



PRAGYAN HARDWARE HACKATHON

HEALTH CARE AND LIFE SCIENCES

PORTABLE BRAILLE

(Guided by Spider R&D Club)

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1. Project Abstract:

Braille is a system of raised dots that allows visually impaired people to read tactilely. Currently, the number of books written in Braille script is less and the cost is high. This project is an approach to solve the problem of unavailability of many of the books and texts in Braille script. The Portable Braille consists of a camera module which captures the image of a printed text material and converts it into text format by using Optical Character Recognition(OCR). The characters in the text are converted into Braille characters(3x2 matrix form) and fed to the actuators. The actuators are the pins in the head of a dot matrix printer. The pins are actuated in such a way that it creates pressure at required points in the fingertip similar to how pressure felt when placed on an embossed braille character. By this way the device sends character by character to the user's fingertip through the actuators. These characters will be sent with appropriate delays to make the user understand words/sentences. Hence a given printed text material can be understood by the blind person through his/her sense of touch.

Keywords— *Braille, Dot Matrix Printer Head, Solenoid, Linear Actuator, Optical Character Recognition(OCR), Portable, Reading Assistive Device.*

2. Proposed Design:

A. Objective:

The main objective of this project is to make a portable braille system which can be easily used by a visually impaired person. This allows them to easily understand the commonly available printed texts like books and newspapers that normal people read in their day to day life.

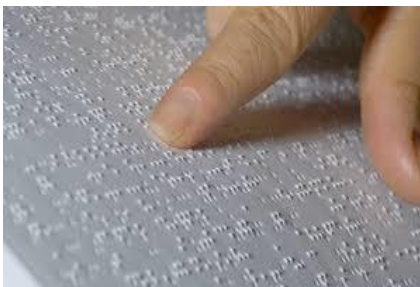
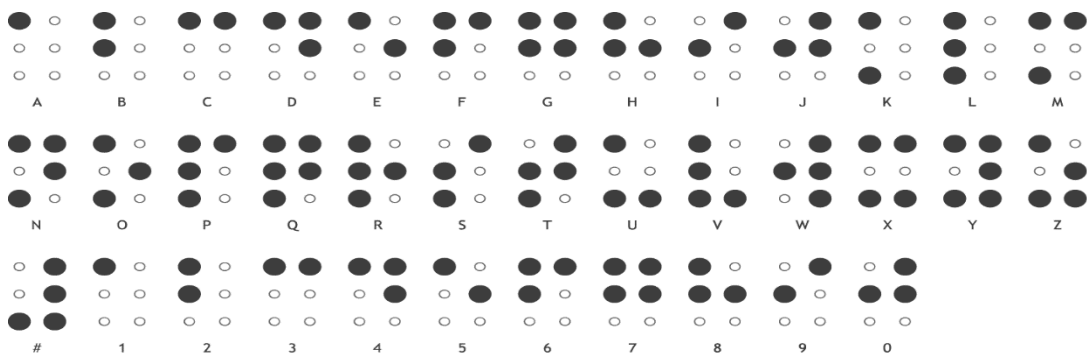


Fig: How braille is actually read



Fig: Placement of actuator

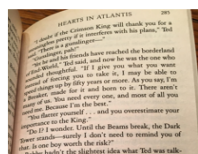


FIG: Normal Text/Image

Image processing
and OCR

The quick brown fox
jumped over the 5
lazy dogs!

FIG: After OCR we have
individual characters
identified

Converting OCR
Into Braille Characters

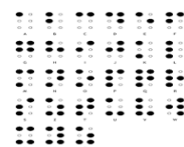


FIG: Recognized characters
are now converted to Braille.

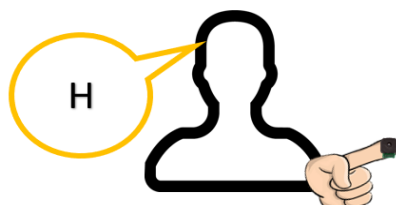


FIG: User sensing this on his
fingertips.

User can feel
it on the
fingertip

Actuating
the
actuators

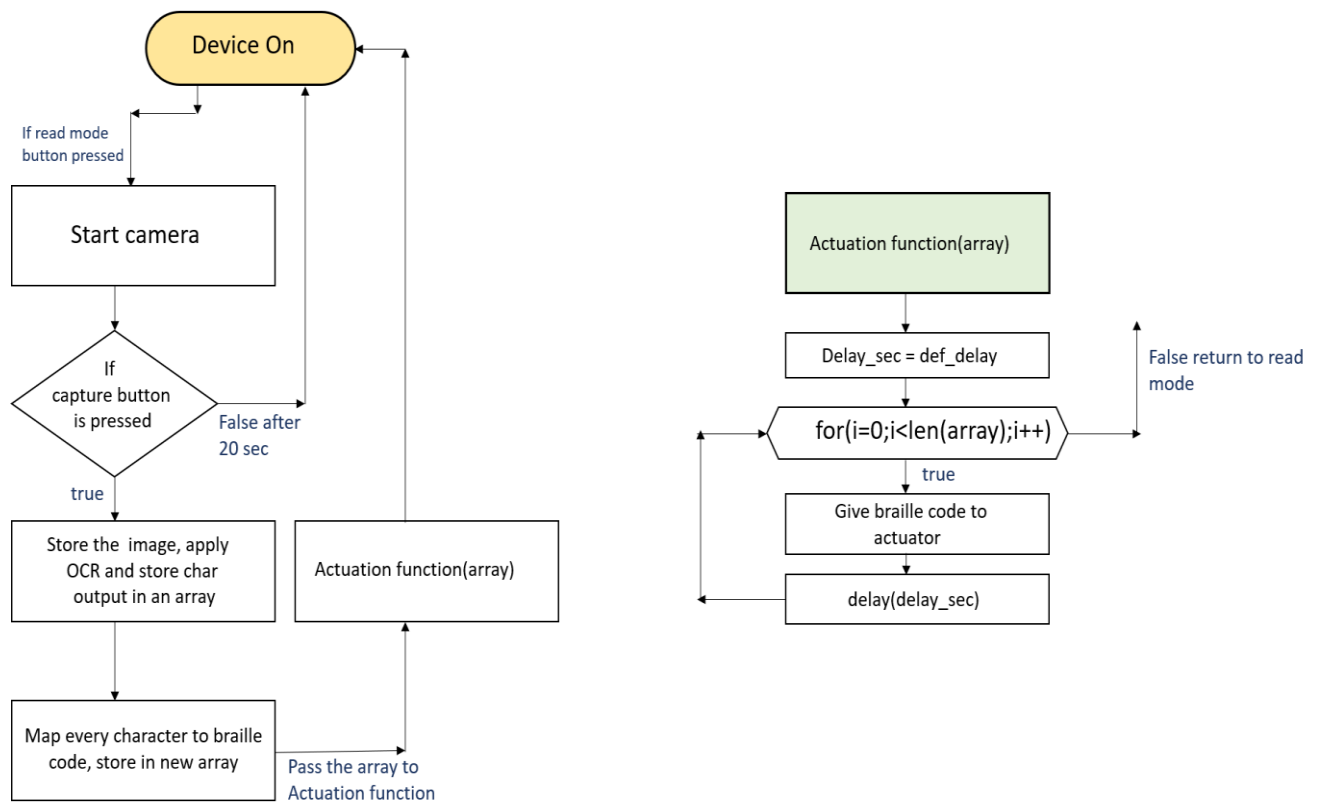
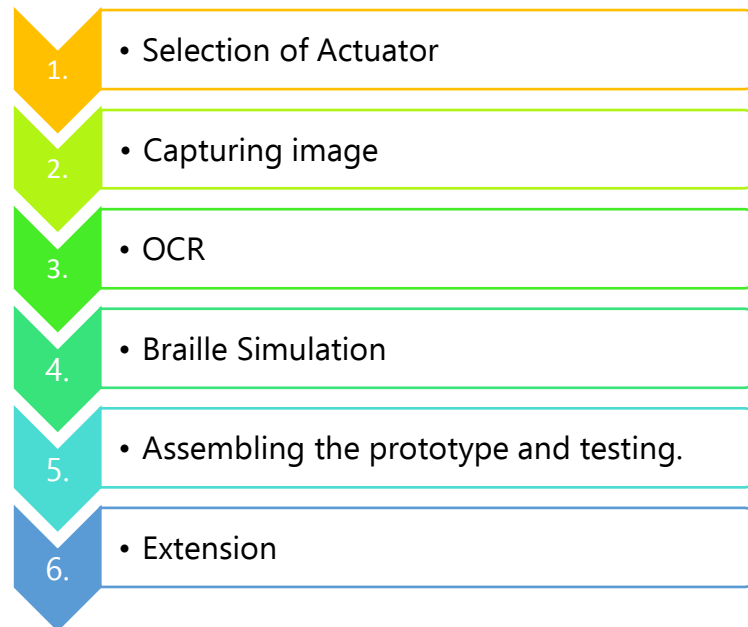


FIG: Dot Matrix printer head.



B. Proposed Solution:

a. Block Diagram:



1. Selection of Actuator:

The head of an old dot matrix printer is used as the actuator to simulate the Braille characters on the fingertip of a blind person. This is preferred compared to other alternatives such as Shape Memory Alloys(SMAs) and servos as the actuators in dot matrix printers are small enough to simulate a whole Braille character(3x2 matrix) in a single fingertip. An appropriate 3D printed structure can be used to change the arrangement of these actuators from linear fashion(9x1) into 3x2 matrix format.



FIG: DOT MATRIX PRINTER HEAD



FIG: ACTUAL LOOK(TOP VIEW).
[ALL PINS ARE IN 1D MATRIX FORM]

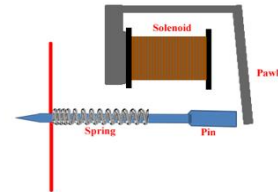


FIG: SCHEMATIC OF HOW A SINGLE DOT IS ACTUATED

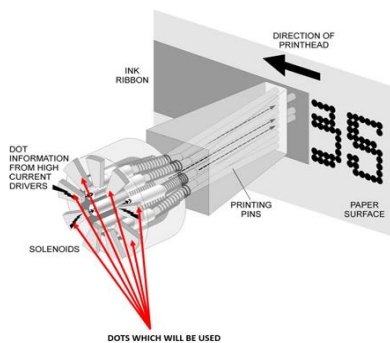


FIG: INTERNAL SCHEMATIC

After using 3D printed
Top Head



FIG: SAMPLE NEW LOOK(TOP VIEW).
[NOW THE PINS ARE IN BRAILLE CHARACTER FORM]

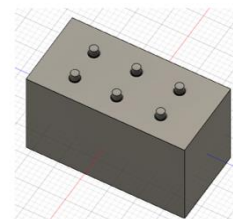


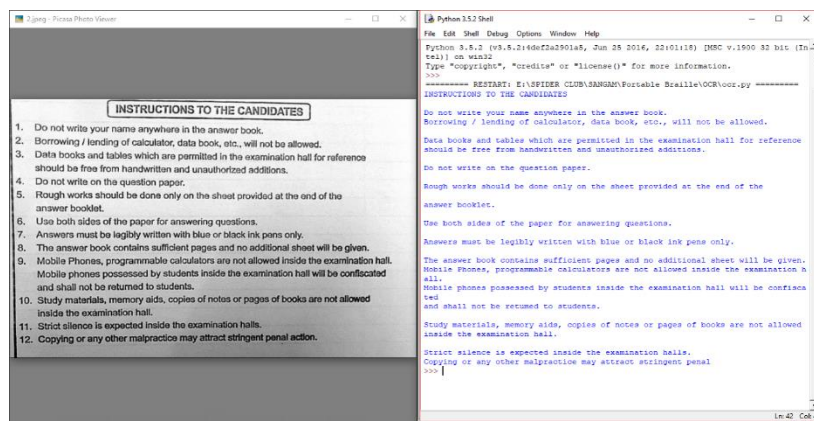
FIG: Sample 3D Model
of the Top head

2. Capturing Image:

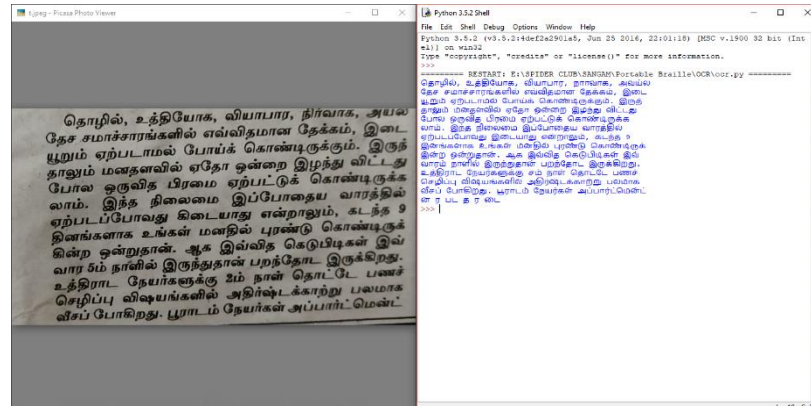
The image of a printed text material is captured through a camera and fed to the microcontroller. The required part is identified and cropped from the captured image. We add necessary filters before applying OCR.

3. OCR:

We use an appropriate algorithm for Optical Character Recognition (OCR) and identify individual characters in the image. Hence the given image can be converted from image format to text format.



Snippet from answer booklet



Snippet from a Tamil newspaper

4. Braille Simulation:

The characters obtained after applying OCR algorithm is translated into its corresponding braille characters and fed into the actuators. These actuators simulate braille by creating pressure in the fingertip at appropriate places.

5. Assembling the prototype:

All the modules used in the prototype like microcontroller, camera, actuators and power circuits are placed in the required places with proper fabrication.

6. Extension:

- Provision for controlling the speed at which braille characters are sent to the actuating units.
- Provision for storing text materials which can be read again later.
- Provision for choosing the language of the text to be read.

C. Components Required:

COMPONENTS/PARTS	Role/functionality
Raspberry Pi	The main part of the project where all processing will take place.
Dot matrix Printer Head	Used for miniaturized actuators
Pi Cam	Used for capturing the required image
Batteries	For powering the circuit
Few 3D printed parts	For fabrication

3. Innovativeness of the Proposed Solution

- The existing prototype which has a similar objective can be found in the reference link. It uses Shape Memory Alloys as actuators in 3 fingers to simulate Braille characters.

- This prototype is more practical as we are able to simulate the characters in a single fingertip.
- The actuation of Shape Memory Alloys is very slow compared to the actuation of the pins in the dot matrix printer head.
- Cost of our actuators is almost NIL(E-Waste) while Shape Memory Alloys are costly.
- Reusing of e-waste (obsolete dot matrix printer head) for a useful cause.

4. Impact of the proposed solution (Application):

- The National Federation of the Blind states that a blind person is considered to be a literate only if he/she knows Braille.
- According to the statistics of NCBI(National Centre for Biotechnology Information) of India, there are around 15000 blind schools in the country with about 200,000 blind students. All of them learn Braille and depend on it for their education.
- Hence this portable system affects them directly by giving them access to all the texts a normal student could get.
- A major part of the blind population falls under the age category of senior citizens. These people use Braille for leisure activities unlike the children and young adults who use it for learning. This makes it more difficult for them to get the Braille form of texts they need, like daily newspapers.
- According to the Forbes article in the reference, the number of books available in Braille is well under 1% of the total literature. According to the website a Braille reader costs around 3000\$-15000\$(~2,00,000Rs - ~10,00,000Rs) which is way too costlier than this portable reader.

5. References

1. <https://ieeexplore.ieee.org/document/5167956>
 - A similar idea implemented with Shape Memory Alloys.
2. <http://www.who.int/blindness/GLOBALDATAFINALforweb.pdf>
 - WHO report on global data for visually impaired people.
3. https://nfb.org/images/nfb/documents/pdf/braille_literacy_report_web.pdf
 - Report of National Federation of Blind of America.
4. <https://www.forbes.com/sites/timworstall/2012/08/18/this-digital-age-why-isnt-it-a-paradise-for-braille-readers/#6f43b3130e75>
 - An article about why the digital world isn't yet a paradise for the blind.