

Report on Book Reader for Blind People CSE-460 (Hardware)

Prepared by Group 4 (Section B)

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1. Introduction

This project is an audio book reader for the aid of visually impaired/blind people. It can work as an aid to anyone with low or no vision. User would place a text document they want to read on a placement board under a stand that will hold the phone with a camera. The camera then would take a picture of the text document and the system reads it out loud. Our project is aimed for users who want to read Bangla printed books or documents. We came to this decision after communicating with blind students who informed us that although there are similar systems/products available for students in the English language which are expensive, there are none for Bangla. Bangla e-books are not as much available as English and braille is not available for all books. Therefore, individuals with visual impairment face this problem regularly and have to ask for help from other people. Considering this we designed our system to suit their needs as much as possible. Since this system is android based, users can also read the text documents remotely by just taking the photo of the document without the need to own a computer.

2. Objectives

To build a device that can read text out loud from any printed book for the blind or visually impaired by

- i. Taking picture of the text document with a camera placed on the stand.
- ii. Extracting the text from the document.
- iii. Converting extracted text to speech.
- iv. Controlling speed, volume of the speech and navigation with user input through external buttons.

3. Features:

- Simplicity
- Speed
- Variable playback speed
- Variable playback volume
- Portable
- User friendly
- Cost efficient

4. Our Project vs Existing Project

There are various reading aids available for the visually impaired and a lot of work has been done in the outside world regarding this. Various android applications are available that provide audio e-books. There are some applications and sites that read printed books but are not free, and come with a heavy price. There are a few stand-alone devices such as Digital Talking Book CD player that contains digital files of books in CDs and can be carried around. But again, these cannot be used to read printed books and are outdated. Another software used by Bangladeshi blind students is named Jaws which helps them use computer by converting all text into speech. But this software doesn't have an android version so the user cannot convert any kind of document unless they take a photo of that content, scan it to make a pdf file and put it in their computer which is a very lengthy process and they have to rely on friends or family to help them. Most importantly, all of these systems only provide services for the English language as there is no Bangla text to speech software for android version.

Whereas, for our project the target audience are visually impaired Bangla language speakers who want to read printed books/documents. This project provides a portable device that can read any Bangla text document/ book, provides real time service, has a book placement holder, a stand for holding the phone and external buttons to adjust the speed and volume of the audio playback to make its use easy and simple for the visually impaired. This device is cost friendly, user friendly and portable. Following is a comparison table between our project and existing projects:

Project Name	Features					
	Hear Books	Adjust Voice Speed	Portability	Multilanguage Reading	Cheap	AI Based
Eye Snap Reader	✓	✓	✗	✗	✗	✗
I-reader desktop scanner	✓	✓	✓	✗	✗	✗
Jaws	✓	✓	✗	✗	✓	✗
Our Project	✓	✓	✓	✗	✓	✓

5. Conceptual Framework

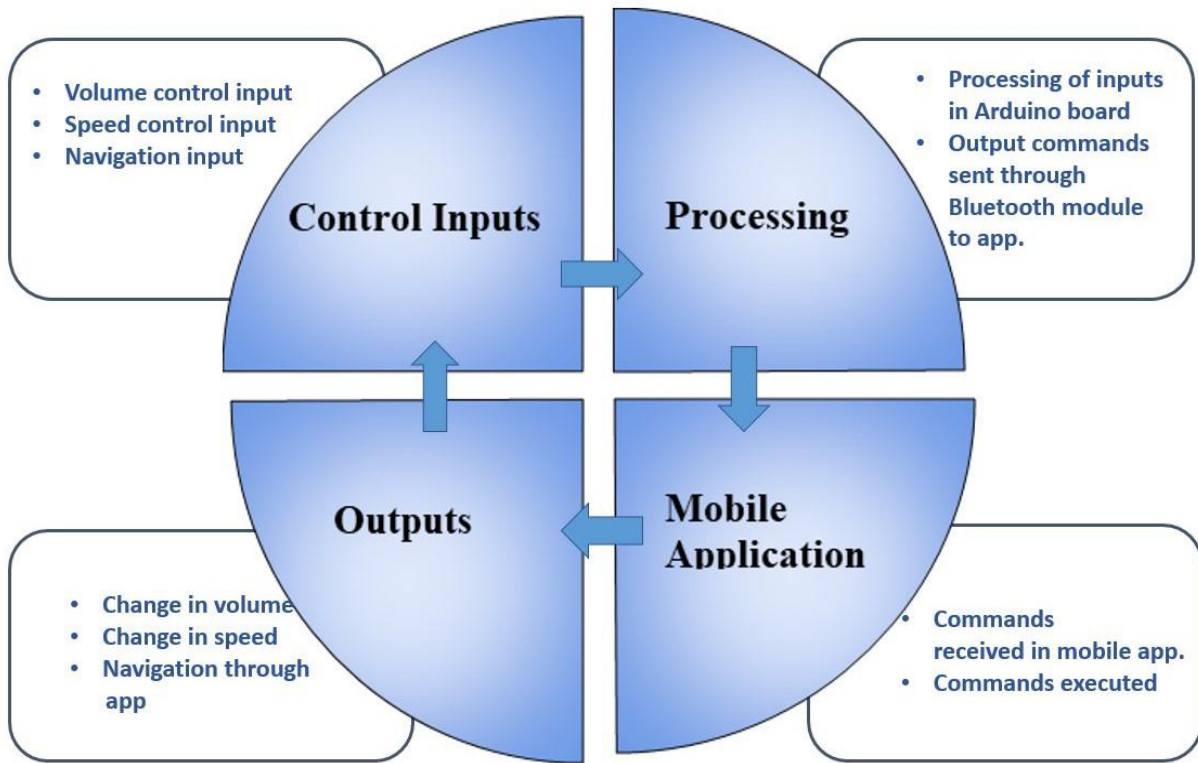


Figure: Conceptual Framework for Book Reader for Blind People

- i. **Control Inputs:** The device contains control buttons. User presses buttons to change the speed of playback, volume of playback and to navigate through the app.
- ii. **Processing:** The inputs are processed in the Arduino board. Output commands are sent through Bluetooth module to the mobile application.
- iii. **Mobile App:** Mobile app processes the commands received from Bluetooth and executes them.
- iv. **Outputs:** Outputs are observed as desired change in speed, volume, image scanned etc.

6. Working Procedure

6.1 Design of the prototype:

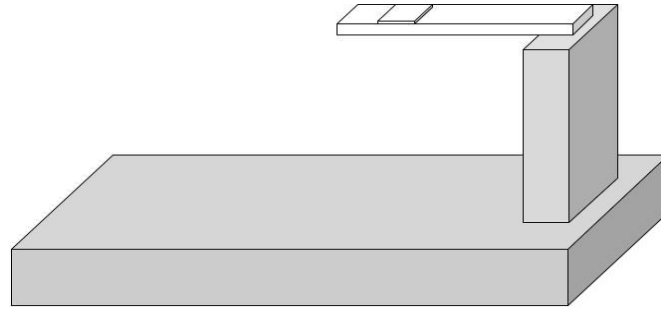
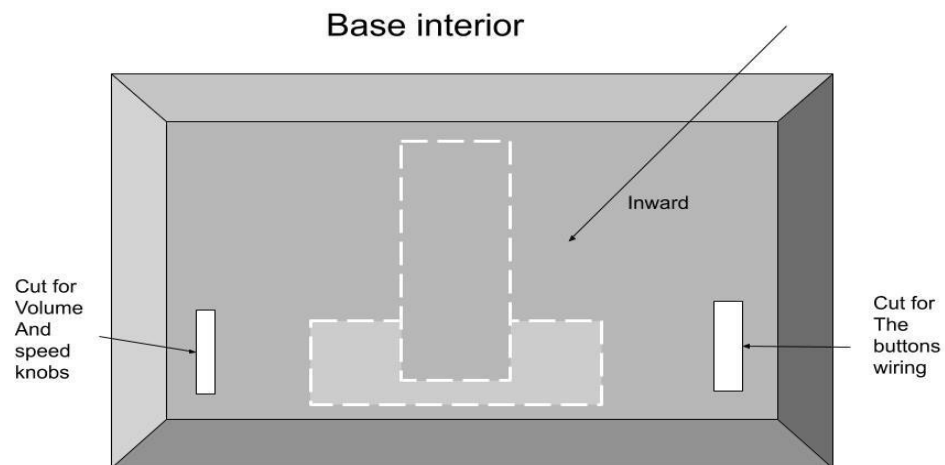


Figure: Design of the book reader (Side View)



Base from below. It should be hollow from the inside and also it should be strong enough to take the camera, stand, head, book's weight.
It needs to be hollow so that all the arduino and other electrical equipment can be attached.

Figure: Design of the Book Reader (Base interior)

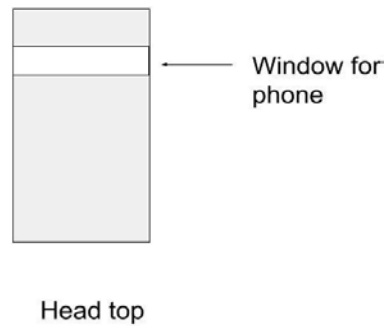


Figure: Design of the Book Reader (Head)

6.2 Working procedure

Our prototype contains a board on which the book will be placed. Buttons are attached on it and inside it the Arduino board and other electrical equipment is attached. On top of this board is a stand that holds a head. A head is a holder for the phone. User will place their phone on the holder and will be able to adjust the stand vertically so that the camera can have a wider or narrower view. User can use this system in two ways:

- i. **Using the app in the phone:** User can navigate through the app using the app interface. For example, user opens the app, presses “take photo” to take a picture, then presses on “scan photo” to scan, presses “read” to listen to the audio of the text, presses speed increase and decrease button for speed change, uses volume buttons of the button to change volume.
- ii. **Using the buttons attached to the board:** User can also navigate through the app using the external buttons attached to the board. User presses the buttons to take picture, go to the next step, to increase and decrease volume and speed etc.

In summary, user according to their preference can operate completely using only their phone or only the external control buttons on the board.

6.3 Materials Used

- Arduino Uno
- Potentiometer
- Buttons
- Book stand (Wooden board, Mobile holder)
- Bluetooth Module
- Resistors
- Capacitor
- Breadboard
- Wires

6.4 System Architecture

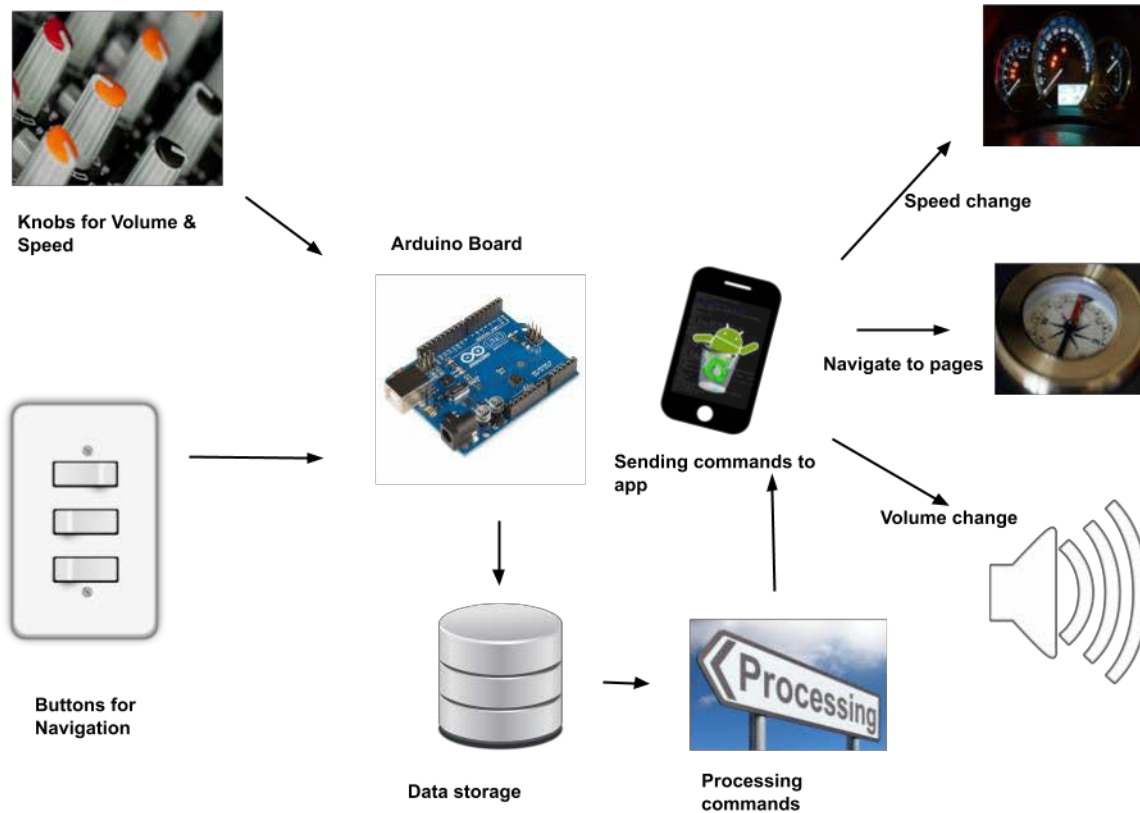


Figure: System Architecture of Book Reader for Blind People

Inputs from volume, speed change and navigation are stored and processed in the Arduino board. The processed outputs are commands for volume, speed change, reading, scanning etc. These commands are sent to the android application through the Bluetooth module. Commands are executed and result in the desired change of volume, speed, navigation etc.

6.5 Circuit Diagram

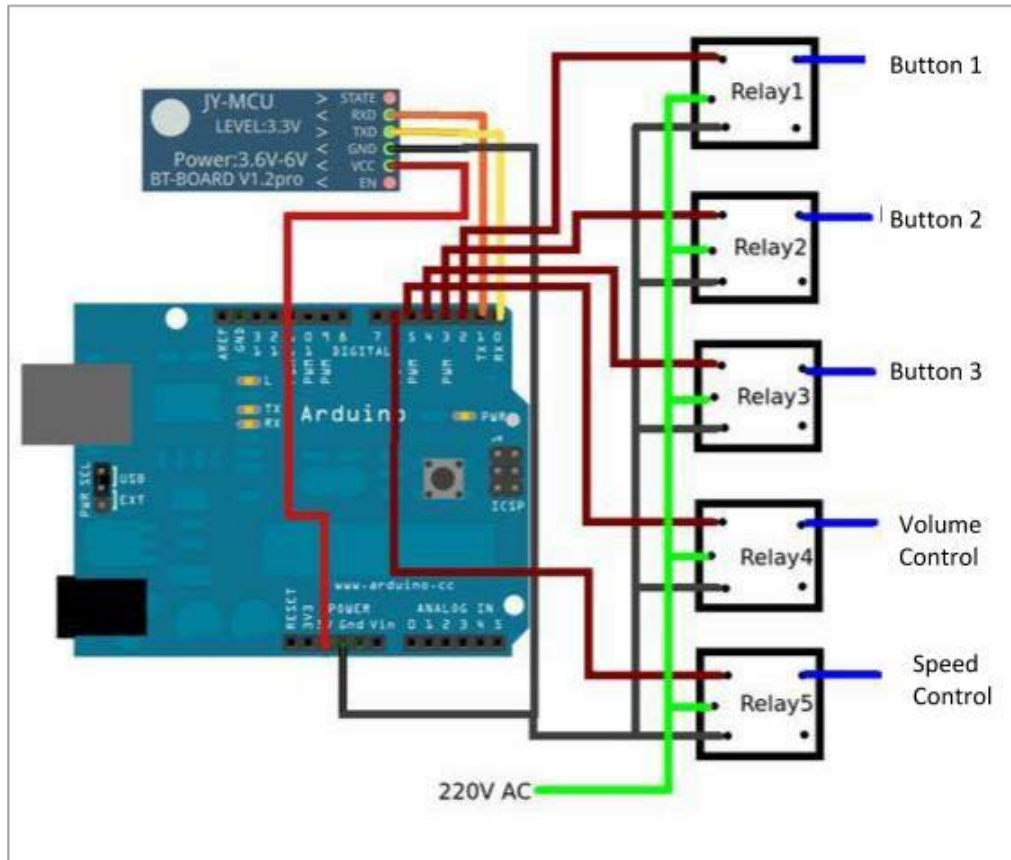


Figure: Circuit Diagram of the Bluetooth module and Control Buttons

The outputs of the buttons are connected to the 5 input pins of Arduino board. When buttons are pressed, input data goes to Arduino and the TX pin of the Bluetooth receives data from the RX pin of Arduino. The code to establish connection is uploaded to the Arduino.

6.6 Workflow Diagram

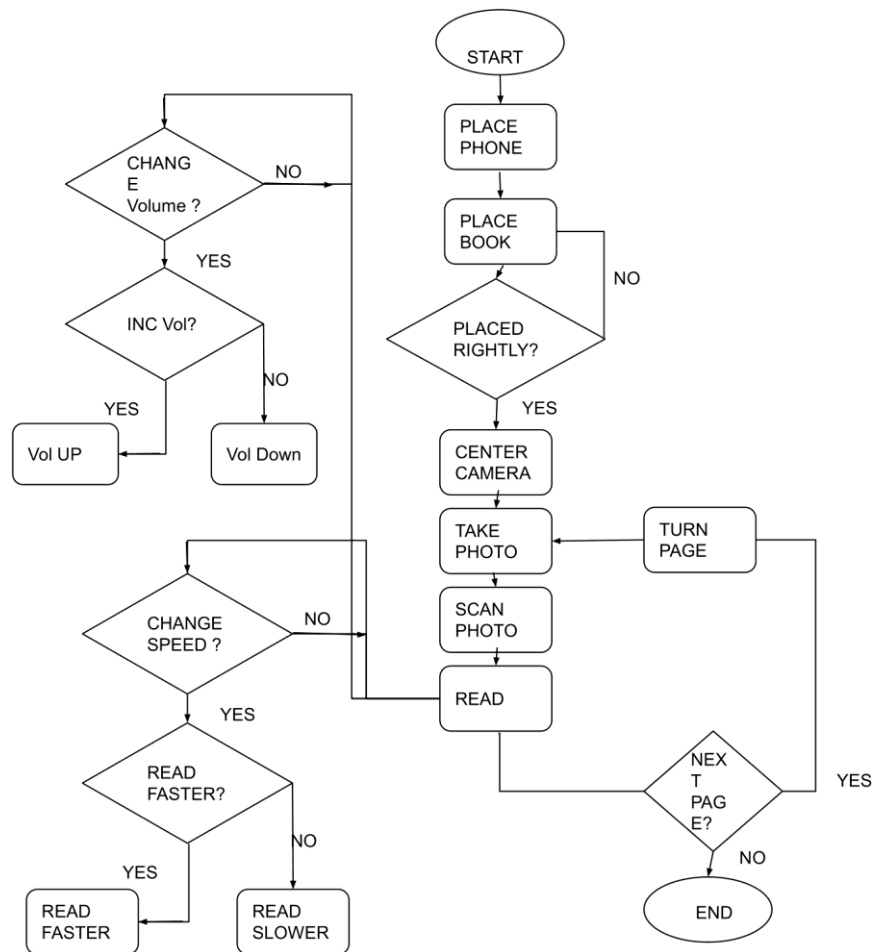


Figure: Workflow diagram of Book Reader for Blind People

The first condition that is checked is whether the book has been placed correctly. If no, book is adjusted to place correctly. If yes, picture is taken, scanned and read. From here the flow of action is:

- i. Volume and/or speed is changed if desired. If no, reading proceeds same as before.
- ii. If user desires to turn page, next page is captured scanned and read.

This process is repeated until user wishes to finish.

7. Cost Analysis

Item	Cost
1. Arduino Uno	420
2. Bluetooth Module (HC-05)	$50 \times 2 = 100$
3. Potentiometer	$50 \times 4 = 200$ tk
4. Buttons	$400 + 100 \times 2 + 100 = 700$ tk
5. Book Stand (Wood, Alloy Bar, Mobile Holder)	$85 \times 2 = 170$ tk
6. Breadboard	10 tk
7. Capacitor	20 tk
8. Resistor	296 tk
9. Wires	100 tk
10. Circuit Board Design	200-300 tk
Total	2316 tk

8. Prototype Testing and Results

The software part of this project includes an app, text detection model for character recognition, text to speech API etc. The software part of our project is working and is in the path to more progress. We had initially achieved an accuracy of 77% for our text detection model which eventually we were able to improve and bring to an accuracy of 85%.

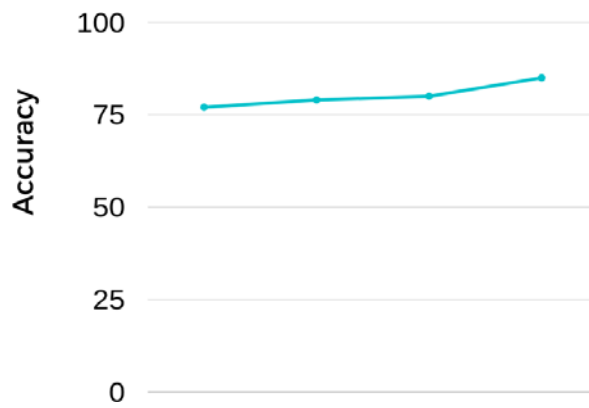


Figure: Text detection model accuracy

On the hardware part, our initial proposal was to use a stand and mobile holder made of wood. Due to the pandemic the making of which was halted. Therefore, we pivoted from our initial proposition and decided to use a camera stand. The different parts of the hardware such as function of the buttons, the Bluetooth module and the app are giving good results. The integration of all the parts is still under testing.

9. Limitations and Future Work

Our book reader for the blind mobile app only works when online. Since there is no offline mode, user has to be connected to the internet for scanning the images. Also, the circuit for our book reader is fragile and has not been placed in a very secured manner, which might result in the damage of circuits. This can be improved with the usage of production quality materials. Also, there is no way to verify if placement of book/document is correct the first time. Meaning, if the book placement is not correct image will not be captured correctly resulting in bad scan. A page detection system may be added to sort out this issue. Also, our image to text generation system is not state of the art and active research is being conducted in this field. In future this model could become more accurate and efficient.

Conclusion

Most blind students of Bangladesh still rely on the braille to read. Many books required in the academics or other purposes do not have the braille version. Needless to say, e-books are hard to find and not available in most cases. So, students largely have to rely on their family members or friends when they need to read any printed text document in Bangla. Our project - book reader for blind people is an attempt to help them become more self-dependent which is cost friendly and designed to suit their needs.

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