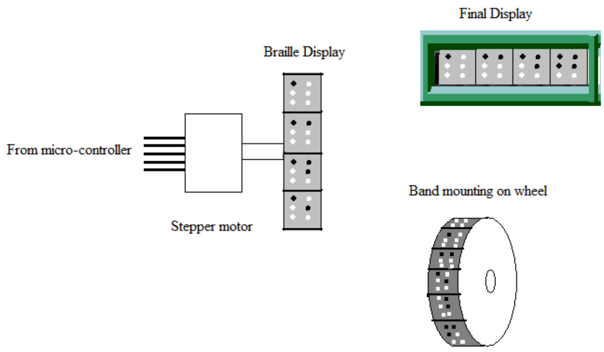
The eight Pin NPN Darlington connected transistor in this family of array are ideally suited for interfacing between low logic level digital circuitry (such as TTL CMOS or PMOS /NMOS) and the higher current /voltage requirement of lamp, really ,printer, hammer or other similar loads for a broad range of computer ,industrial and consumer application. All devices featuring open-collector output and freewheeling clamp diode for transient suppression. the ULN2803 in designed to be compatible with standard TTL families while the ULN 2803is optimized for 6to15 volts high level CMOS or PMOS.

3.2.4. AUDIO PROCESSING APR6106.

The APR6016 offers non-volatile storage of voice and/or data in advanced Multi-Level Flash memory. Up to 16 minutes of audio recording and playback can be accommodated. A maximum of 30K bits of digital data can be stored. Devices can be cascaded for longer duration recording or greater digital storage. Device control is accomplished through an industry standard SPI interface that allows a microcontroller to manage message recording and playback. This flexible arrangement allows for the widest variety of messaging options. The APR6016 is ideal for use in cellular and cordless phones, telephone answering devices, personal digital assistants, personal voice recorders, and voice pagers. APLUs Integrated achieves this high level of storage capability by using a proprietary analog multi-level storage technology implemented in an advanced non-volatile Flash memory process. Each memory cell can typically store 256 voltage levels. This allows the APR6008 voice to reproduce audio signals in their natural form, eliminating the need for encoding and compression which can introduce distortion.

3.2.5 BRAILLE OUTPUT DISPLAY

This is going to be the output unit of the calculator. For this purpose, we will be carrying out embossing of the braille digits on the rubber band. This rubber band will be mounted on the circumference of robotic wheel as shown in figure. Accordingly there will be four wheels to display 4-digit output of the calculator. The rotation of all these wheels will be carried out with the stepper motor. Once the micro-controller has calculated the result of arithmetic operations entered by user, each motor will rotate according to the value at each digit position of the answer. Each of this rotation will be with respect to reset position (ANS-0000 position)



4.OUTPUT CALCULATON

1) The output is 4 digit so we are using four stepper motors one for each digit display. Each stepper motor has 11 braille digits 0 to 9 and point (.) embossed on it.
2) The diameter of our wheel is 7cm.So the circumference = pi*d = 22cm.This 22cm corresponds to 360 degrees.
3) We are rotating the stepper motor by 27 degrees for one digit which will correspond to 1.65cm of circumference. Therefore one Braille digit has length of 1.65 cm.
4) To rotate stepper motor 27 degrees i.e. to display one we have to send entire sequence (A,9,5,6) 3 times(3*7.2=21.6) and 3 more steps i.e. (3*1.8=5.4) the total sequence giving 27 degrees(21.6+5.4=27).
5) Similarly to display 2 we have to rotate the stepper motor by 54 degrees and so on for other digits

5. CONCLUSION

The stepper motor will rotate in steps according to the angle calculated by microcontroller after the input keys are pressed which are in Braille. The stepper motor stops rotating after the angle of rotation is completed and the blind person can read the output in Braille with their sense to touch. The output is also available in audio form so that it becomes easier to use. The designed Braille calculator currently works for 4 digits. With some improvements the calculator can be incorporated with more features.

Furthermore improvements would include a list of possible things-

1. As our display of Braille calculator has limitation of display up to 4 digits, it can be extended up to 8 digits with further sophistication needed.
2. It can be extended to operate on floating point numbers.
3. As nowadays calculators are available with scientific functions, it may be possible to incorporate them in Braille calculator
4. An increased number of cells on our display, the ability to read more than 100 character longer lasting battery Also, we would like to make our device thinner. Although increasing the number of cells would make our device larger, we might be able make our device wider, which would allow us to make it thinner and still increase the display size

With these possible enhancements implemented correctly and shown good results , It can have applications like-

1. Assistive technology programs that run on off-the-shelf computers can speak the text on the screen or magnify the text in a word processor, web browser, e-mail program or other application.
2 Stand-alone products designed specifically for people who are blind or visually impaired, including personal digital assistants (PDAs) and electronic book players provide portable access to books, phone numbers, appointment calendars, and more.
3. Optical character recognition systems scan printed material and speak the text. Braille embossers turn text files into hard-copy Braille.

6. REFERNCES

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