REFRESHABLE BRAILLE DISPLAY

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Introduction

India has an overwhelming population of 15 million visually impaired. Only 2% of them know to read and write. Literacy is very critical to sustain in this competitive world. Braille being the only means to read and write for them it is essential that we promote braille education.

One of the major reasons for the diminished growth of braille is lack of availability of resources. It has been noted that after learning braille from blind schools, people feel helpless due to unavailability of information in braille outside schools. In today's computerized era, braille is loosing its importance due to speech-to-text converters. The difficulty of learning braille coupled with unavailability of braille material and higher availability of other easier forms of communication like the text-to-speech converters have led to the downfall of Braille. But it has been proved that braille cannot be replaced by any other means and it has also been noted that 80% of the employed blind use braille. Hence there is a very strong correlation between braille learners and their employment opportunities and subsequently financial independence.

Text has transferred from paper to electronic displays in a big way but braille in electronic form apparently has not gone through this transition massively. We all know how much welfare the transition to electronic text has made and it is my dream that the same happens to braille.

One major reason blocking this transition is the cost of electronic braille displays. Electronic braille displays are commonly known as "Refreshable braille display" which have pins moving up and down emulating the braille dots. The cost of these devices range from Rs. 1.2 lakh to 3.4 lakh which is extremely high for the utility of the device.

Objective

To build a refreshable braille display nearly at one-tenth of the cost of today's displays while having the same utility by capitalizing on frugal innovation.

Refreshable braille display – current technology

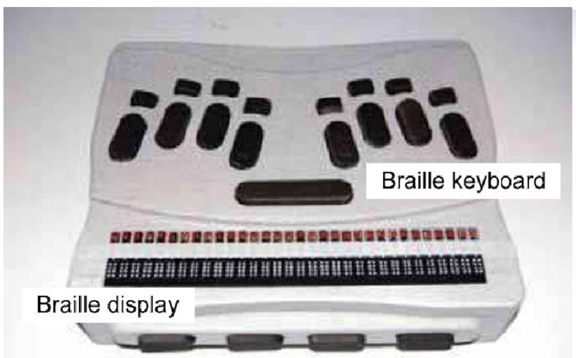
A **refreshable braille display** or **braille terminal** is an electro-mechanical device for displaying braille characters, usually by means of round-tipped pins raised through holes in a flat surface.

The base of a refreshable braille display is a pure braille terminal. There, the input is performed by two sets of three keys plus a space bar, while output is via a refreshable braille display consisting of a row of electromechanical character cells, each of which can raise or lower a combination of six (or in some cases, eight) round-tipped pins. Other variants exist that use a conventional QWERTY keyboard for input and braille pins for output, as well as input-only and output-only devices.

The mechanism which raises the dots uses the piezo effect of some crystals, whereby they expand when a voltage is applied to them. Such a crystal is connected to a lever, which in turn raises the dot. There has to be a crystal for each dot of the display, i.e. eight per character.

Because of the complexity of producing a reliable display that will cope with daily wear and tear, these displays are expensive. Usually, only 40 or 80 braille cells are displayed. Models with between 18 and 40 cells exist in some notetaker devices.

My idea is based on a very different concept which helps escape the high cost of piezoelectric actuators.



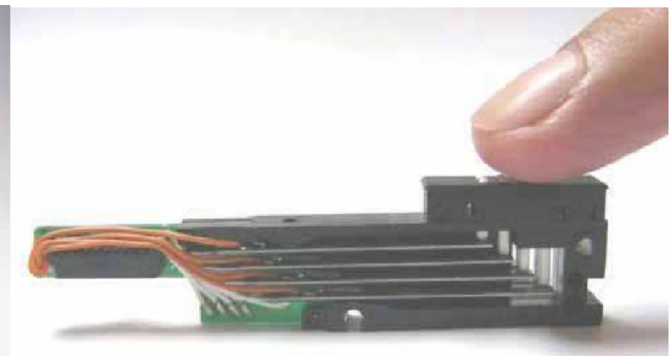


Figure: (left) Braille notetaker with reading and writing capability. (right) A single piezoelectric braille cell

Rotating braille – innovation

The idea of this display stems from the single line moving LED displays. Braille is read by brushing the fingers over embossed dots. Here the static element is changed from the cells to fingers. The fingers will remain static and the moving braille cells will move underneath the fingers emulating the same sensations.

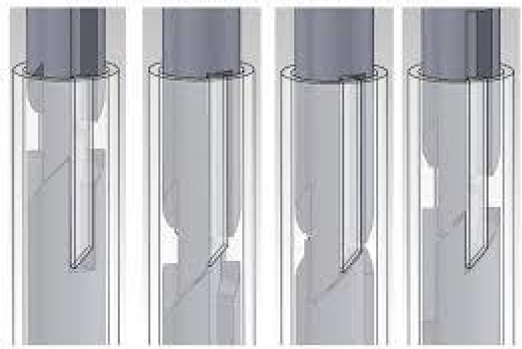
The idea is to minimize the number of actuators required to move the dots since they account for the major proportion of display costs (70%). A rotating display contains essentially of an array of braille cells mounted on a belt. These braille cells will have a latching mechanism which will help them retain the dot values (up or down) when they move on the belt. These cells will be actuated by electromagnets. At a time only 1 cell is actuated so the no. of electromagnets required drops down to 6 (for each dot in a cell).

The underlying principle is of a screw coupled with a rack and pinion. The cells move like a conveyor belt so there is a continuous flow of characters. The electromagnets refresh the cells as they pass by the actuating node. The belt can move either way so if the user wants to look into some word that has already been read, he can move the belt backward or see the previous text.

A very smooth control over the speed of the belt (matching his reading speed) will be provided to enhance the experience.

The latching mechanism is based on the commonly used pen-click mechanism.

Figure 1: The 4 Stages of Mechanism Motion



A microcontroller (Arduino) will be used to perform these actuations and keep the display rotating.

Costs

particular	Amount (Rs.)
Arduino	1,000
solenoids	6 x 1,500 = 7,500
3D printing and other hardware	8,000
Electronics	1,000
Total	17,500

Timeline

Development of 1 cell (mechanism)	**15 days**
Development of actuation	15 days
Making the rotating mechanism	10 days
Completion of hardware part of display	1 month
Developing the software	1 month
Combining the hardware and software and other buttons	1 month
Final prototype	1 month