Broad Problem Statement

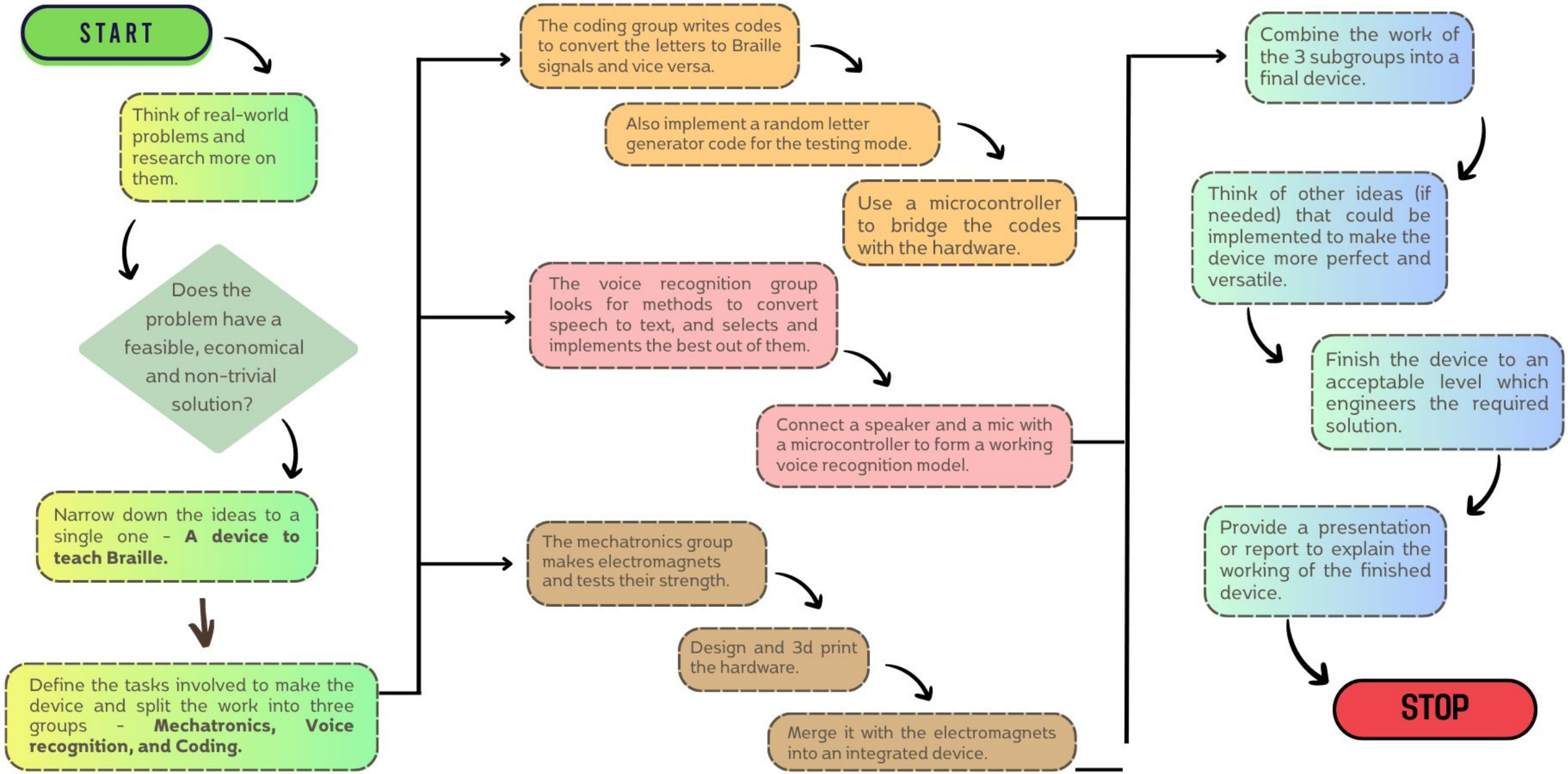
- **Braille** is a vital communication tool that enables blind and visually impaired individuals to read and write independently.
- **The problem** we have identified is the **limited access to braille education and literacy** for visually impaired individuals especially in developing countries like **India**.
- The **significant challenges faced by the visually impaired community**, in accessing Braille education in India are given below:
  - We **don't have enough braille teachers** as a result of which, the underprivileged blind are deprived of a very basic skill of literacy. Learning is possible **only in their presence**.
  - Moreover, the electronic gadgets meant for remote braille training are too **expensive** for many visually challenged people in India to afford (based on this report).

Braille education in India is restricted **only to English** and not to any **native language** in India.

Specific Problem Statement

To develop an interactive and **self-sufficient** device to assist visually-challenged individuals in **learning Braille** digits and letters in English and possibly, local Indian languages.

FLOWCHART


START
Think of real-world problems and research more on them.
Does the problem have a feasible, economical and non-trivial solution?
Narrow down the ideas to a single one - **A device to teach Braille.**
Define the tasks involved to make the device and split the work into three groups - **Mechatronics, Voice recognition, and Coding.**
The coding group writes codes to convert the letters to Braille signals and vice versa.
Also implement a random letter generator code for the testing mode.
Use a microcontroller to bridge the codes with the hardware.
The voice recognition group looks for methods to convert speech to text, and selects and implements the best out of them.
Connect a speaker and a mic with a microcontroller to form a working voice recognition model.
The mechatronics group makes electromagnets and tests their strength.
Design and 3d print the hardware.
Merge it with the electromagnets into an integrated device.
Combine the work of the 3 subgroups into a final device.
Think of other ideas (if needed) that could be implemented to make the device more perfect and versatile.
Finish the device to an acceptable level which engineers the required solution.
Provide a presentation or report to explain the working of the finished device.
STOP

Calculations/Quantifications

List of Components:

- Device frame [3D printed with PLA]
- Cylindrical button shaped extrusions [3D printed with PLA] (6)
- Components of the electromagnet - iron rod, enamelled copper, permanent magnet (6 sets)
- Speaker
- Voice recognition module/Microphone
- Microcontroller (Arduino Uno R3 or Raspberry Pi 3)
- Mode-changing buttons (3), Multipurpose button (1), ON/OFF button (1)

Calculations/Quantifications

$B = \mu nI$, $n = N/L$ where
N = Number of turns in the electromagnet
L = Length of electromagnet

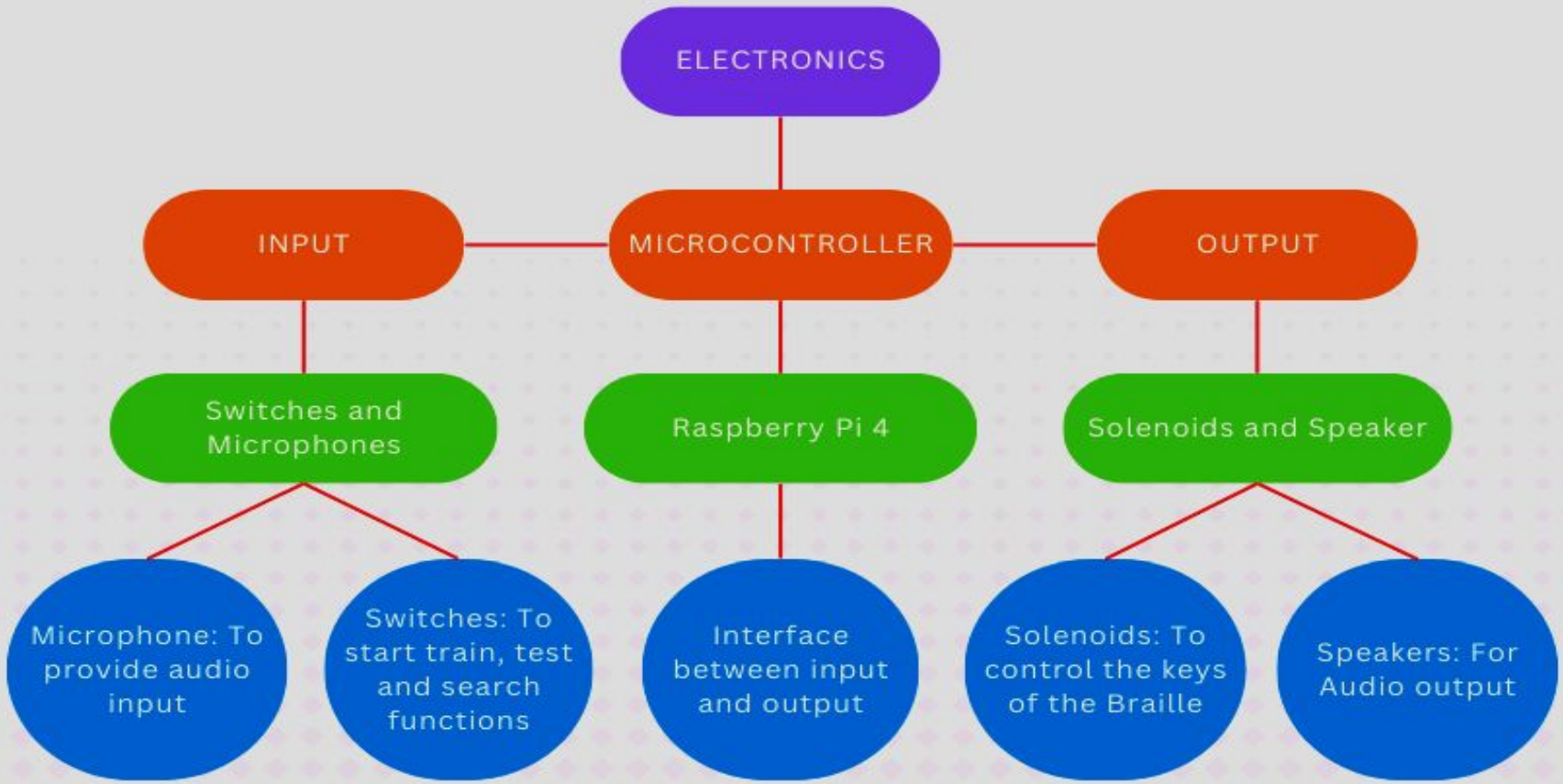
$\mu = \mu_r \times \mu_o$ where μ_o = Permittivity of free space

After building a prototype of the electromagnet to be used, we decided on the following specifications:
N = 200
L = 3 cm
Power source rated at 12V 3A DC

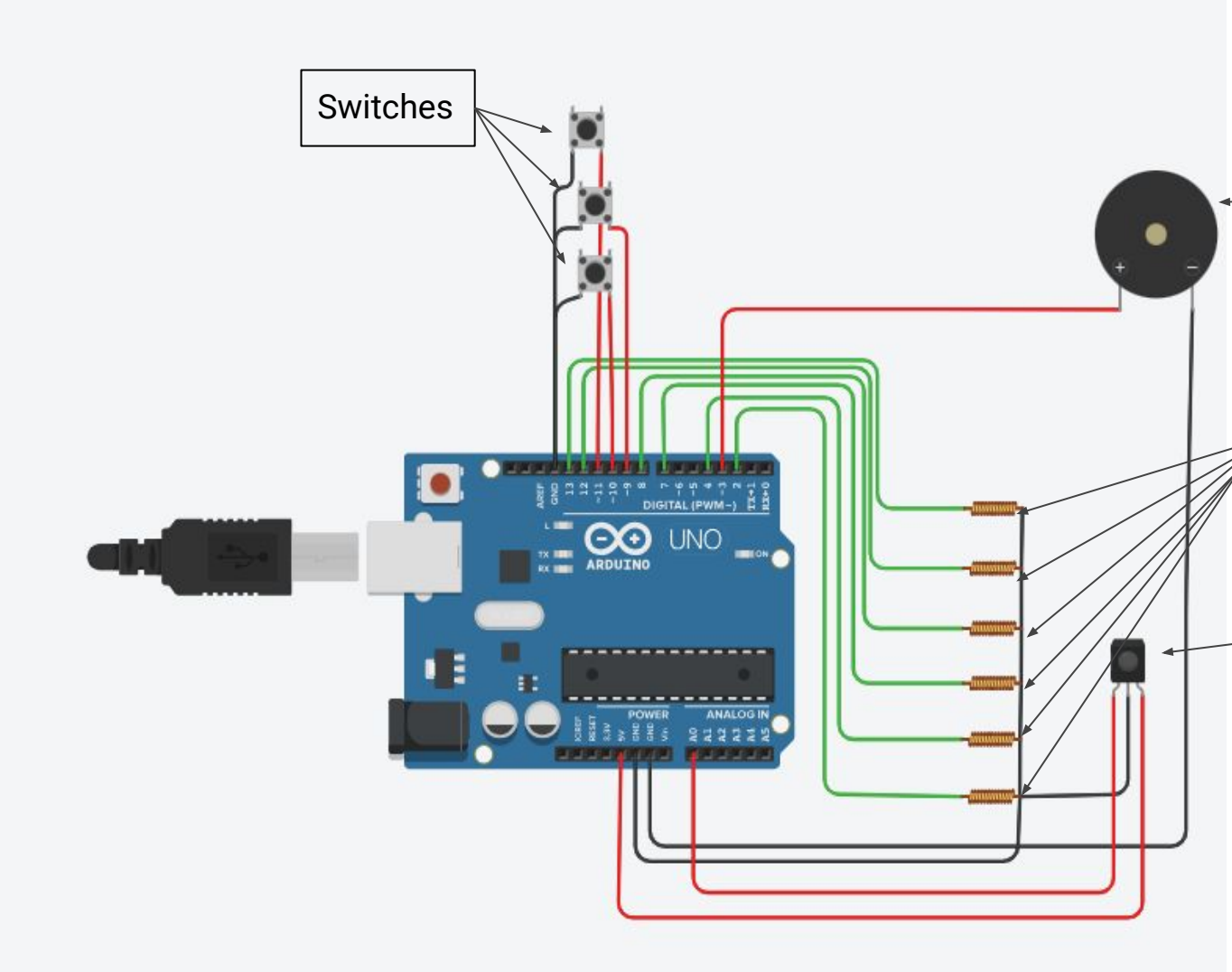
From the above calculations, calculated value of magnetic field turned to be:
B = 0.098 T

AutoCAD Model of the Proposed Device

ELECTRONIC COMPONENTS TO BE USED



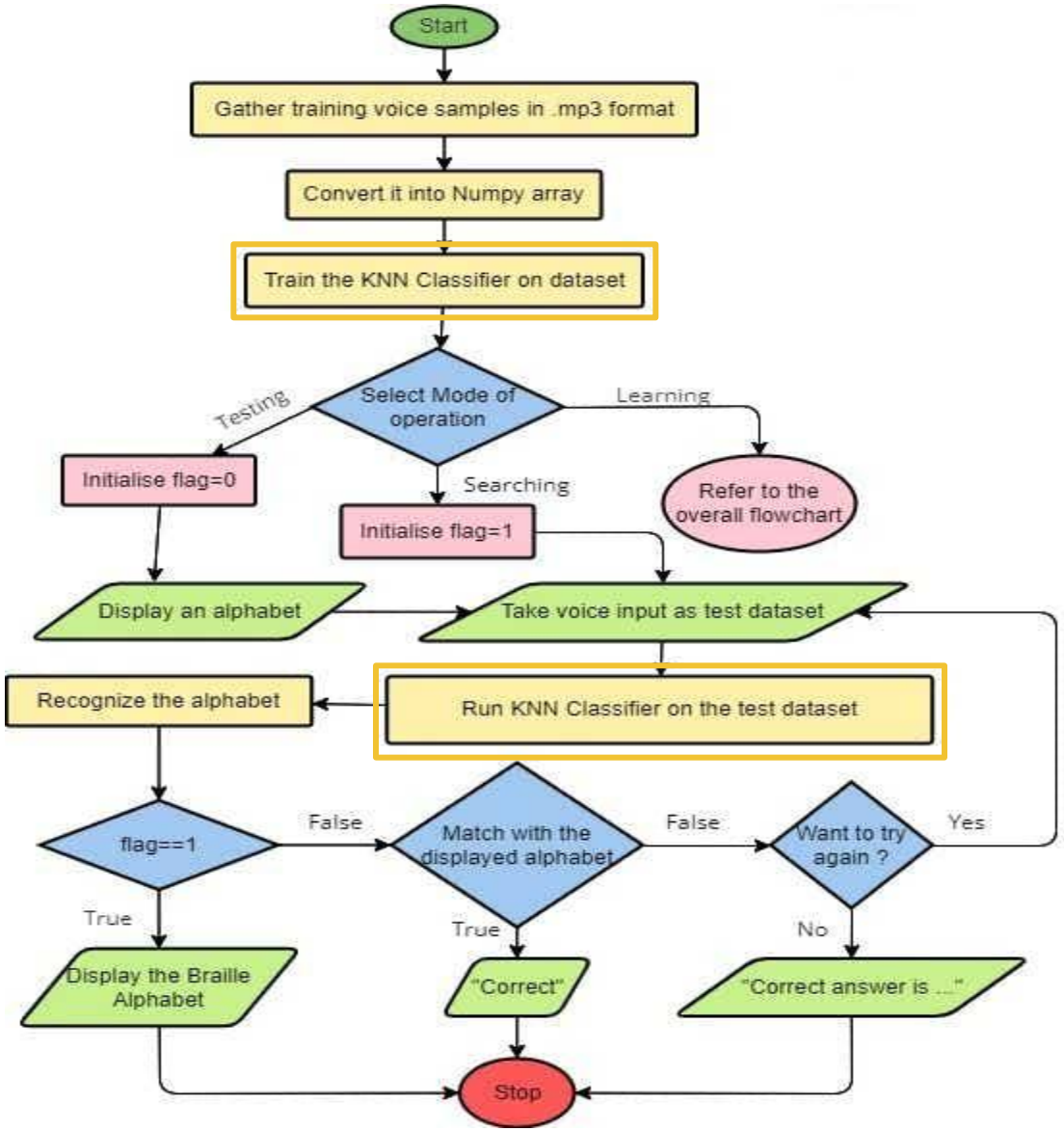
Electronic Circuit Diagram



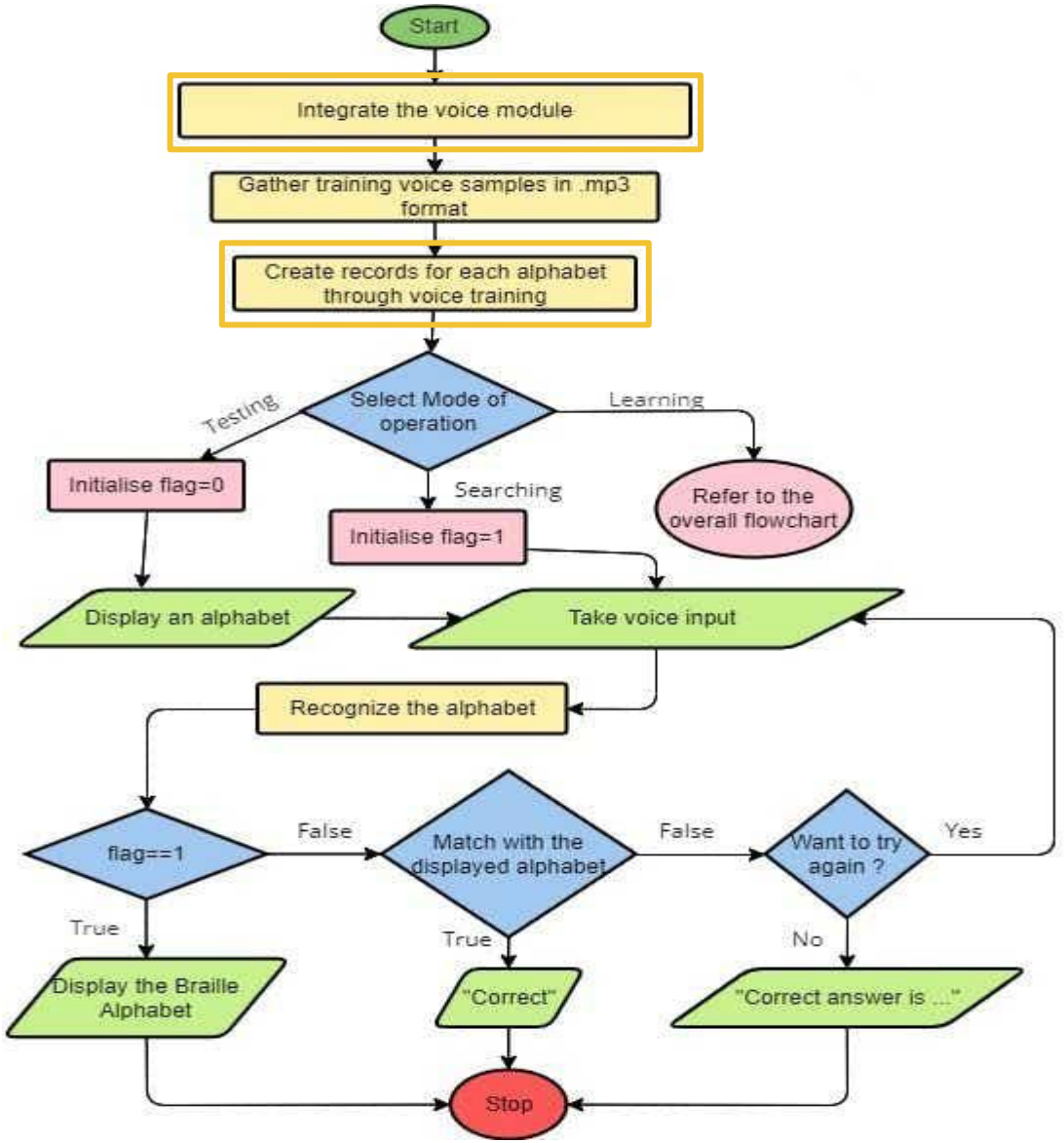
Made on TinkerCAD

Voice Recognition Flowchart

Method 1



Method 2



Pseudo Code

Program Flow:

Setup

Choose Mode

—----------

Setup:

Initialize Braille matrix representation for letters A, B, and C

Choose Mode::

Ask user to choose searching, training, or learning mode:

If user chooses searching mode, Enter searching mode

If user chooses training mode, Enter testing mode

If user chooses learning mode, Enter learning mode

Obtain Function:

Obtain voice input

Return input to IC

Learning Mode:

Loop through each letter in Braille representation:

Display Braille representation and Speak letter

Pause and ask if user wants to repeat (Voice Mode)

Searching Mode:

Loop until exited:

Get user's voice input letter

Match input to Braille representation key and display it

Pause to ask if the user wants to repeat (Voice Mode)

Testing Mode:

```
Loop until exited:
    Display a randomly selected letter
    Pause to get user's input
    If input matches selected letter:
        Speak success message
        Ask if user wants to continue
        If user wants to continue, repeat loop
```

Voice Function:

```
Loop until valid input received:
    Obtain voice input
    If input is "Yes" or "No":
        Return True if "Yes", False if "No"
    else:
        Speak "Didn't quite get you, please repeat"
```

*The pseudo code on these two pages is the summary of the actual code that we have developed. The next page contains the code that will be implemented.

```python
import numpy as np
from time import sleep

def setup():
    a=[1,0,0,0,0,0]
    b=[1,0,1,0,0,0]
    c=[1,1,0,0,0,0]
    braille=np.zeros((3,2))
    di={"A":a,"B":b,"C":c}
    for i in d:
        d[i]=d[i].reshape(3,2)
    return d,braille

d,braille=setup()

def learning_mode():
    print_voice("You are now in learning mode")
    while True:
        for i in d:
            print(d[i])
            print_voice(i)
            sleep(5)
            print(braille)
            sleep(5)
        print_voice("Do you want to repeat ?")
        if voice():
            print_voice("You chose to return to learning mode")
            continue
        else:
            break

def voice():
    while True:
        obtain_voice()
        if voice_input=="Yes" or voice_input=="No":
            if voice_input=="Yes":
                return True
            else voice_input=="No":
                return False
            print_voice("Didn't quite get you please repeat")

def voice2()
    while True:
        obtain_voice()
        if voice_input in list(d.keys()):
                return voice_input
        print_voice("Didn't quite get you please repeat")

def searching_mode():
    print_voice("You are now in searching mode")
    while True:
        voice2()=k
        print(d[k])
        print_voice(k)
        sleep(5)
        print(braille)
        print(braille)
        sleep(5)
        print_voice("Do you want to repeat ?")
        if voice():
            print_voice("You chose to return to searching mode")
            continue
        else:
            break

def obtain():
    obtain_voice()
    return(voice_input)

def testing_mode():
    print_voice("You are now in testing mode")
    while True:
        q=np.random.choice(list(d.keys()))
        print(d[q[0]])
        print_voice(q[0])
        sleep(5)
        print(braille)
        sleep(5)
        if obtain() == q[0]:
            print_voice("Kudos you got that right")
            print_voice("Do you want to continue")
            if voice():
                continue
            else:
                return
        else:
            print_voice("Oops im afraid thats wrong")
            print_voice("Do you want to try again")
            if voice():
                while True:
                    print(d[q[0]])
                    print_voice(q[0])
                    sleep(5)
                    print(braille)
                    sleep(5)
                    if obtain() == q[0]:
                        print_voice("Kudos you got that right")
                        print_voice("Do you want to continue")
                        if voice():
                            p=1
                            break
                        else:
                            p=2
                            break
                    else:
                        print_voice("Oops im afraid thats wrong")
                        print_voice("Do you want to try again with the same chracter")
                        if voice():
                            continue
                        else:
                            print_voice("Do you want to know the answer")
                            if voice():
                                print_voice(q[0])
                            else:
                                pass
                            print_voice("Do you want to exit testing mode")
                            if voice():
                                return
                            else:
                                break
            else:
                print_voice(q[0])
                sleep(5)
                print(braille)
                sleep(5)
                if obtain() == q[0]:
                    print_voice("Kudos you got that right")
                    print_voice("Do you want to continue")
                    if voice():
                        p=1
                        break
                    else:
                        p=2
                        break
                else:
                    print_voice("Oops im afraid thats wrong")
                    print_voice("Do you want to try again with the same chracter")
                    if voice():
                        continue
                    else:
                        print_voice("Do you want to know the answer")
                        if voice():
                            print_voice(q[0])
                        else:
                            pass
                        print_voice("Do you want to exit testing mode")
                        if voice():
                            return
                        else:
                            break
    if p==1:
        continue
    elif p==0:
        return
    else:
        print_voice("Do you want to exit testing mode")
        if voice():
            return
        else:
            break

def choose_mode:
    print_voice("please choose one of the three options searc
    while True:
        obtain_voice()
        if voice_input=="searching":
            searching_mode()
        elif voice_input=="training":
            testing_mode()
        elif voice_input=="learning":
            learning_mode()
        else:
            print_voice("Didn't quite get you please repeat")


setup()
choose_mode()
```

THANK YOU!