Text to Braille Conversion System

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DECLARATION

We hereby declare that the project work entitled Text to Braille Conversion System is an authentic record of our own work carried out as requirement of Product Design Lab for the award of degree of B.Tech Electronics & Telecommunication Engineering, Symbiosis Institute of Technology, Pune, under the guidance of Dr. Priti Shahane, during Jan–June 2021.

The material borrowed from other source and incorporated in the report has been duly acknowledged and/or referenced.

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ABSTRACT

Braille is a vital means of communication that is a system of touch reading and writing for blind persons in which raised dots represent the letters of the alphabet. It is a combination of six impressions that each represent a type of alphabet and it also contains equivalents for punctuation marks. Braille is typically read by using the sense of touch, by moving the hand from left to right along each of the lines. Braille is an extremely important tool for blind people to become literate and it is a critical component that supports educational advancement and increases employment prospects. It is just like sign language, it is universally accepted but mostly, only the visually impaired people learn braille, unlike sign language which at least the family members of the deaf or hard of hearing individuals learn to be able to communicate with them. The blind should be taught braille to be able to become literate, which is a necessity in today's world. Braille is a much harder language than sign as there are a lot of combinations of the impressions of the six raised dots that are not easy to memorize. Text to braille Conversion system acts as a means of communication between those who do not know braille and the blind who do understand how to read braille. One would no longer require knowing braille himself to be able to communicate with someone who is visually impaired. He could just simply type in normal text and those texts would get translated to Braille characters in real time.

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CHAPTER I: INTRODUCTION

1.1 Motivation

The World Health Organization(WHO) did a survey in 2020 the results of which were that about 76 million people out of the 7.8 billion in the world are visually impaired. Being blind in an environment designed for the sighted means it is expected that a lot of typical mishaps happen. Dealing with sight loss is already a challenge, on top of that, the societal stigma attached to the blind and the lack of employment opportunities make life even more difficult, these are all factors frequently leading blind or low vision individuals in isolation. This stigma makes it difficult to adapt, leading to a loss of social and self-acceptance. The society has a big role to play in the betterment of the lives of the disabled, blind, or not. Besides treating them as equals and not considering them any less there is also a need to minimize the communication gap that lies in between. The Text to Braille Conversion system that is discussed in this report is one such attempt at inclusivity. This project aims at bridging the communication gap that prevents the society from being at ease with the blind.

1.2 Need for this product

Braille is a tactile system that has 6 embossed or raised dots in the form of two columns and three rows. Combinations of these 6 impressions are used to represent various letters of the alphabet and a few of these combinations are also reserved for special characters. This system is used by the blind people to learn to read and write and become literate in this fast-paced world. It is well proven that reading and writing skills are extremely necessary as they help us in obtaining access to information which in turn contributes to comprehension and awareness. And awareness is power since it gives one the ability to achieve, function in your family, excel in your community, succeed at work, and contribute to society. Braille is a key factor that promotes educational development and improves job opportunities for blind people who are learning to read and write. It is similar to sign language in the sense that it is universally recognized, but it is observed that in a family where there is one blind person, only the visually impaired studies braille, while in the case of sign language, it is taught to the other family members of the deaf or hard of hearing people as well. When this happens, it essentially indicates that the other family members do not speak the language

of the one member who is blind which is a very evident example where the blind is made to feel different from others or not included in the “normal”.

Text to Braille Conversion system is a well-designed and thought-out mechanism for those who wish to communicate with the blind. An individual does not need to know braille to be able to do so as this product acts like a translator. The Text to Braille conversion system is a product that takes in letters of the words that need to be said to a blind person and converts them into braille language first before creating impressions on a flat surface at the top of the product.

1.3 Comparison with the existing product

A lot of Braille teaching products exist in the market that are used in special schools to teach children to read but no such product exists that can translate normal text to braille. No such product, translator or conversion system exists in the market that can essentially translate text into braille language. This could be because of the stigma attached to the blind in a world made for sighted people. A similar product was developed by students at Massachusetts Institute of Technology in 2017, the students received $10,000 Lemelson-MIT cash prize that year for their Text to Braille converter, which they were supposed to spend to refine and improve the device and release it into the market. Although the product has not been made available for sale in the market.

The most advanced version of this converter has a camera scanner that scans the sentences in real time when placed on top of text say from a book, or a newspaper or any type of journal and reads the alphabets and creates braille impressions for those on a light surface on top which can then be read by the blind people. Since this system had a camera scanner and integrated AI system that would identify the written alphabets, it would be priced at a very high cost. Our version of Text to Braille conversion system would contain six servomotors, six metal rods corresponding to each servomotor and a basic universally used microcontroller which is the Arduino UNO making the system components to be very reasonable and hence in turn making the product a cheap and affordable one.

1.4 Innovation in this product

In this Text to Braille conversion system the input alphabets or text would have to be fed through a keyboard rather than a scanner reading pre-written text which makes the system a real-time application. This converter would be affordable and would be a substitute for normal messaging like it is for sighted people. The alphabets or text can be fed in real time and the braille equivalents of the fed letters would also be generated within seconds and as the letters are entered one by one, the braille letters would keep changing, making the system more dynamic and easier to use for both the sender of alphabets and the receiver of the braille letters.

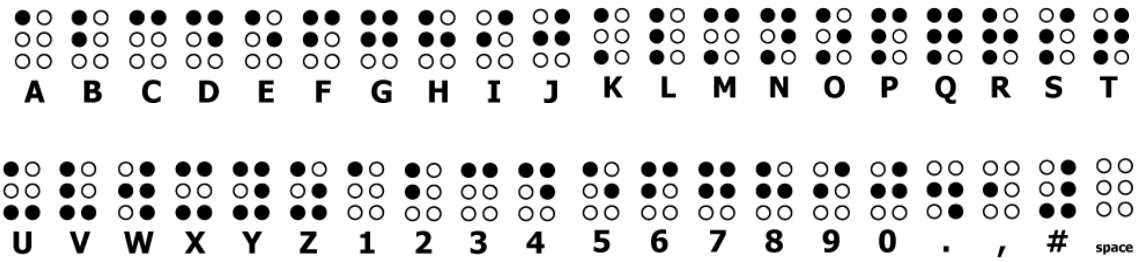


Figure 1.1 Braille equivalent alphabets

1.5 Relevance of the Project

This Text to Braille conversion system is extremely relevant in today's age, communication is becoming easier with each day that passes, with WhatsApp messaging, Facebook & Instagram connecting the world and Zoom and other such Video conferencing platforms making the world a smaller place, we often forget to realize or acknowledge the hardships of the people who are missing out or cannot make use of these platforms. Being blind in a world for those with vision is a pain no one can fathom. The youth being the future of the country should take it upon themselves to make the world a better place for everyone in it or at least do everything in their capacity to make sure no one falls prey to the societal stigma.

1.6 Problem statement

To take text from keyboard and convert the alphabets into equivalent braille letters so that someone who has no knowledge of braille can communicate with a visually impaired person.

CHAPTER II: DETAILS OF THE PROJECT

2.1 Block diagram

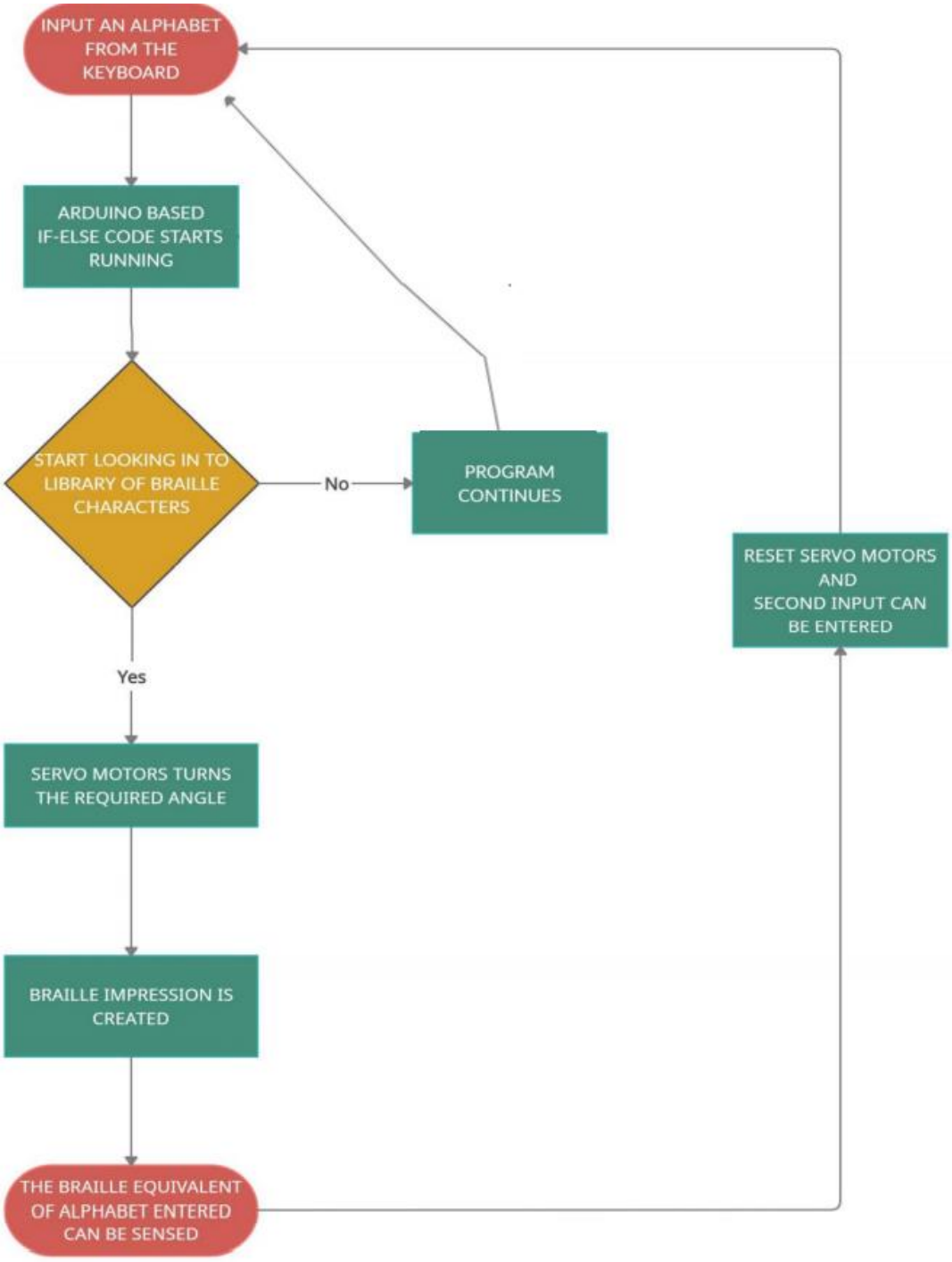


Figure 2.1 Block Diagram of Text to Braille Conversion System

2.2 Working

To convert text to braille , input is being taken from the keyboard of a laptop , one letter at a time. The user types the letter in the serial monitor window of Arduino. After receiving the letter, Arduino processes it according to the source code. In order to simulate braille letters there will be 6 servo motors connected to the Arduino and the swing arms of these motors are connected to 6 metal rods. When the servo motors rotate by a small angle the connected rods correspondingly move backwards or forward depending upon the direction of rotation. This back-and-forth motion of the rods will result in a depression or elevation on the surface of the device. With 6 rods arranged in 3 rows and 2 columns we can create all braille letters. The source code of the device is a simple if else construct , all alphabets will be saved and their braille equivalents will be the overall output of the system, this will be in terms of servo rotations by a small positive angle for elevation and a small negative angle for depression that will raise the metal road and result in the kind of impressions that someone who understands braille can use to read what someone needs to convey. It is extremely hard for some individuals to acquire fundamental and vital data required for their living. They are at a danger of being socially avoided because of this. A text to braille converter hence is an attempt at bridging the communication gap that is caused.

2.3 FLOW CHART OF THE SOFTWARE IMPLEMENTATION:

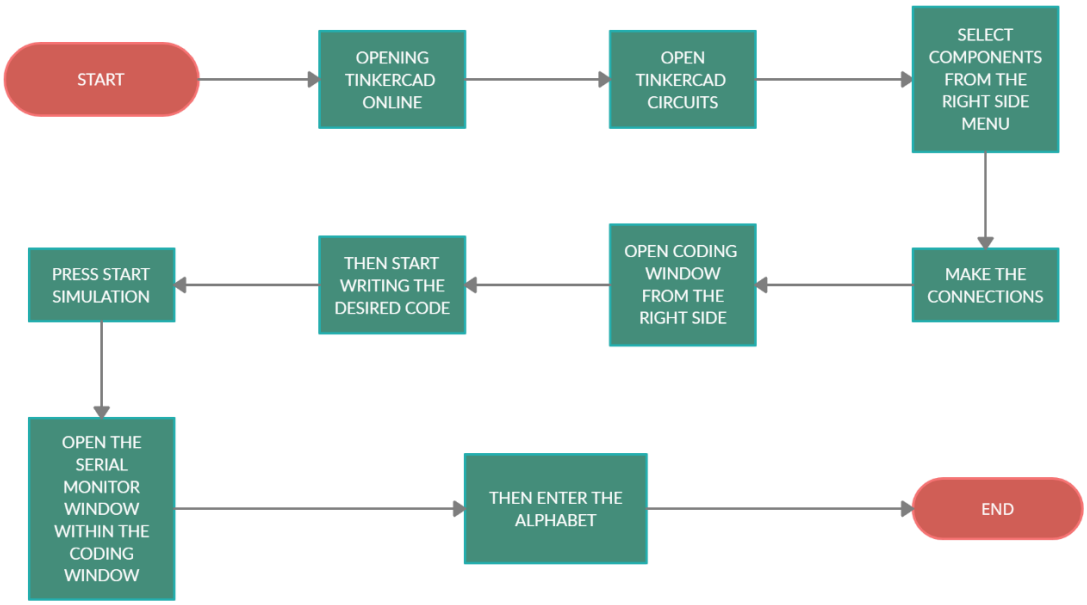


Figure 2.2 Flow Chart of Software implementation

2.4 Component Selection:

1. ARDUINO UNO
2. SERVO MOTORS
3. JUMPER WIRES
4. HEADER PINS
5. COPPER CLAD BOARD

2.5 Component Description

1. ARDUINO UNO :

Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz ceramic resonator a USB connection, a power jack, an ICSP header and a reset button.

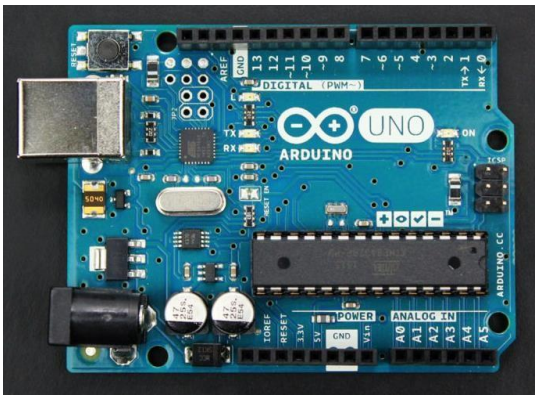


Figure 2.2 Arduino Uno Microcontroller

2. SERVO MOTORS :

A servomotor (or servo motor) is a simple electric motor, controlled with the help of servomechanism. If the motor as a controlled device, associated with servomechanism is DC motor, then it is commonly known as a DC Servo Motor. If AC operates the controlled motor, it is known as an AC Servo Motor.

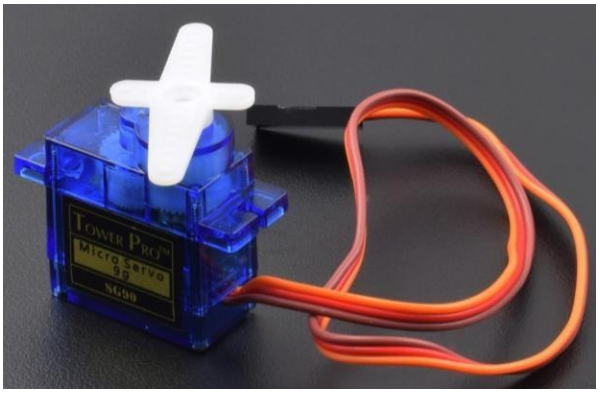


Figure 2.3 Servomotor

3. JUMPER WIRES:

A jump wire is an electrical wire, or group of them in a cable, with a connector or pin at each end, which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering. There are different types of jumper wires and the one we are using are : Solid type, these are used to connect on/with a breadboard or female header connector. The arrangement of the elements and ease of insertion on a breadboard allows increasing the mounting density of both components and jump wires without fear of short-circuits. The jump wires vary in size and color to distinguish the different working signals.

Figure 2.4 Jumper Wires (Solid type)

4. HEADER PINS

A pin header (or simply header) is a form of electrical connector. A male pin header consists of one or more rows of metal pins molded into a plastic base, often 2.54 mm (0.1 in) apart, though available in many spacings. Male pin headers are cost-effective due to their simplicity. The female counterparts are sometimes known as a female socket header, though there are numerous naming variations of male and female connectors.

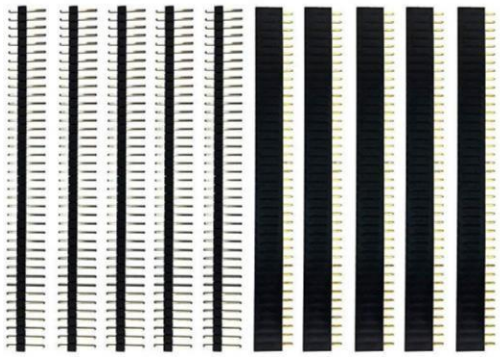


Figure 2.5 Header Pins

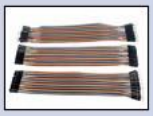
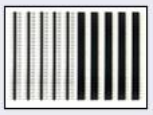
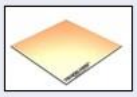
5. COPPER CLAD BOARD

Copper Clad Laminate, abbreviated to CCL, is a type of base material of PCBs. With glass fiber or wood pulp paper as reinforcing material, a copper clad board is a type of product through lamination with copper clad on either one side or both sides of reinforcing material after being soaked in resin.

Figure 2.6 Copper Clad Board

2.6 BILL OF MATERIALS [BOM] :

Table 1 Bill Of Materials

S.No.	Picture	Part	Manufacturer	Manufacturer Part Number	Qty	Description	Top / Bottom	Rate [INR] (subject to differ)	Amount
1.		Micro-controller	Arduino	MBAR	1	9V-42mA (ATmega328)	top	399	399
2.		Servo motor	ADRAxX	SG90	6	(5-6)V-1A	top	269	1614
3.		Jumper wires	TECHLEADS	TL-26105	1	Male-Male, Male-Female, Female-Female Jumper Wires	Top	231	231
4.		Header pins	Scriptronics	SRG0091/92	5	Male & Female Pin Headers	Top	37	185
5.		Data cable	TECHTONICS	TECH1735-00	1	Type-A to Type-B USB Cable	Top	120	120
6.		Copper clad board	TechDelivers	TD-CLAD12GE	1	[30cm * 30cm] Board	top	199	199
								TOTAL (approx.)	2748

CHAPTER III: SCHEMATIC & PCB LAYOUT

3.1 Schematic

A schematic, or schematic diagram, is a representation of the elements of a system using abstract, graphic symbols rather than realistic pictures.

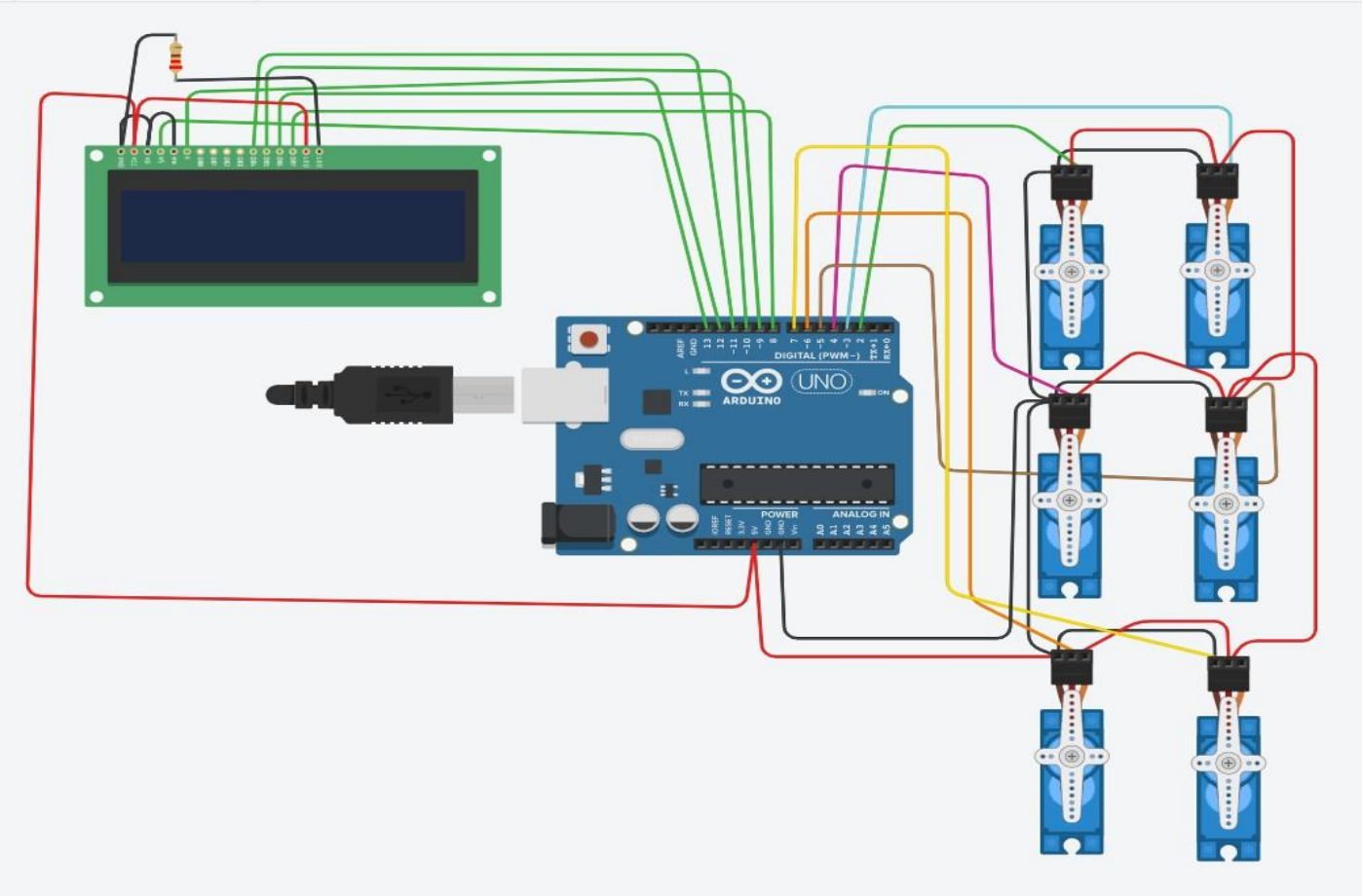


Fig. 3.1 Servomotors with LCD in TinkerCAD

Figure 3.1 shows the schematic diagram of Text to Braille Conversion System with Servomotors and LCD as done in TinkerCad. Tinkercad is a free online collection of software tools that help people all over the world think, create and make. Figure 3.2 shows the circuit diagram of the same in EasyEDA.

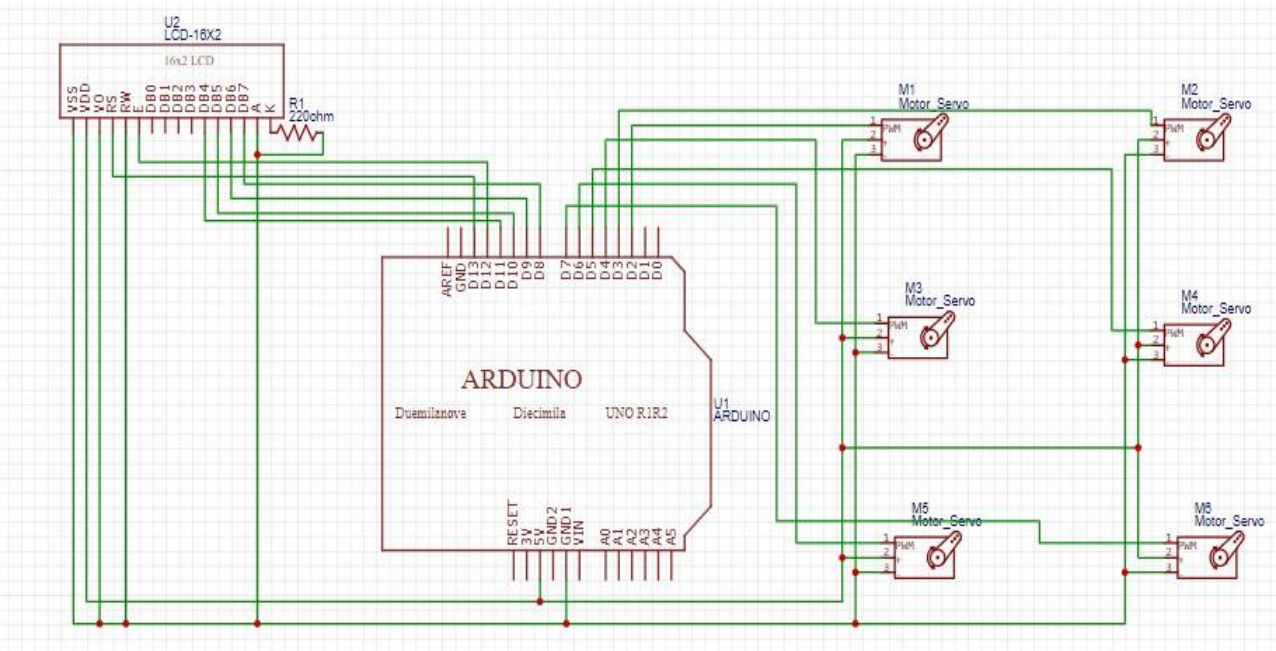


Fig. 3.2 Servomotors with LCD in EasyEDA

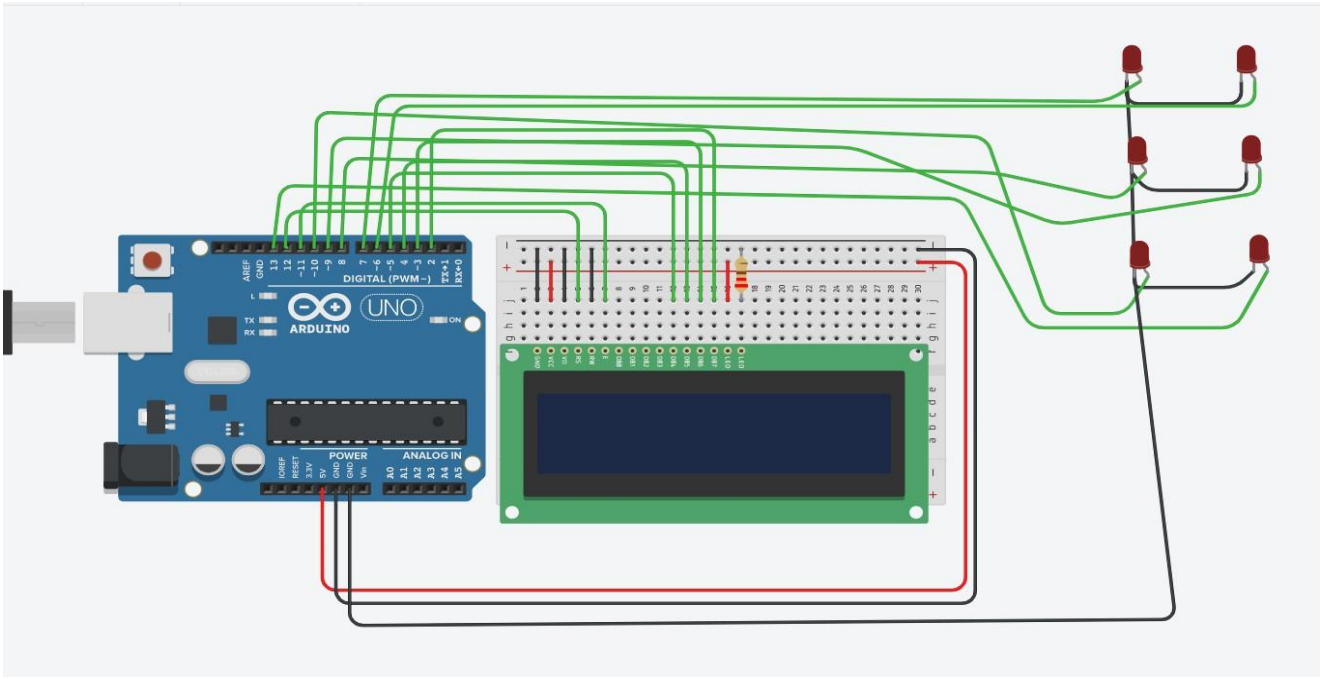


Fig. 3.3 LEDs with LCD in TinkerCAD

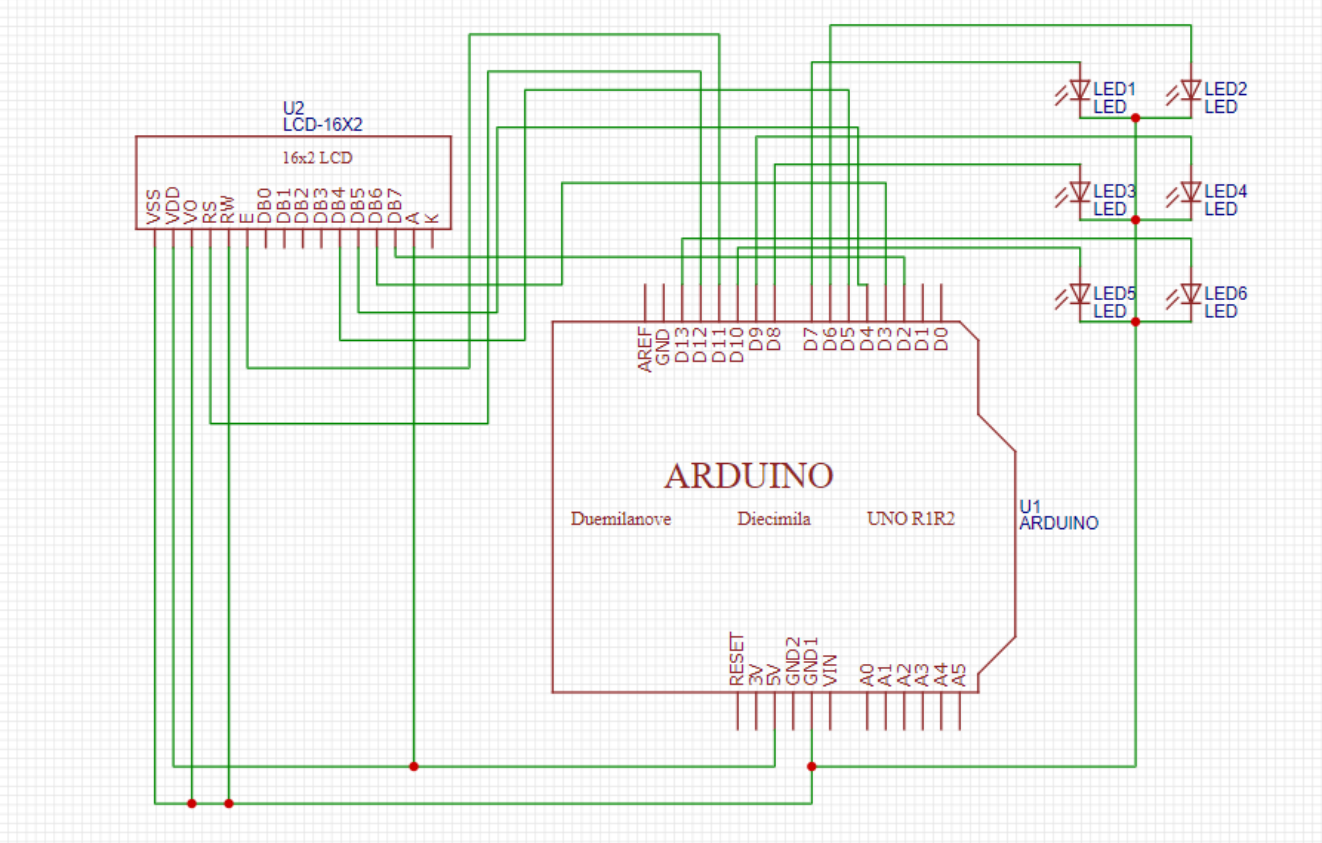


Fig. 3.4 LEDs with LCD in EasyEDA

Figure 3.3 shows the schematic diagram of Text to Braille Conversion System with LEDs and LCD as done in TinkerCad. Figure 3.4 is of the circuit in EasyEDA. EasyEDA has been used to make the schematics. EasyEDA is a web-based EDA tool suite that enables hardware engineers to design, simulate, share - publicly and privately - and discuss schematics, simulations, and printed circuit boards.

3.2 PCB Layout

PCB Layout is a high-level engineering tool for board design featuring smart manual routing of high-speed and differential signals, shape-based auto router, advanced verification, and wide import/export capabilities.

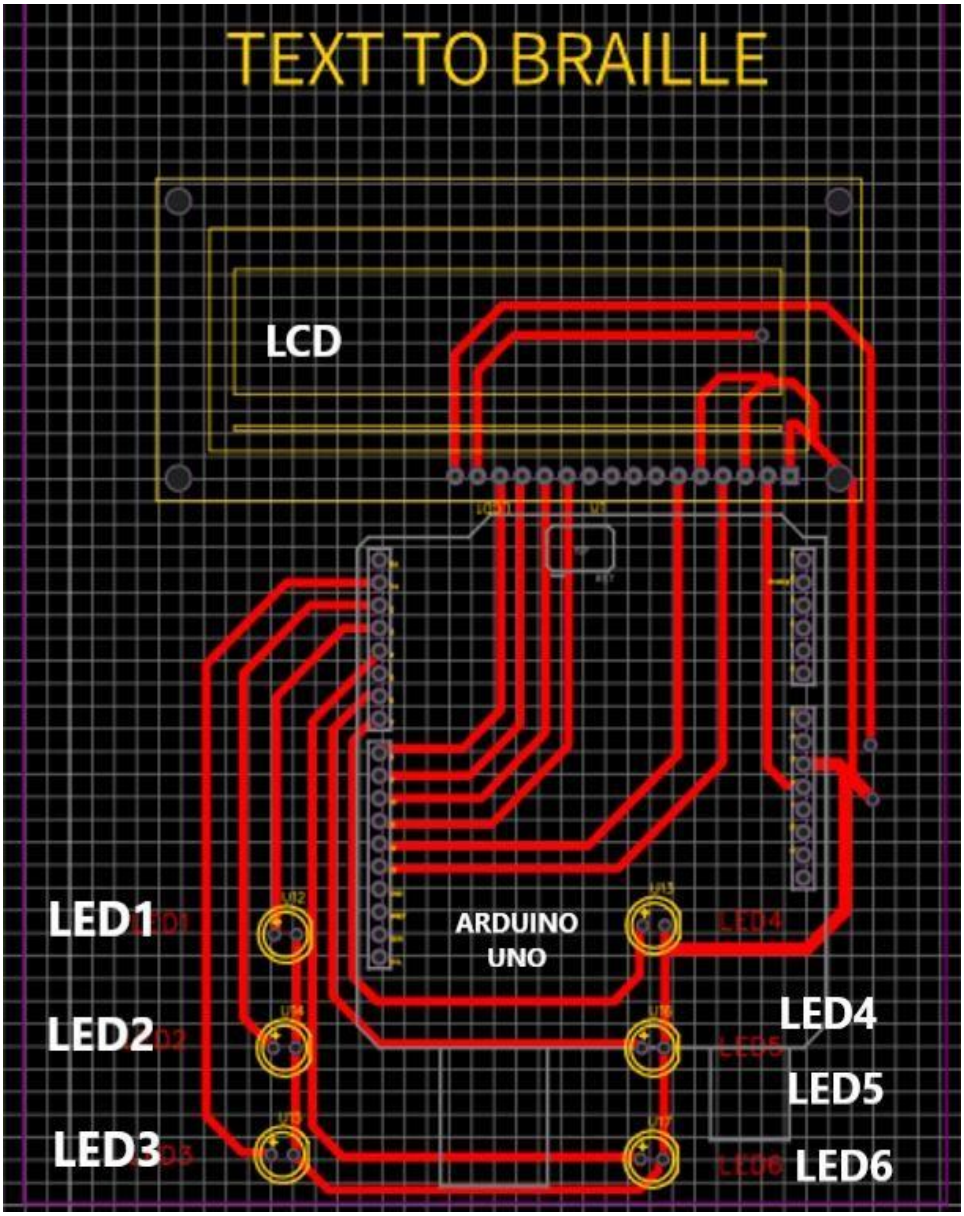


Figure 3.5 PCB Layout with LCD and LEDs

Figure 3.5 depicts the 2-D PCB Layout with LCD and LEDs. This was done in EasyEDA. Figure 3.6, 3.7, 3.8 and 3.9 shows the 3-D PCB Layout from different angles, top view, bottom view, left and right view in EasyEDA as well.

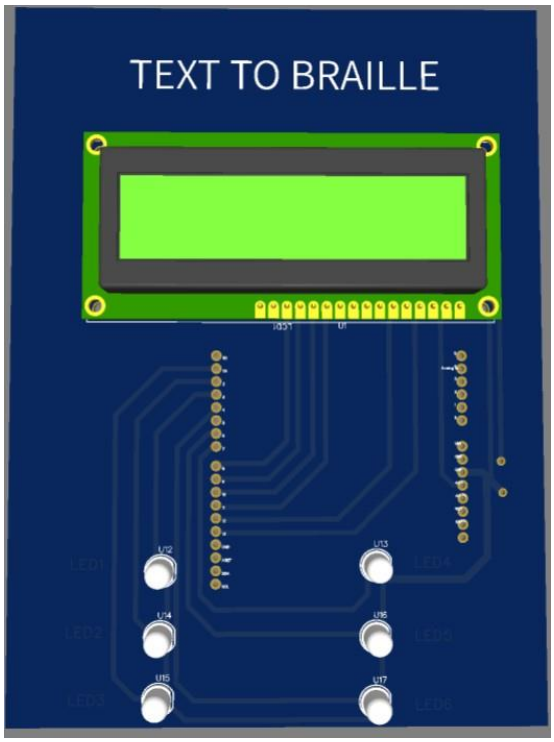


Figure 3.6 PCB Layout with LCD and LEDs from Top View

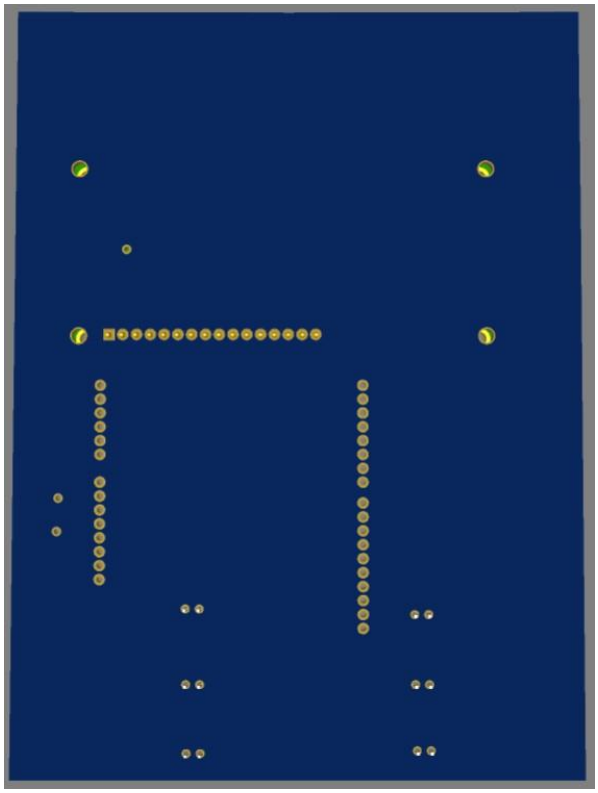


Figure 3.7 PCB Layout with LCD and LEDs from Bottom View

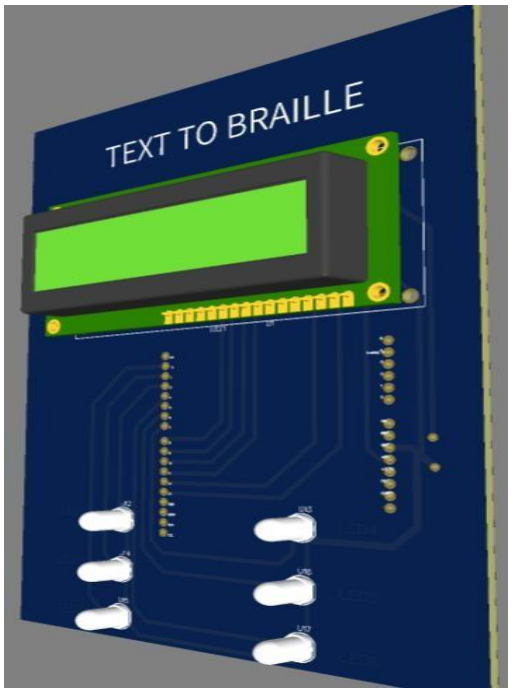


Figure 3.8 PCB Layout with LCD and LEDs from Right side View

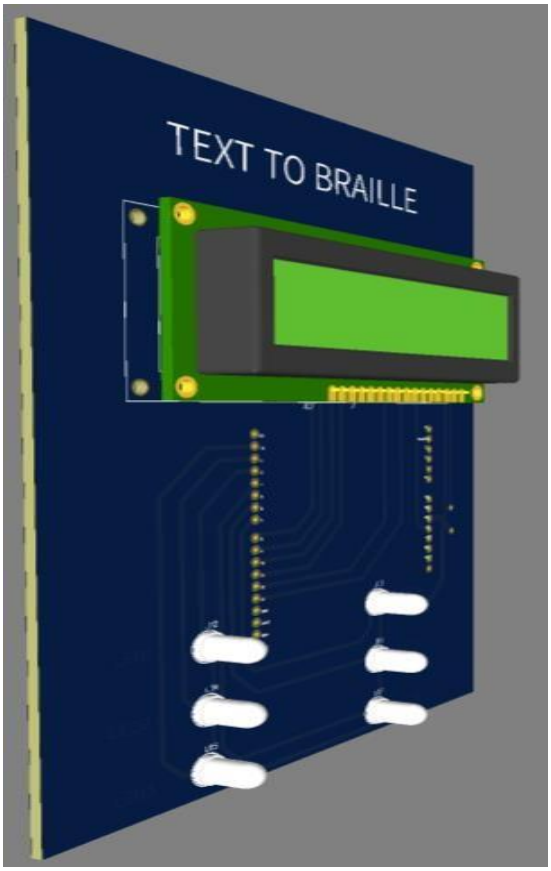


Figure 3.9 PCB Layout with LCD and LEDs from Left side View

3.3 Rules for PCB Designing

3.3.1 PCB Rules:

1. Correct Component Placement

   - Orientation:

     It is advisable to orient similar components in the same direction as this will help with effective routing in PCB design. It also helps ensure an efficient and error-free soldering process during assembly.

   - Placement:

     Avoid placing components on the solder side of a board that would rest behind plated through-hole components as that would be very inconvenient to manage along with other components.

   - Organization:

     It is recommended to place all your surface mount devices (SMD) components on the same side of your board according to SMD PCB design rules. All through-hole (TH) components should be placed on the top side of your board to minimize the number of assembly steps.

2. Correct routing of power

3. Maintaining distances between components

   Heating components cannot be near the wire and the heating-sensitive components; the high-heating components should be evenly distributed.

4. Determine the standard track width to be used:

   It is necessary to balance the standard track size to be used within the design. If the tracks are too narrow and too close there is a greater possibility of short occurring. Additionally, if they are too wide and too far apart then it can restrict the number of tracks in each area, and this may force the use of additional planes in the boards to ensure the PCB design can be routed.

5. Consider track size for lines carrying current:

   The thin tracks used in today's printed circuit boards can only carry a limited current. Consideration needs to be given to the size of track for any that carry power rails rather than low level signals. The table below gives some track widths, or a 10 degree C temperature rise for different thickness copper boards.

3.3.2 PCB Layout Rules followed for Text to Braille Converter

1. Must avoid 90’ angles while routing the connections because the outside corner of that 90-degree angle has the likelihood of being etched narrower than your standard trace width.

2. Power and ground connections should have more width than digital signal connections because power and ground carry higher currents than signal connections.

3. Must keep the signal tracks as short as possible to avoid noise.

4. The PCB should be in mirror image format while printing because it will be inverted again during ironing on the copper clad board.

5. The text on the PCB should not touch the traces because it will become conductive after the etching process.

CHAPTER IV: SIMULATION

4.1 Simulation case

The simulation is done in TinkerCad circuits. Tinkercad is a free online collection of software tools that help people all over the world think, create and make. Arduino Uno is used in this project because Arduino has some sound advantages, such as large user community, free and broad ranges of libraries of codes, relatively low-cost components, and so forth. The Arduino is based on Atmel's ATMEGA8 and ATMEGA168 microcontrollers. The programming is done in C language which is simple and easy to debug.

The input pins of servomotors and LEDs are connected to digital pins 2 to 7 of the Arduino Uno. By knowing which LED and servomotor in the braille letter grid corresponds to which digital pin number on the arduino, it is possible to control each LED and servomotor in the code. The user types the letters into the text to braille conversion system through a keyboard, for simulation, the text was entered through the serial monitor window and the device gets the letter through the serial read command. Once arduino gets the letter, it compares it to all the letters through the if-else statements to configure the correct braille letter equivalent. Programming was done for the braille letters within the if statements as a combination of digitalwrite(HIGH) and digitalwrite(LOW) statements to turn the LEDs on and off respectively, and servowrite(angle1) and servowrite(angle2) to activate and deactivate servomotors. The letter that the user puts is also printed on the liquid crystal display using lcd.println command.

4.2 Enclosure Design

The electronic enclosure is one of the most critical components in electronic circuits. It also protects it from damages and circuit failures caused due to various environmental factors. Thereby, it is becoming of utmost importance to select appropriate electronic enclosures according to the project specifications to mitigate the risks of downtime and operational hindrances by also keeping in mind the fact that the enclosure should not take up too much space. The more compact and contained the enclosure is the better it is. Fusion 360 is the only tool that connects the entire product

development process into a single CAD/CAM/CAE cloud-based platform. It has various tools for complete product design and development.

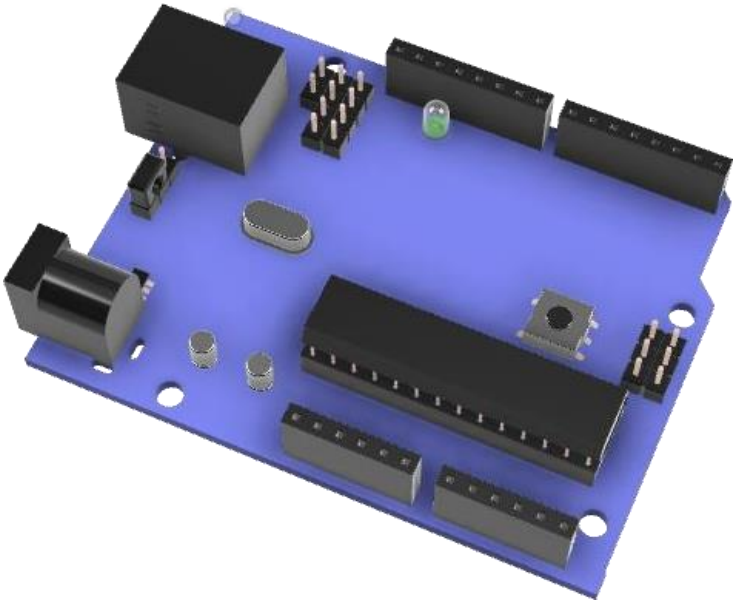


Figure 4.1 Arduino Uno module from Fusion 360

Figure 4.2 Outer look from Fusion 360

Figure 4.3 Top look from Fusion 360

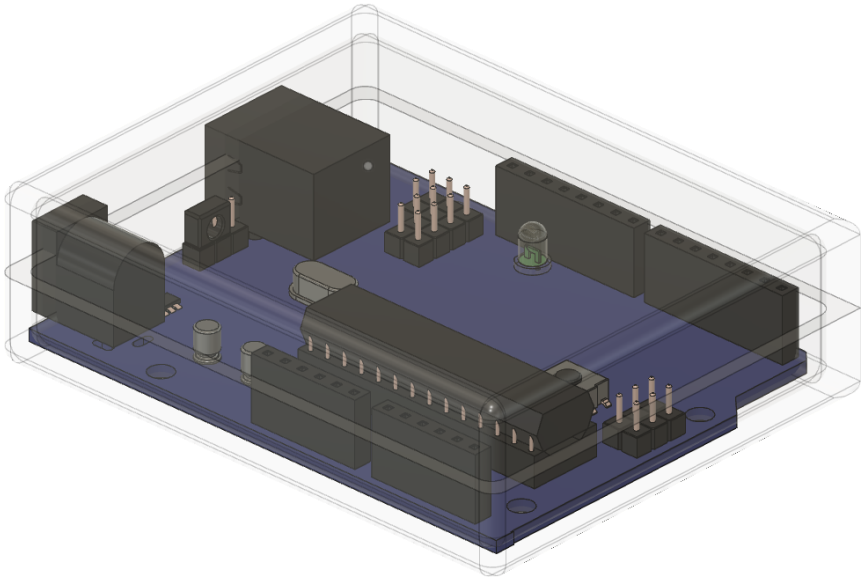


Figure 4.4 X-Ray view from Fusion 360

Figure 4.5 Side bottom view from Fusion 360

4.3 Changes made in the original product idea

Originally, the idea was to make the Text to Braille Conversion System using servomotors with metallic rods only, but no software exists for simulating or demonstrating mechanical movements. So, the change implemented was to replace servomotors with LED so that simulation can be done for the same logic.

CHAPTER V: CONCLUSION

5.1 Conclusion

The Text to Braille Conversion System is an extremely relevant tool in today's time. The main idea behind the making of Text to Braille Conversion system is that it is a translator or a converter that takes alphabets from a keyboard or a keypad and then converts the letters into braille language one by one with the help of servomotors that have metallic rods that rotate at certain angles when a particular alphabet is sent into the conversion system. This product is an attempt at bridging the communication gap between those who are visually impaired and those with vision. Using this, someone can communicate with the blind people without requiring knowledge of braille scripture themselves. With the help of this project, it is possible to employ someone who is visually impaired to do basic tasks by giving instructions through the Text to Braille Conversion system which can then be read by someone who knows the braille language. This product uses basic electronic components, simple microcontroller technology and knowledge of C programming to solve a socially relevant problem.

5.2 Scope for the future

Although this conversion system is compact for now, there a few changes that can be done, the keyboard that takes the input can be made wireless. The keys can be mounted on the Text to Braille Conversion System itself. That might increase the size of the overall size of the system, but it would be more convenient if the product could run without any USB cables. Further another conversion system which does the opposite, one that converts braille into text could also be an advancement, this way the same system would be able to do two-way communication. Braille to text and Text to Braille.

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2. *Increased accesibility for blind and visually impaired people with Lumi Industries' Text to Braille converter — Lumi Industries (lumindustries.com)*