



**Marmara University Faculty of Engineering
Computer Engineering Department
CSE 4097 - Engineering Project I**

**“BANA SES VER”
Analysis and Design Document**

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1.Introduction

1.1. Problem Description and Motivation

One-fifth of the estimated global total experience significant disabilities and therefore need special kind of treatment. Generally such people aren't able to accomplish their daily needs in a way which other people can do. They need "customized things" where objects were modified for easy use by some category of disabled people.

One kind of disability is blindness in which person faces various difficulties in a daily life such as problems at orientation, location, recognition or information retrieval. A research done three years ago has revealed that currently there are 39 million blind people and it is estimated that this number will grow up to 75 million at 2020 [1], that is approximately 5.2 million more people every year.

Getting information is an important task for people to be connected to surrounding events and existents. All friendships, meetings, feelings are taking communication as a base. All of these are important for ordinary people but when we talk about blind people, it is especially important. It is because blind people are deprived from visually which caters continuous delivery of information about world.

Fortunately, this problem of blind people was recognized decades ago and there are some solutions. The first solution was found during wars hold at 1800s in which Napoleon has requested Charles Barbier to develop an alphabet that can be used by French soldiers to read letters without lighting. Barbier came with a dotted alphabet where up/down combinations of six dots were representing a letter at French alphabet. The alphabet was named Braille alphabet to the honor of Charles Barbier [2]. The soldiers were not required to see the letters as feeling them by fingers was enough. This property has made the Braille alphabet one of the popular solutions to the problem of information delivery to blind people.

The 64 braille cells^[a]

decade		numeric sequence										shift right	
1st	○ ○ ○ ○ ○ ○	● ○	● ○	● ●	● ●	○ ●	● ●	● ●	● ○	○ ●	○ ●	○ ●	○ ●
2nd	○ ○ ○ ○ ● ○	● ○	● ○	● ●	● ●	○ ●	● ●	● ●	● ○	○ ●	○ ●	○ ●	○ ●
3rd	○ ○ ○ ○ ● ●	● ○	● ○	● ●	● ●	○ ●	● ●	● ●	● ○	○ ●	○ ●	○ ●	○ ●
4th	○ ○ ○ ○ ○ ●	● ○	● ○	● ●	● ●	○ ●	● ●	● ●	● ○	○ ●	○ ●	○ ●	○ ●
5th	shift down	○ ○	○ ○	○ ○	○ ○	○ ○	○ ○	○ ○	○ ○	○ ○	○ ○	○ ○	○ ○

Figure 1. The 64 Braille Cells (source: en.wikipedia.org/wiki/Braille)

Today this alphabet is used in a very wide range. You can easily find some books, magazines or other materials in book shops. Blind people can take some training classes and learn to read the text with Braille alphabet. Unfortunately there are some difficult sides of this solutions as listed below.

- Availability of books with Braille alphabet is limited because of production expenses
- Cost of such books is higher than ordinary ones as they need more production effort
- As Braille letters take more space than ordinary letters, it is hard to carry Braille versions of large books

The second most important invention was audiobooks. At the beginning audio recordings was used for purposes like information passing, communication with far distances and entertainment. Starting from 1930s various kinds of audio files has begun to be available at music shops. And from 1980s audiobooks began to attract book retailers resulting at display of audiobooks on bookshelves rather than in separate displays [3]. This was very effective way to deliver data to blind people. There wasn't any need to learn new things. All need was to listen an audio file. This solution is very comfortable but has some drawbacks too. Firstly, there must be someone to read audiobook and record the sound in a special studio, which can result in extra costs and results. Secondly, this time the person who reads the book must be obtaining some abilities to read fluently. The second also resulted in extra costs because the people who has such abilities usually don't work for free.

Lastly, with the development of technology new devices called "braille pads" were engineered. Main feature of this devices is loading books from some storage and displaying letters by "braille cells". Each cell is an electromechanical piece and consists of six or eight dots. Typically there are 20 to 50 cells in each "braille pad" enabling user to read multiple letters

at one slide of fingers. The solution is practical and effective, but there are two issues. Firstly, “braille pads” are very expensive and most cheap one starts from \$2500, which is very high for most of the blind people. Other issue is about availability of materials. Many publisher don’t publish their books in a compatible format.

The summarization of above solutions to the problem of information delivery to blind people is given in the below.

Solution	Pros	Cons
Braille Text	<ul style="list-style-type: none"> • Simple and easy solution • Usually accessible in developed countries 	<ul style="list-style-type: none"> • May have higher cost than normal material • Special training is required • Not available at every region • Have a larger size than normal material
Audiobooks	<ul style="list-style-type: none"> • Simple and time efficient solution • No special training is required 	<ul style="list-style-type: none"> • Time consuming for people who record • Additional studio costs • Expenses for fluent reading of the material
Braille Pads	<ul style="list-style-type: none"> • Portable • Can be used many times to read different materials (reusable) • Usually contains many features at once 	<ul style="list-style-type: none"> • Very expensive • Special training is required

So from above text you can easily observe how important is finding a solution to the problem of delivering information to blind people. Also the existing solutions were presented along with their drawbacks. All of that lead to thinking about new solutions by using modern technology.

The other result we obtain when analyzing “traditional” solutions is the lack of social effect. The general observations show that there are many social projects around and almost all of them don’t use any technological advances. But there are facts that a social project is a collaborative work and there are technological ways of managing crowd. Unfortunately, none of “traditional” solutions implement collaborative features.

We aim to build an online system where normal people can voluntarily help blind people to pass obstacles. Basically system will consist of two parts. First part will help people to record audio versions of books to the system. This records will be kept on control by our

system. When blind people will enter to the system, they can listen among recorded audios. There will be a rating system that will help to deliver best recording firstly. And of course to ensure scalability everything will be automated and work through the web. Secondly, we have decided to make some device similar to Braille pads. But this device will be cost efficient, work with first part of the system and connect to tablet PC. The device on itself will attach to tablet PC's backside by special cover and will receive data from it. According to received data, Braille Cells (each consist of six dots) will show appropriate letters.

1.2. Scope of the Project

1.2.1. Outcomes

1.2.1.1. Website

The main objective of the website is providing a platform for audiobook recording and listening. Volunteers can contribute by using provided interface to read books paragraph by paragraph. After each paragraph correctness check will be performed and if the correctness is below defined threshold, user will be required to re-read the paragraph.

There are three types of users and they have following functionalities:

	Disabled Person	Volunteer	Moderator
Listen	*	*	*
Read new book	-	*	*
Modify Data	-	-	*
Comment & Rate	*	*	*
See analytics	-	(partially)	*

System will provide two different ways of search to find requested data - catalog and direct search. As all content will be categorized users are expected to easily locate their content. Direct search is more advanced tool that can search by queries from users. The queries can be about other user's name, surname, username or material's name, publish date or category. To make things more comfortable there will be following options:

- Sort results by rating, date or alphabetically
- Define how many results will be displayed per page (user can select this from the list which will be defined by us)

Rating and commenting system will be another key part of our website and is used to deliver best content at first place. Users can rate other users or audio records. Rating scores will be calculated as a weighted average of all raters and a weight of a user will be his/her own rate.

$$\text{Average Rating} = \frac{\sum_{i=0}^{\# \text{ of rate giving users}} \text{userRate} * \text{userWeight}}{\sum_{i=0}^{\# \text{ of rate giving users}} \text{userWeight}}$$

Also the Web application will provide a commenting system where users can comment about the performance of the reader. Every comment will have a rate and highest three rates will be shown at the top of all comments.

And lastly there will be a User Management Panel where users can modify their information like name, surname, profile avatar, age, password and email address.

1.2.1.2. Android Application

The app will be able to perform everything that website does along with three extra features:

- Continuous Listening – Listen to audio records while Android device is locked or app is a background process
- Offline Listening – Downloaded audio records can be listened when there is no internet connection
- BraillePad Mode – Control Braille Pad based on user actions.

1.2.1.3. Attachable Braille Pad

A Braille Pad that can attach to an Android tablet and display 5 Braille characters at a time. The device will communicate with Android application over a AABP protocol (will be designed & implemented by us).

Device consists of 5 Braille cells where each cell has 6 dots, additional control buttons, a mechanical actuator for each dot, Android connectivity module, battery and SMD chips to control actuators. Our aim is to keep this device as simple as possible, making all complex operations on the Android side.

1.2.2. Relation with Previous Project

“Bana Ses Ver” was originally developed during Software Engineering course at 2016/spring term. Previous version was consisted from Web and Android application parts. The After Analysis (which was done by us) has revealed many bugs and making Attachable Braille Pad was thought as a good and practical idea.

Current project targets to fix bugs, building an Attachable Braille Pad and improving overall software architecture of the project. At the software side, new User Interface and functionalities will be developed, while keeping stability, usability and performance on mind.

1.2.3. Assumptions

- Users will have one of the followings to use our product:
 - An Android device with version 5.0 or upper with sufficient storage space to install our application.
 - A computer with Windows or Linux OS and Chrome 53.0+ Browser to use developed website
- Users will have a microphone (for audio recording) and speaker (for audio output)
- In case of users have Attachable Braille Pad they are assumed to use it with 9 inch tablet PC.
- User devices will have steady internet connection with speed of higher than 8 mbps while interacting with the system. One exception is the listening to pre downloaded audio recordings.
- All purchases made online for developing this project will arrive at 3 days (domestic) or 30 days (international) at max.
- Team’s own resources will be enough to fund the project
- Team will have unlimited access to android tablet, remote server and development machines.
- Attachable Braille Pad will not be blocked by user’s hand or any other material while tries to move.
- User will not shake, throw, boil, heat or shock the Attachable Braille Pad.
- User’s Android device will have necessary storage for proper work of Android application.

1.2.4. Constraints

1. Project budget is 1000 TL.
2. Device is supposed to work at a range starting from 5 to 45 degrees Celsius.
3. Device must work using internal power supply
4. Website content will be available only for signed users
5. Every user will have only one audio recording per content.
6. Moderators can add/delete/edit all of the data of the system.

1.3. Definitions, acronyms, and abbreviations

1. *Braille Alphabet* – A type of alphabet where characters are represented as a combination of dot bubbles and can be felt by fingers.
2. *Audiobook* – An audio record of a book read by someone.
3. *Braille Pad* – A device that can display multiple letters in the format of Braille Alphabet at the same time using electromechanical parts.
4. *Braille Cell* – A part of Braille Pad which is capable of displaying one letter. Typically consists of 6 or 8 dots.
5. *AABP Protocol* – Android to Attachable Braille Pad Protocol. Will be designed & implemented through the project in order to define a communication standard between Android application and Attachable Braille Pad.
6. *SMT* – Surface-Mount Technology. In this documents context SMT refers to electronic components used at hardware device.
7. *PDA* – Personal Digital Assistant
8. *Voiceover* – An audio recording of book reader. Similar to Audiobook but voiceover is also referred to voice data of individual paragraphs in this document's context.
9. *SSL* – Secure Sockets Layer. Used to secure communication between two network users, e.g., client and server.
10. *ER Diagram* – Entity-Relationship Diagram. Describes relationship between Database entities.
11. *GUI / UI* – Graphical User Interface / User Interface.
12. *Back-End* – Server side of the system, includes system core, business logic, database and file storage systems.
13. *Front-End* – Client side of the system. This parts runs on client machine and used for interactive responses as well as for some initial controls.

14. *DC Motor* – An electrical motor typically working at 3V to 12V range.
15. *Muscle Wire* – An SMA technology where a metal wire reverts to pre-defined shape when heated.
16. *SMA* – Shape Memory Alloy. A technology used to describe materials which can revert back to pre-defined shape when some type of action is performed (heat, shock and so on).
17. *Solenoid* – A Linear Motor that moves by applied electric current.
18. *Step Motor* – A Magnetic Motor that moves by magnetic polarity change and can control movement degree.
19. *Postgre SQL* – An SQL Database Management System.
20. *Amazon ES3* – A cloud filestorage system by Amazon.
21. *REST API* – A communication method between end systems using HTTP header messages. Each message is binded to particular event but event-actions have no dependency on each other making system stateless.

2. Literature Survey

One of previous works in this area has focused on refreshable braille display. It is called also braille terminal. It is a mechanical device for displaying braille characters. The base of a refreshable braille display is a pure braille keyboard. It can connect to computer, mobile devices or PDA via Bluetooth or USB cable. With this keyboard, blind people can read anything on computer screen with screen-readers programs. Screen readers are audio interfaces. Rather than displaying web content visually for users in a "window" or screen on the monitor, screen readers convert text into synthesized speech so that users can listen to the content [4]. Usually, 40 braille cells are displayed.



Figure 2 Refreshable Braille Display (source: en.wikipedia.org/wiki/Refreshable_braille_display)

Another one of related works is rotating-wheel braille display. It was developed in 2000 by the National Institute of Standards and Technology [5]. It is developed because braille displays use a lot of actuators and these actuators are expensive. Purpose of this displays, reduce cost of materials but they could not achieve to manufacture this product. Because it was heavy and it was still expensive.

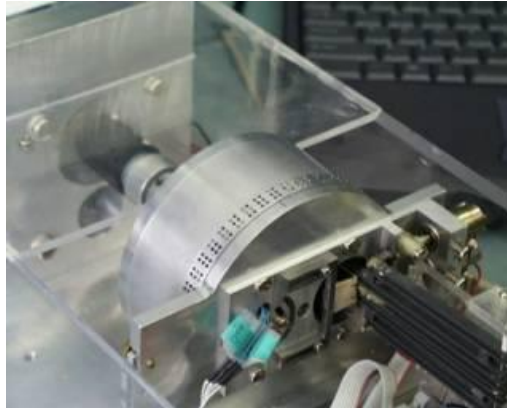


Figure 3 Rotating-wheel Braille Display (source: zatang.blogspot.com, Articles 18/08/2004, Rotating-Wheel Based Refreshable Braille Display)

Last related work with our project is full braille computer monitors. It has been patented but not yet produced [6].

The most related work with our project is braille display. It is also making easier to read books. It can connect also with computers, and mobile devices. The displays provide either six dots or eight dots per cell (originally Braille was always six dots per cell, but in some cases, particularly computer displays, eight dots are used). A common characteristic of the commercially available displays is that every dot of every cell is individually controlled by an actuator (solenoid actuators have been used, but piezoelectric actuators are now common), so, for example, an 80-cell, 8-dot display requires 640 actuators, plus the associated drive electronics for the actuators. The number of actuators is the primary cost factor in Braille displays. This cost changes between \$1000 - \$5000[7]. According to this information, cost of each individual pin(dot) is approximately \$4. In spite of this, we will reduce the cost of manufacturing our product because in our project we will not use piezoelectric actuators. Also, refresh rate of braille display is too slow. It means when braille display shows sentence and when it changes to the next sentence, this elapsed time is too long. But in our product, we will solve also this problem because this problem is about piezoelectric actuators.

Related Works	Advantages	Disadvantages
Refreshable Braille Display	<ul style="list-style-type: none"> • Simple, durable and usable solution 	<ul style="list-style-type: none"> • Very expensive • Slow refresh rate
Rotating-wheel Braille Display	<ul style="list-style-type: none"> • Developed by National Institute of Standards and Technology • Reduction of material expenses 	<ul style="list-style-type: none"> • Very heavy • Can't start manufacturing phase • Expensive
Full Braille Computer Monitors	<ul style="list-style-type: none"> • Patented 	<ul style="list-style-type: none"> • Not produced

We will design our product like tablet cases. Any people, user does not have to be blind person, can use this case with their tablets. With this case, they can read any book at anywhere because of portability. Also, braille display does not provide to communicate with other blind people but our product will provide to communicate other people.

3. Project Requirements

3.1. Functional Requirements

i. The system must have a registration service.

Users can be registered as:

- Volunteer User
- Regular User

ii. The system provides 3 types of users:

- Regular Users
- Volunteers
- Admins

- iii. The system must provide a login system. Users can log in the system by using:
 - Local login system
 - Social Media Platforms:
 - Facebook
 - Twitter
 - Google+

- iv. The system must provide a password recovery service.

- v. Each type of user shall be able to:
 - List all books and and voice actors.
 - List volunteers of a particular item.
 - View the profiles of other users.
 - Comminucate with other users.
 - List all voiceovers by any user.
 - Listen all the books.
 - Post a book ad.

- vi. Regular users shall be able to:
 - Give a star rating to a voiceover.

- vii. Volunteers shall be able to:
 - Voiceover any books in the system

- viii. System admins shall be able to:
 - Add/remove/update books and voiceovers
 - Modify profiles of any users (expect another admin)
 - Give permission to a user
 - Ban a user

3.2. Nonfunctional Requirements

3.2.1. Security Requirements

- The system must provide an authorization system.
- The system must have a firewall for hazardous attacks.
- Passwords must be encrypted with well-known algorithms.
- Connection must be encrypted with SSL.

3.2.2. Usability Requirements

- The interface of the system must be responsive.
- All the content in the system must be designed for the readability of blind people.
- Each page must be designed to supply best interaction with the user without having any unnecessary and useless content

3.2.3. Performance Requirements

- The system must have a 15 minutes connection timeout for inactivity.
- System's downtime must not exceed 10 minutes per day
- Response time must not exceed 2 minutes for any action in the system
- System must take daily backups at midnights.

3.2.4. Ethical Requirements

- All the texts in the system must be checked by an algorithm for slangy words.

4. System Design

4.1. UML Use Case Diagrams

Following diagrams show which operations are accessible to each user during main use cases.

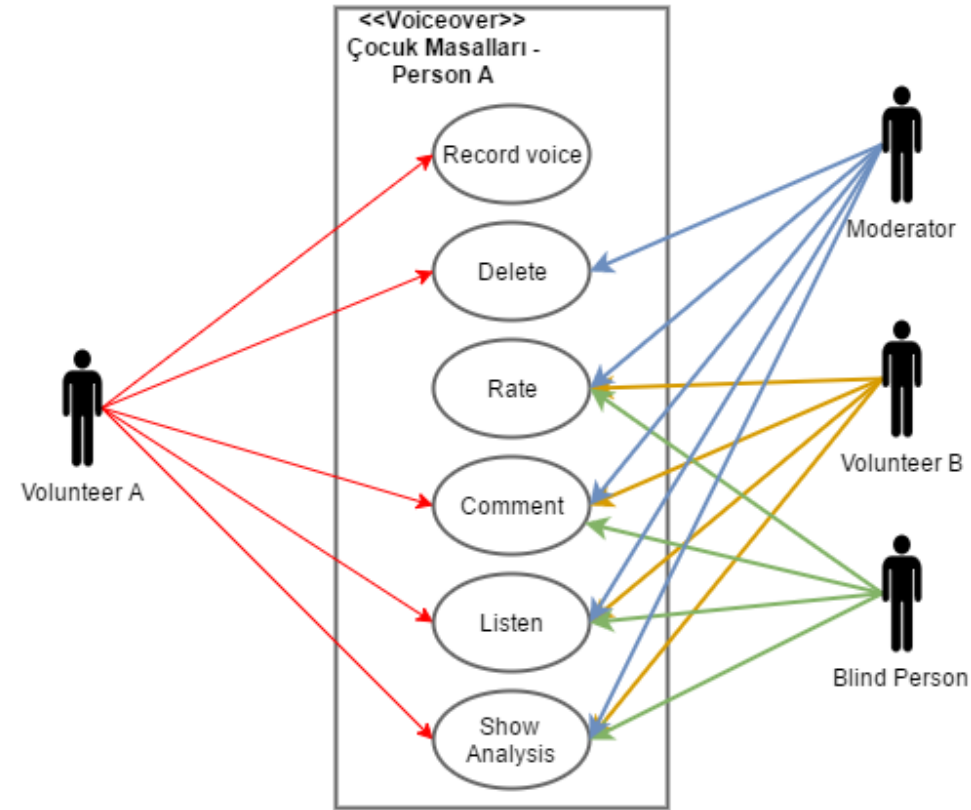


Figure 4 UML Case Diagram - Voiceover

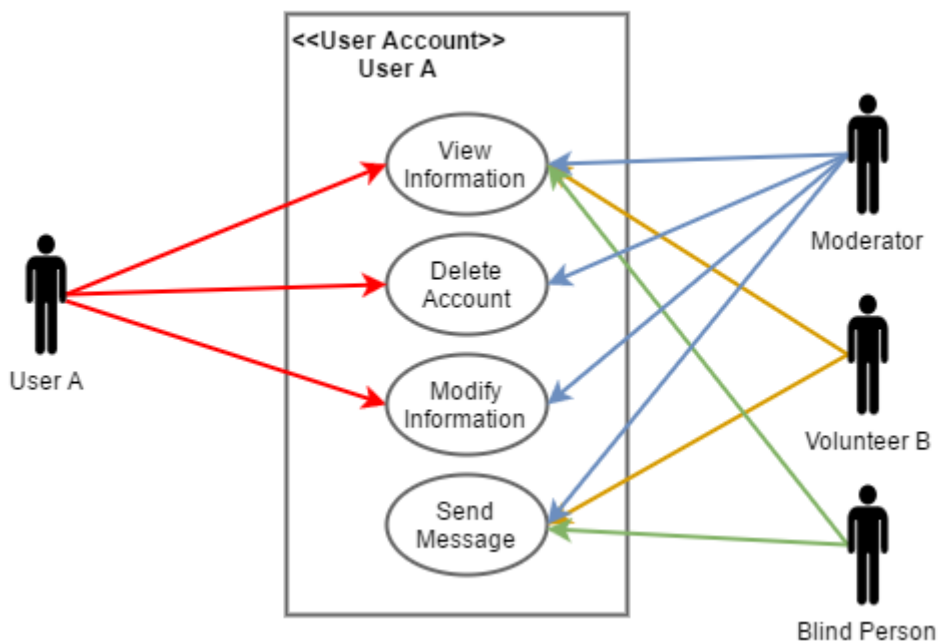


Figure 5 UML Case Diagram - User Account

4.2. UML Class and Database ER diagrams

In this section, information about the database entity relationship (ER) diagrams will be briefly given which used in this project. An ER diagram illustrates the relationships between entities in a database.

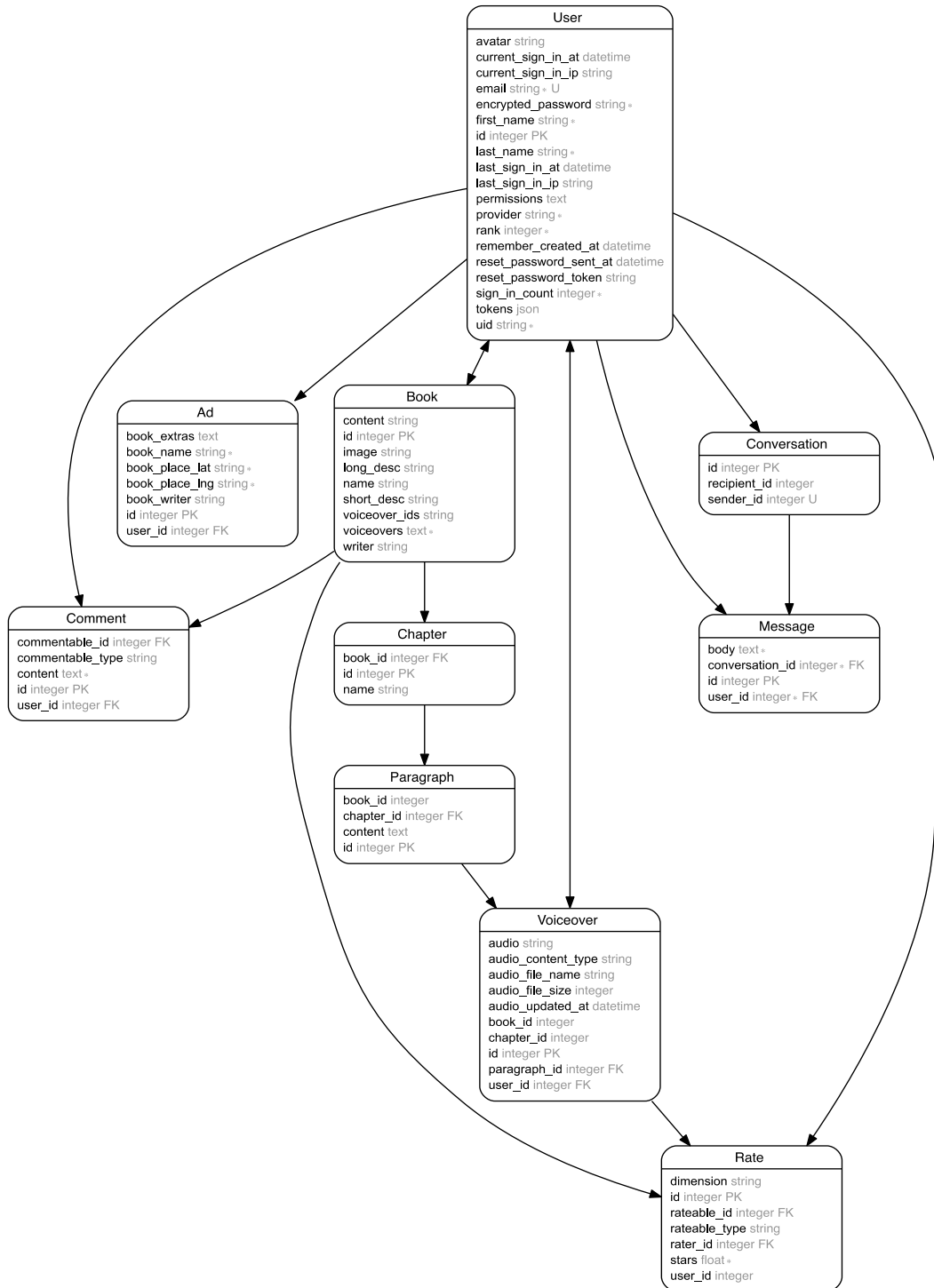


Figure 6 Database ER Diagram

Figure 6 depicts Database ER Diagram. In this diagram every entity represents a model. These models are:

- User
 - User has an id(unique), avatar, email, encrypted password, first name, last name, rank, and other attributes (See Figure 3).
 - User may have many comments, ads, conversations, messages, rates, and voiceovers.
 - User can be Volunteer User or Regular User by rank number

- Book
 - Book has an id(unique), name, content, image, writer, short description, long description, and voiceovers.
 - Book may have chapters, comments, rates.

- Chapter
 - Chapter has an id(unique) and name.
 - Chapter belongs to Book.
 - Each chapter may have paragraphs.

- Paragraph
 - Each paragraph has an id(unique) and content.
 - Paragraph belongs to Chapter.
 - Paragraph may have voiceovers.

- Voiceover
 - Voiceover has an id(unique), audio, and other attributes (See Figure 3).
 - Voiceover belongs to Paragraph and User.
 - Each voiceover may have rates.

- Rate
 - Each rate has an id(unique), stars, and other attributes (See Figure 3).
 - Rate belongs to User and Book.

- Conversation
 - Each conversation has an id(unique), and other attributes (See Figure 3).
 - Conversation belongs to User.

- Message
 - Message has an id(unique) and body.
 - Message belongs to Conversation and User.

- Comment
 - Comment has an id(unique), content, and other attributes (See Figure 3).
 - Comment belongs to User and Book.

- Ad
 - Each ad has an id(unique), book name, book writer, and other attributes (See Figure 3).
 - Ad belongs to User.

4.3. User Interface

The user interface consists of a set of pages through which the user can interact with data on the project's website. These pages include “Main Page”, “Sign Up Page”, “Sign In Page”, “Books Page”, “Detailed Book Page”, “New Ad Page”, “Ads Page”, and “Settings Page”. The user will interact with the pages through the web browser. Each page will consist of various GUI components, such as buttons, labels, text fields, audio player, and some animations. These components will be arranged in such a way that the user will be able to quickly grasp the purpose of each page and perform whatever task it is designed for efficiently. A detailed description of these pages and their interactions with each other will be described and illustrated in following pages.

When users enter the project’s website for the first time, users can view following pages:

- Main Page
- Sign Up Page
- Sign In Page

But on the other hand, when users have already logged into project’s website, they can view following pages:

- Books Page
- Detailed Book Page
- New Ad Page
- Ads Page
- Settings Page

- **Main Page**

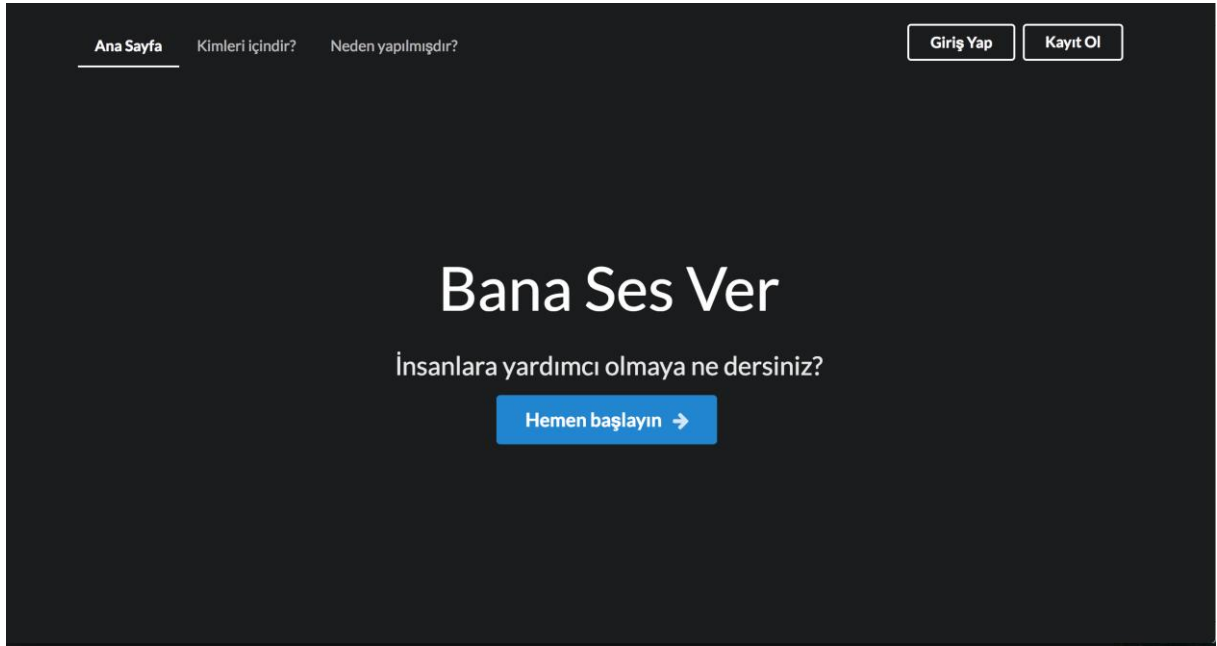


Figure 7 User interface of Main Page

When users entered the project’s website for the first time, they encounter with above page. With this page, they can answer the following questions “What is this project?”, “This was made for whom?”, and “Why was it made?”. And also it provides to users for accessing these pages: “Sign In Page” and “Sign Up Page”.

- **Sign Up Page**

Figure 8 User interface of Sign Up Page

If users don’t have account for accessing to project’s website, this page provides them to create an account. Users can sign up with their first name, last name, email address, and password. Also there is a dropdown menu in here, it offers to users two different types of

membership. One of them is Volunteer User type, it provides to record voiceover to the user for books. Another one is Regular User type, it provides to listen these voiceovers to the user.

- **Sign In Page**

Kullanıcı giriş sistemi

Şifremi unuttum

Figure 9 User interface of Sign In Page

When users want to access the other pages, they have to log in to the system. They can log in with their email address and password. Also, if they have accounts on one of these social platforms (Facebook, Twitter, or Google Plus), they can log in to the system.

- **Books Page**

Ana Sayfa Katalog En çok okunanlar İlan ver İlan ara İletişim admin admin

Arama yap

Kategori: Seç

Anahtar kelimeler: Ara...

Turkce Masallar
Mayıs 2015
Turkce Masallar
Daha fazla →

Oğuz Atay
Tutunamayanlar
Mayıs 2015
"Tutunamayanlar", Türk edebiyatının en önemli eserlerinden biridir.
Daha fazla →

Kürk Mantolu Madonna
Mayıs 2015
Sabahattin Ali, bu kitabında güçlü bir tutkunun resmini çiziyor.
Daha fazla →

Harry Potter
Mayıs 2015
Sekizinci Hikâye. On Dokuz Yıl Sonra...
Daha fazla →

07
OLASILIKSIZ 12
EMPATİ FİRE ZORLUK
ADAM FAWER
Daha fazla →

Figure 10 User interface of Books Page

A user who has successfully logged in to the system, like the above Figure 7, he or she can search books, view books, access to the settings page, post ads and search them, and so on. Volunteer users can record voices for books. Also, if Regular User wants to listen a book, he or she can view voiceovers who record voices for chosen book. In addition, Regular User can rate these voiceovers and with this Regular User can see which user's record better than others. Following figure demonstrates this information.

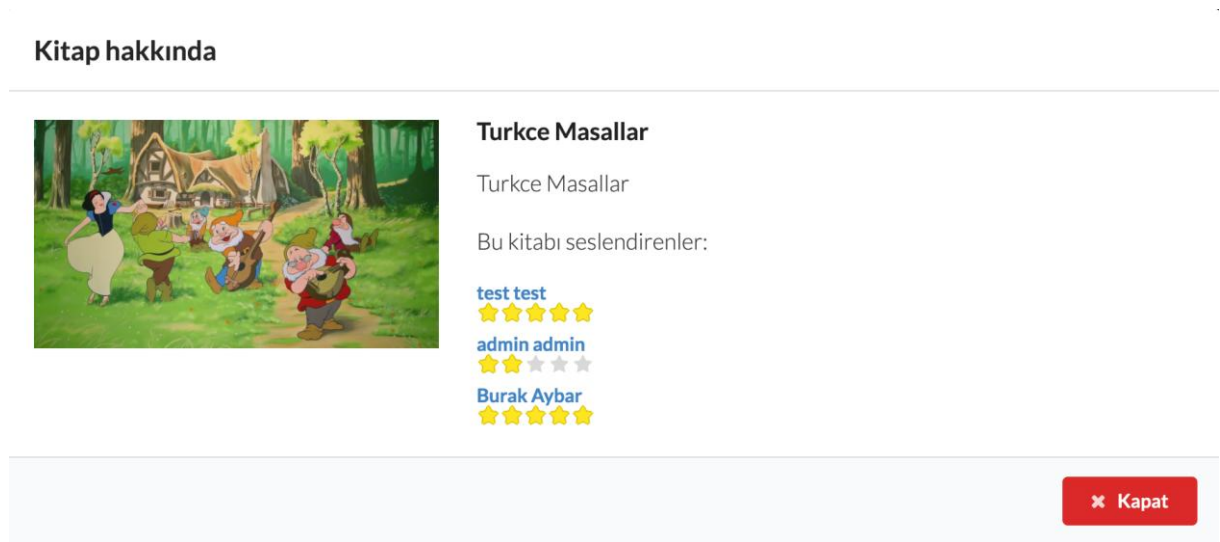


Figure 11. User interface of List of Voiceovers Page

• Detailed Book Page



Figure 12. User interface of Detailed Book Page

As you can see in the Figure 9 above, the Regular User can view and listen to the chapters after selecting the user who records voices for chosen book. Also, this user can download these records.

- **New Ad Page**

Ana Sayfa Katalog En çok okunanlar İlan ver İlan ara İletişim admin admin

Kitap ilanı ver

Kitap ismi

Kitap yazarının ismi

Ek bilgiler

Harita Uydu

Figure 13. User interface of New Ad Page

With this page, all users in the system can post ad with book's name, writer's name, and users can choose location on the map where they want to give.

- **Ads Page**

Ana Sayfa Katalog En çok okunanlar İlan ver İlan ara İletişim admin admin

OZ
Adam Fawer
Yeniden keşfetmeye hazırlan: OZ'u ya da kendini!
Hemen mesaj gönder

Harita Uydu

Figure 14. User interface of Ads Page

Users can see posted ads in the system, and they can send a message to ads owners with this page.

- **Settings Page**



The screenshot shows a user profile settings page titled "Kullanıcı sistemi". It features two input fields for the name "admin", an email field with "admin@admin.com", a gender dropdown menu set to "Erkek", and a user type dropdown menu set to "Normal Kullanıcı". A teal button at the bottom is labeled "Değişiklikleri kaydet".

Figure 15. User interface of Settings Page

On this page, they can edit their profile information and also they can change their user type membership.

4.4. Test Plan

This section describes the procedure and expectations for testing this project. The objective of this test plan is to ensure a high level of confidence in the correctness and usefulness of the project deliverables. Testing will be performed at several points in the life cycle as the product is constructed. Testing is a very 'dependent' activity. As a result, test planning is a continuing activity performed throughout the system development life cycle. Test plans must be developed for each level of product testing.

The interfaces between the following subsystems will be tested:

1. Website
2. Android Application
3. Attachable Braille Pad

Some test scenarios for these subsystems are presented in the following pages.

- Website

Test Case #1

Test Case Name:	Sign Up
Requirement:	System shall allow user to sign up through the Sign Up Page
Procedure:	Fill out the necessary information on the Sign Up Page
Expected Results:	System accepts the user for registering

Test Case #2

Test Case Name:	Sign In with Correct Information
Requirement:	System shall allow user to sign in through the Sign In Page
Procedure:	Fill the input fields on Sign In Page with correct information
Expected Results:	System accepts the user

Test Case #3

Test Case Name:	Sign In with Wrong Information
Requirement:	System shall allow user to sign in through the Sign In Page.
Procedure:	Fill the input fields on Sign In Page with wrong information
Expected Results:	System shouldn't accept this user to enter the system and give an error to the user

Test Case #4

Test Case Name:	Change Password
Requirement:	System shall allow user to change password through the Settings Page
Procedure:	After logging in to the system, go to the Settings Page, and change password
Expected Results:	System accepts the password change

Test Case #5

Test Case Name:	Search Books
Requirement:	System shall allow user to search books through Home Page
Procedure:	After logging in to the system, fill the search input field with book's name and search it
Expected Results:	System should show results of books with exact same book name with user's entered

- [Android Application](#)

Test Case #1

Test Case Name:	Listen Book
Requirement:	System shall allow user to listen books through Book Screen
Procedure:	After logging in to the system, select random book, and listen with random user's voiceover
Expected Results:	System should play records with chosen user's voiceover

Test Case #2

Test Case Name:	Record Voice with Regular User Account
Requirement:	System shall allow user to record voice for books through Record Screen
Procedure:	After logging in to the system with Regular User account, select random book, and record voice
Expected Results:	System should not display record page to the this user

Test Case #3

Test Case Name:	Internet Connection
Requirement:	System needs steady internet connection
Procedure:	After opening the android application, turn off internet and try to sign in or sign up to the system
Expected Results:	System should display an error message about Internet connection

- **Attachable Braille Pad**

Test Case #1

Test Case Name:	Connection between Tablet and Braille Pad
Requirement:	Connection is broken between tablet and braille pad
Procedure:	After logging in to the system, turn off the connection or remove braille pad from tablet
Expected Results:	Braille pad should turn off by self and if dots are already at the outside, it should pull them back

Test Case #2

Test Case Name:	Battery of Braille Pad
Requirement:	The battery of braille pad is low
Procedure:	After logging in to the system, battery of pad is getting reduce
Expected Results:	Braille pad should send a low juice message to the android application

Test Case #3

Test Case Name:	Turned Around
Requirement:	Braille Pad turned around
Procedure:	Hold the braille pad and turn around
Expected Results:	Braille pad's dots should not fell down

5. Software Architecture

5.1. Data Flow

There are number of Database tables in the system and each of them is associated with particular subset of functions. Almost all functions require some kind of Database manipulation but function availability depends on user type. Most of them are available to all users where recording voiceovers is only available if user is a “Volunteer” or “Moderator”. The complete Data Flow Diagram can be seen below. Note that, this diagram based on “Users and the System” as it doesn’t depend if the user uses the system through the Web or Android applications.

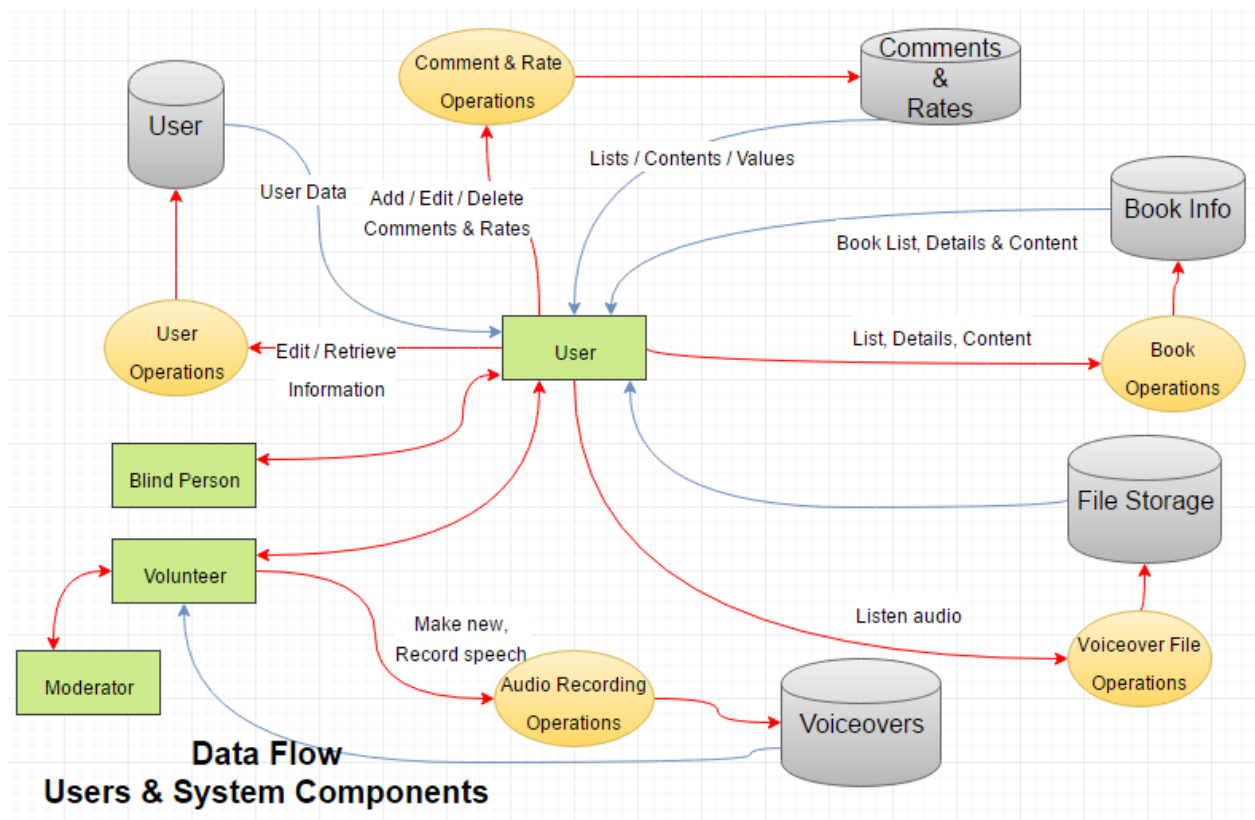


Figure 16. Data Flow

5.2. Control Flow

Each User Interface page has a particular scenario where control sequence starts with some kind of user interaction and then continues at the system part. The system is actually consists of three parts – Front-End, Back-End and File Storage / Database. The third part always modified by Back-End system and sent as a response to Front-End part. The diagrams describing different scenarios are given below. Each diagram depicts involved parts of the system, controls & actions done to accomplish the task.

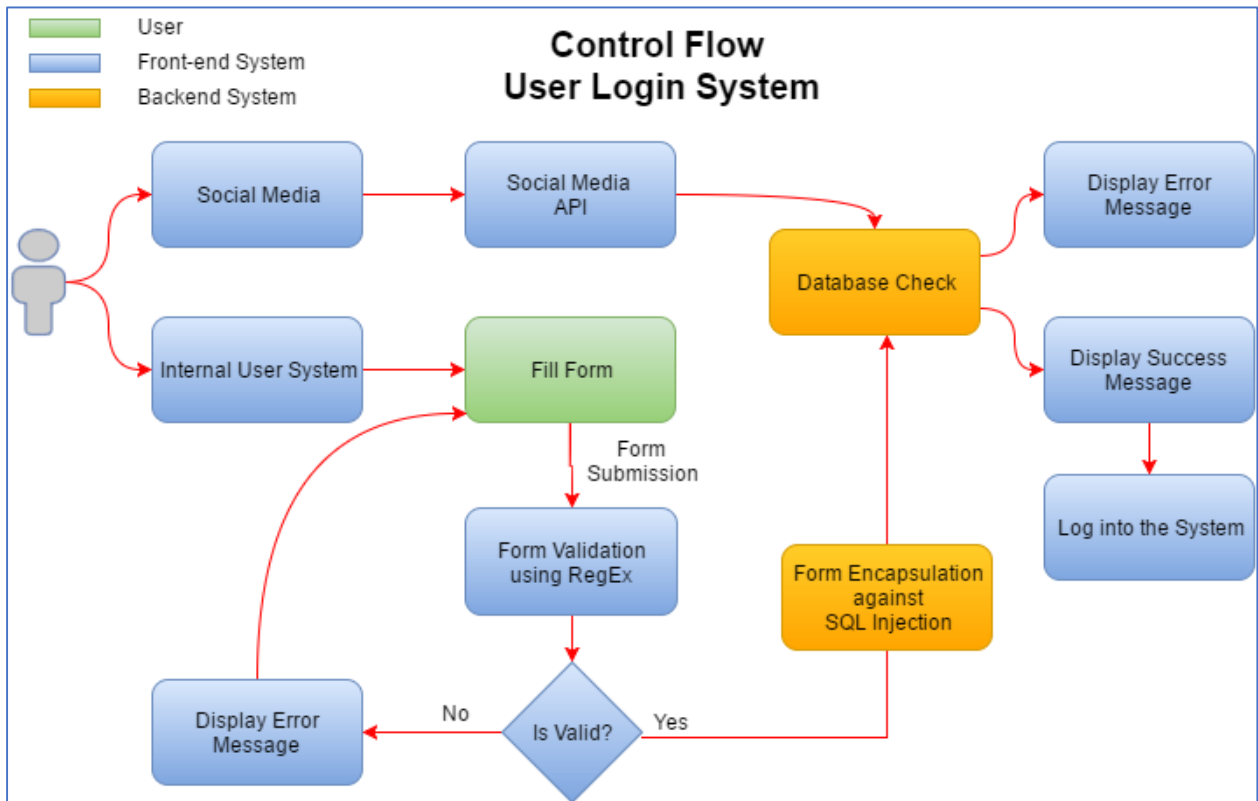


Figure 17. Control Flow – User Login System

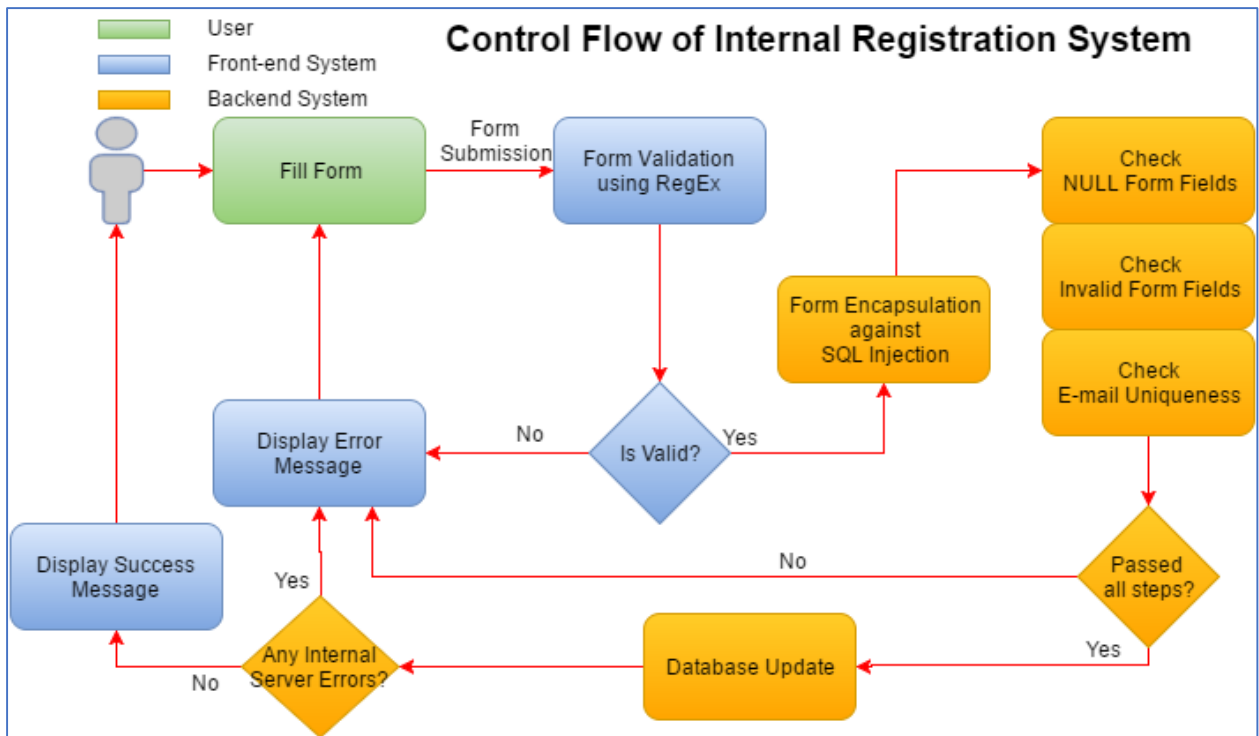


Figure 18. Control Flow of Internal Registration system

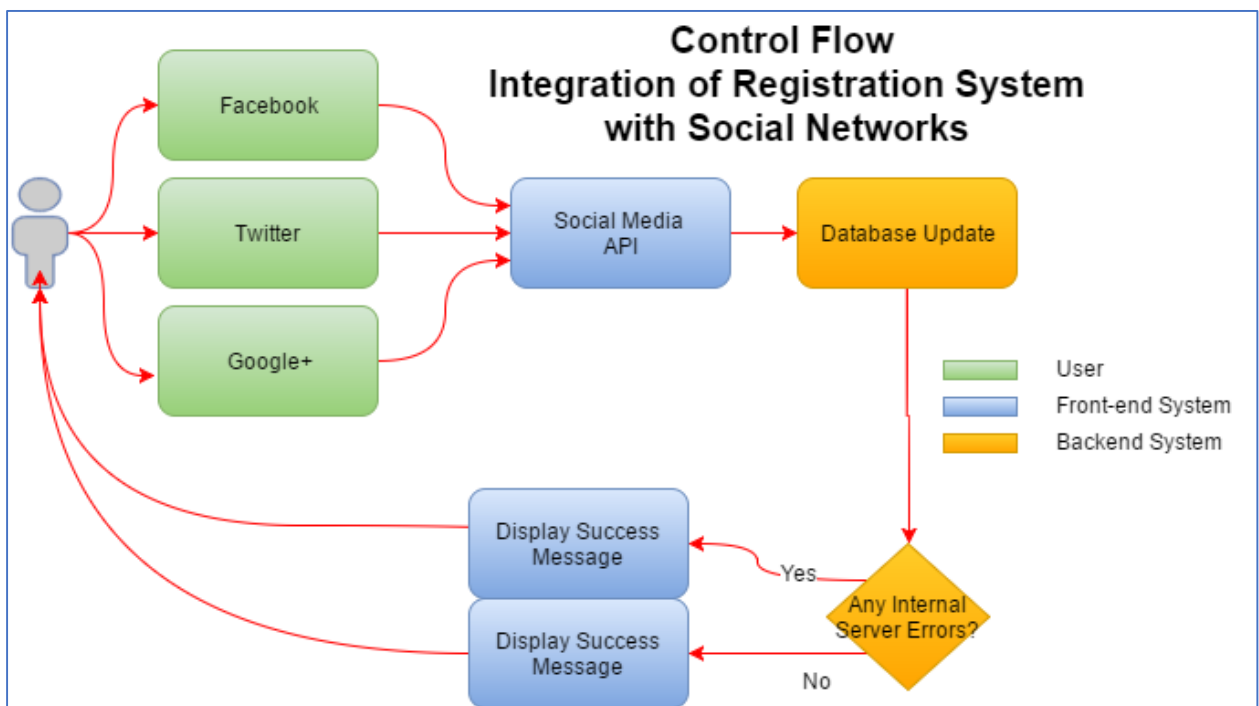


Figure 19. Control Flow of Social Networks

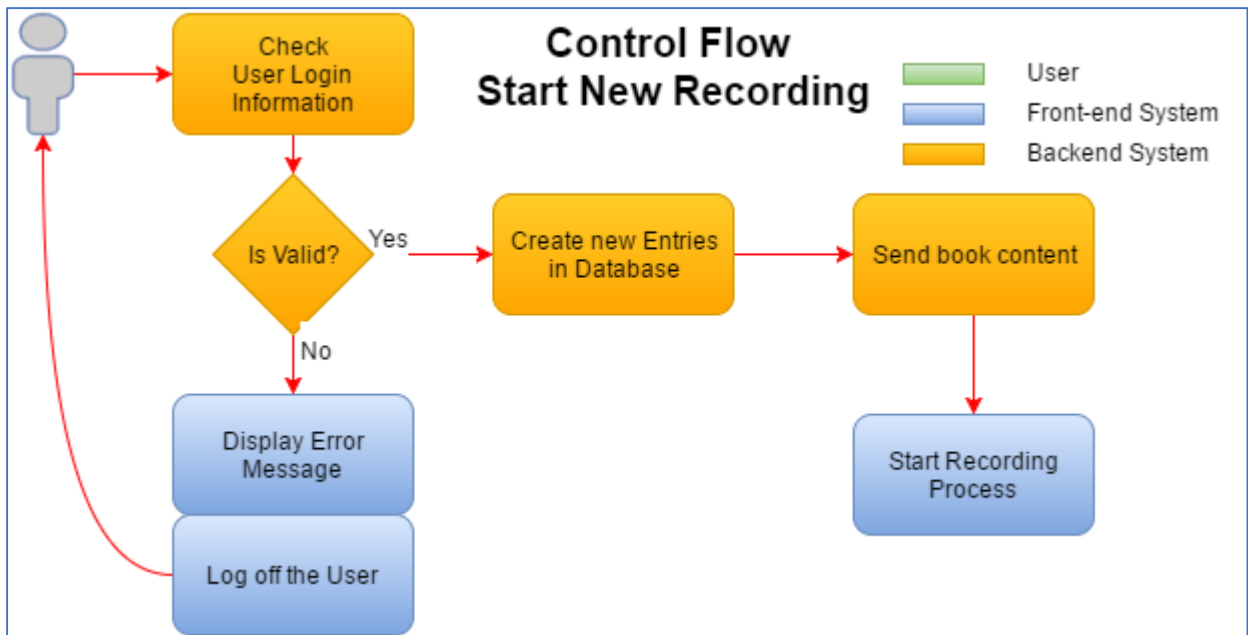


Figure 20. Control Flow Start New Recording

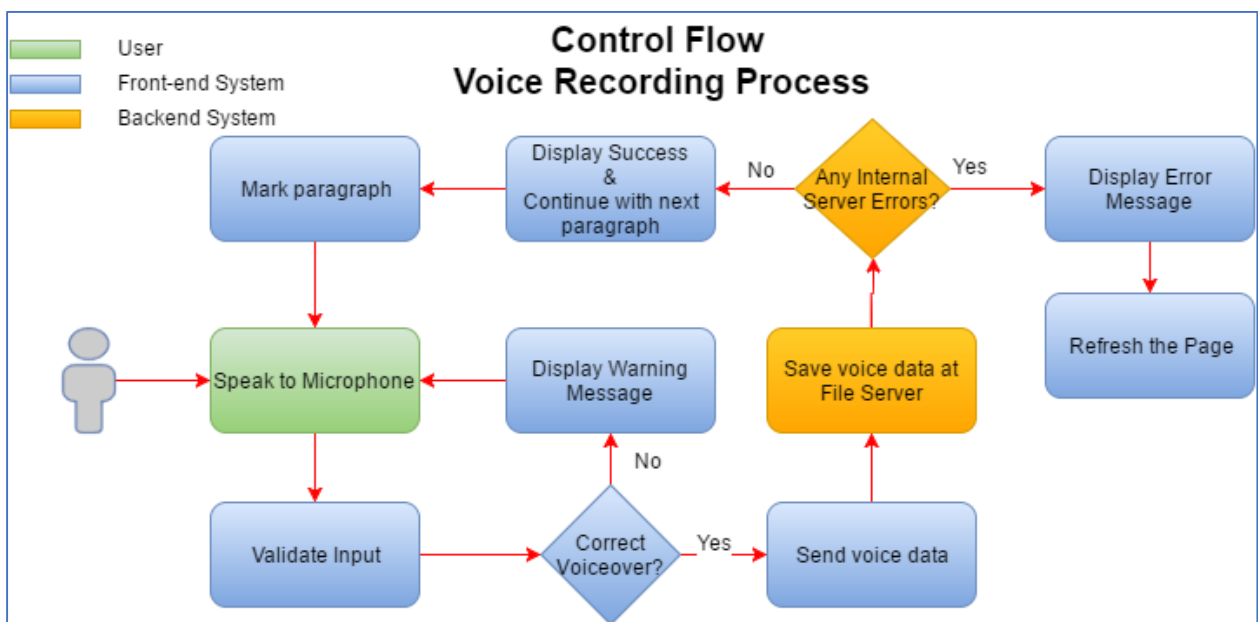


Figure 21. Control Flow Voice Recording Process

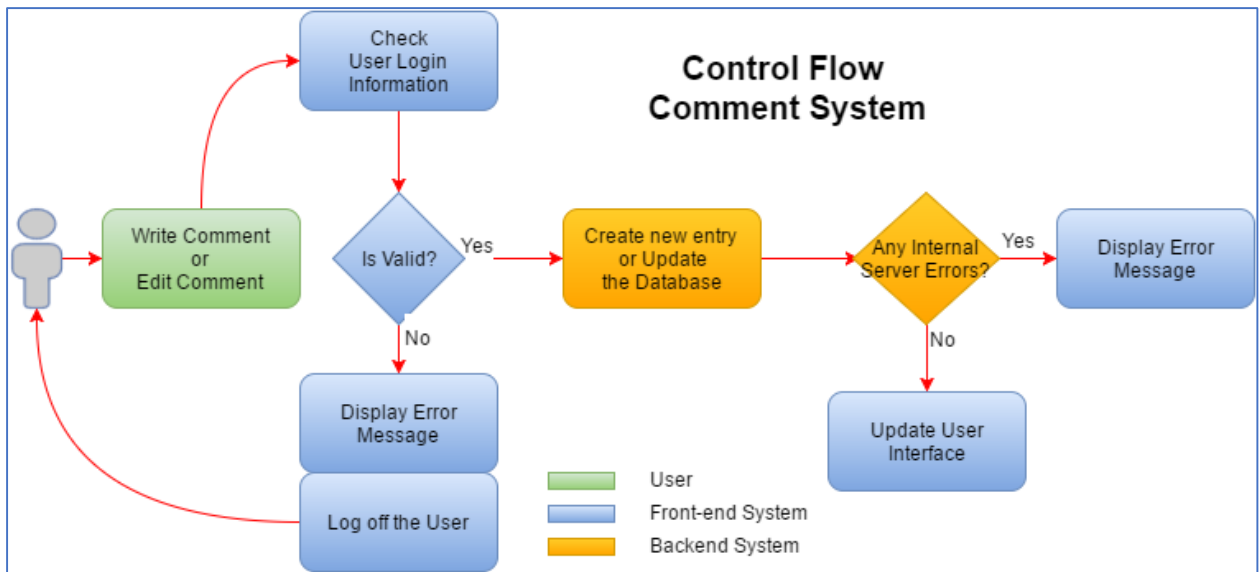


Figure 22. Control Flow Comment System

5.3. Modular Design

The whole system consists of 4 parts:

- UI / Front-End – The part where users interact with system and basic/initial controls of interactions are done. Each User Interface page has a separate controller (whenever it is Web or Mobile application)
- Back-End – All business logic, final controls, database and file system manipulations, API implementations are going here.
- Braille Pad – Receiving encoded characters and displaying them in Braille Alphabet.

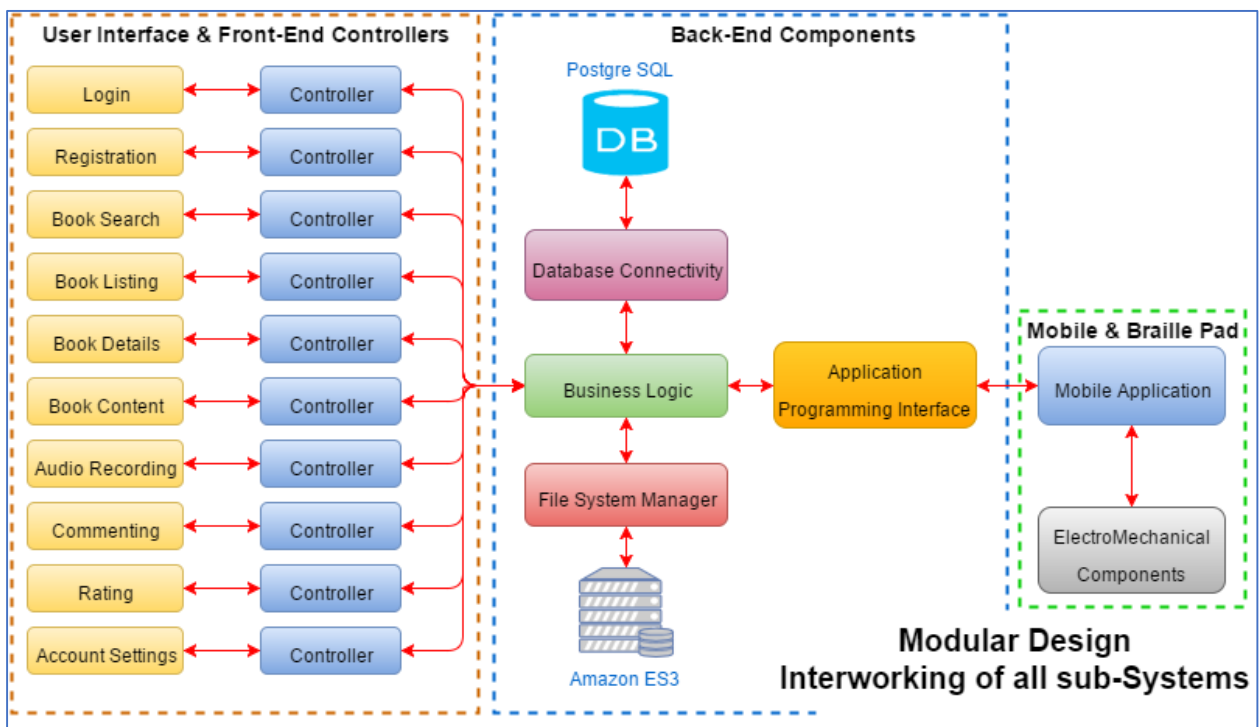


Figure 23. Modular Design

5.4. Hardware – Software Interaction

Attachable Braille Pad is manipulated through the Android Application. Following diagram shows how Data Flow is distributed at the device and how different Electronic and Mechanic parts assemble to make a Braille Pad.

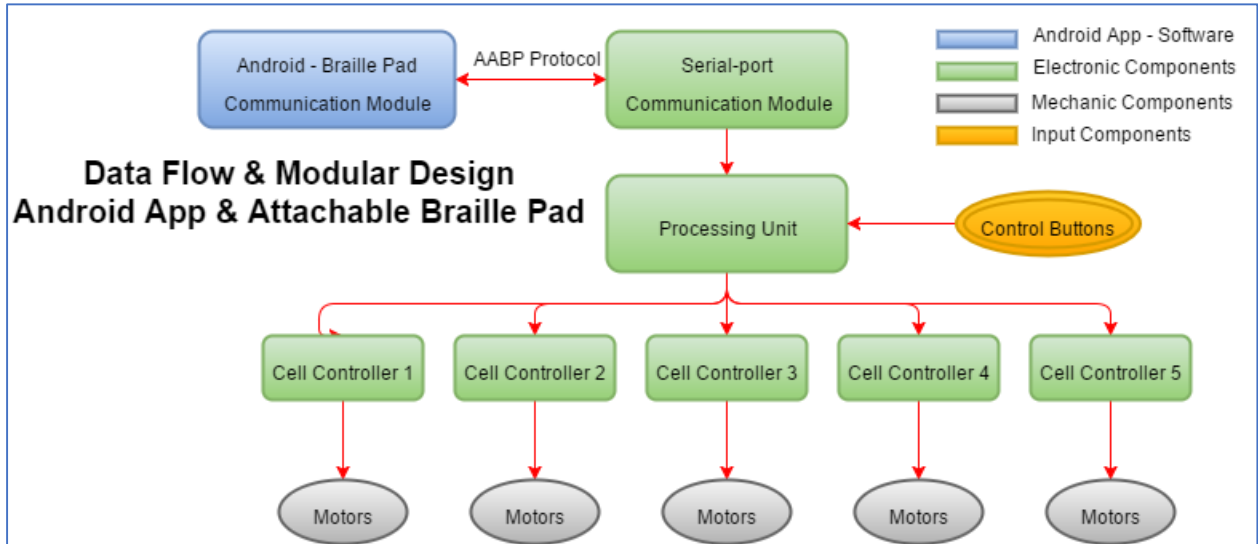


Figure 24. Hardware – Software Interaction

6.Tasks Accomplished

6.1. Current state of the project

The final project based on DC motor system combined with connectors and extension wires. These combination can supply enough power for actuating Braille output. Benefits of this system are:

- Simple
- Creates less temperatures
- Easy to operate
- Maintainable.

The final view of the product is shown in figures:

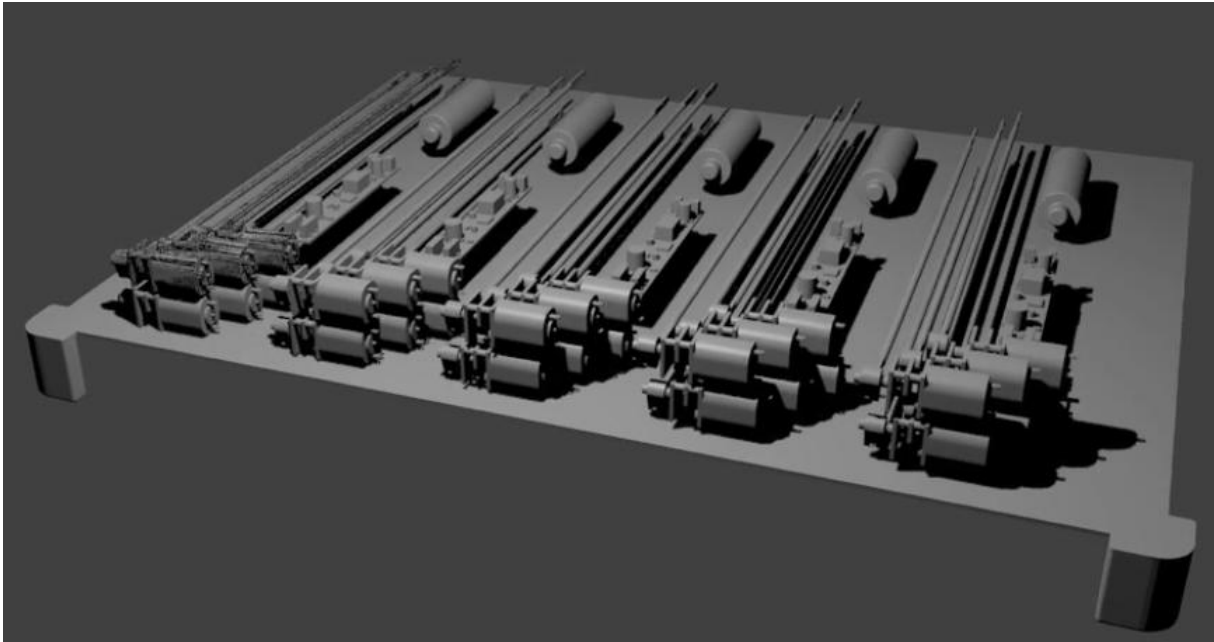


Figure 25. Back Side Of The Hardware

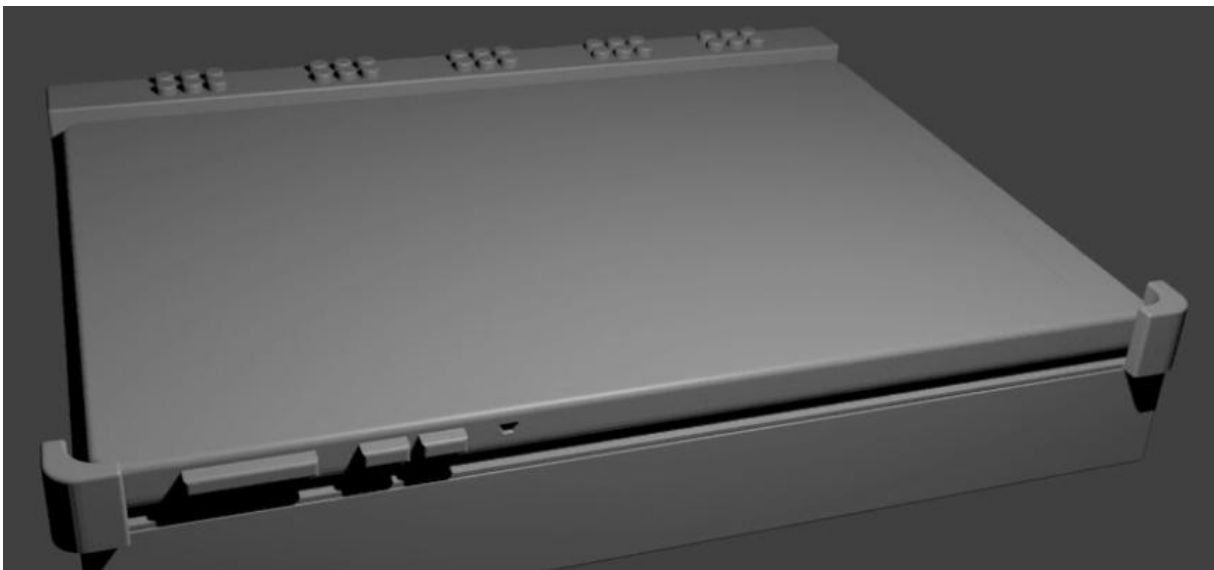


Figure 26. Front Side Of The Hardware

6.2. Task Log

- Preparation for Hardware Design

24.09.2016 – 4Hours

Research for creating hardware solutions to problem. 4 different solutions found for creating actuating system. They are step motors, muscle wire, selenoids and DC motors.

- Building Hardware Step 1 - Step Motors

1.10.2016-15.10.2016 – 12 Hours Total

Creating an actuating system using step motors. Created an electronic motor driver for driving step motors with a microcontroller. Step motors can not supply enough power for actuating. They are also requires more space to fit them into a case.

- Building Hardware Step 2 – Muscle Wire

17.10.2016-30.10.2016 – 8 Hours Total

Researching for the one dimensional movement using muscle wire. Muscle wire is a type of shaped memory alloys. It stores its shape when you heat it up around 400 degrees celcius. After that when an electricity applied to muscle wire it tries to get its older shape you constructed before. Disadvantage of the system is efficiency. Electricity also creates heat and muscle wire can not get its older shape exactly.

- Building Hardware Step 3 – Selenoids

2.11.2016-12.11.2016 – 13 Hours Total

Magnetic force used to build an actuating system. We bought isolated wires and created selenoids with these wires. Selenoids can actuate bits in Braille output. The problem is selenoids requires continuous electricity to actuate and this continuous electricity creates high temperatures.

- Building Hardware Step 4 – DC Motors

16.11.2016-01.01.2017 – 20 Hours Total

An actuating system combined over DC(Direct Current) Motors. DC motors can supply enogh power for actuating Braille output. DC motors creates a rotational movement. We have

designed an 3D model and printed them using 3D Printer. These connectors converts rotational movements to vertical movements. We are also designed a spring system by using extension wires and combined these two system together.

- Preparation for Software Design

10.01.2017 – 3 Hours

Future plan made for software part of the project. Database tables created. Frontend views designed. Details of the system components have specified.

6.3. Task Plan with Milestones

	January	February	March	April	May
Hardware Development & 3D Printing					
Architecture Design & Backend Services					
Mobile Application Development					
Web Service Implementation & Front-End Development					
Data Collection & Testing					
Project Thesis & Presentations					

- Hardware Development & 3D Printing
Creating first preview of the hardware. Process of building 3D printed parts, battery management system, electronic boards for motor controller, mechanical connectors and interface between mobile phone and our device.
- Architecture Design & Backend Services
All the systems for storage of any item in the system will be defined. Database system and interfaces between system components will be constructed.
- Mobile Application Development
A mobile application for using system services and also connecting to our hardware will be constructed. Our mobile application will only runs on Android Operating System.

- Web Service Implementation & Front-End Development
We will create a REST API for getting data from the server. We will also create responsive and usefull designs for each page in the system.
- Data Collection & Testing
The process of collecting data from users and testing these data on the live system. We will collect voiceovers from volunteers.
- Project Thesis & Presentations
Time for preparing project thesis and project presentations.

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