Braille Reader for Visually Impaired People

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***Abstract*—Braille reading has been a vital tool for visually impaired individuals to access information and literature. In recent years, technological advancements have made it possible to develop Braille readers that are efficient, user-friendly, and economical. This research paper aims to discuss the design and components of a Braille reader for visually impaired people. The essential components required for the Braille reader will be discussed in detail, including the microSD card, solenoid, motors, driver circuit, and microcontroller. The micro-SD card functions as a storage device, storing the texts that are to be read by the user. The solenoids and motors, on the other hand, provide tactile feedback, allowing the user to interpret the Braille characters. This paper will explore the role of these components in the Braille reader, to provide an in-depth understanding of the technology behind this invaluable tool.**

Keywords—Micro SD Card, Solenoid, Driver Circuit, Microcontroller.

I. INTRODUCTION (*HEADING 1*)

Visually impaired are the people who may either have a temporary or a permanent loss of vision. Reading traditionally is impossible for these unfortunate people. India has the second-largest blind population in the world, which makes this device so essential.

People who are blind or have low eyesight can read a system of raised dots called braille using their fingertips. Only a few books are available in Braille. They are also very large and heavy, with one Braille page equivalent to three regular pages. If this medium of knowledge and entertainment were made less complicated, more affordable, and simpler, then a significant portion of the blind population would have easier access to education. This would raise the currently low percentage of blind people who are literate. Using technology to help with this, would be the best course of action.

As a result, numerous businesses developed Braille displays, printers, audiobooks, and text-to-speech converters. Though text-to-speech converters can address this issue by turning any book into an audio format, the resulting audio can be incredibly repetitive and expressionless. There are very few audiobooks on the market. A few thousand USD is a steep price for Braille displays, and they require a PC. One example of a portable eBook reader that can read Braille is called "TactoBook". However, to convert regular books into a Braille format, it needs a software on PC. Furthermore, because the paper used for printing is the same as that used for regular Braille, Braille printers cannot function without a PC.

Several previous proposals have solved the same problem, but each of them had a few drawbacks, such as the weight of the embossing tool in the earlier Braille display models can slow down the rotational speed of the stepper motor and add to the cost of the product [2]. The device currently consists of only two Braille cells, which may not be sufficient for reading longer texts or documents [5]. The refresh speed of the Braille cells must be at least as fast as the mean reading speed of 7.5 characters to ensure a smooth reading experience [3]. The device aims to have at least one hour of battery life, which may not be sufficient for extended use [4]. The existing Braille systems lack portability and are not easily accessible for visually impaired individuals [5].

The piezoelectric Braille cells require 200V input for the actuation purpose. To provide such a large input is difficult in the case of portable devices [1].

Our research paper aims to eliminate all of these drawbacks. This project is an embedded system. A computer system with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints is known as an embedded system. This project presents an electronic aid to help visually impaired people read conventional printed text by giving the corresponding Braille outputs at a refreshable Braille display. This research paper aims to discuss the design and components of a Braille reader. It will explore the role of these components in the Braille reader, to provide an in-depth understanding of the technology behind this invaluable tool.

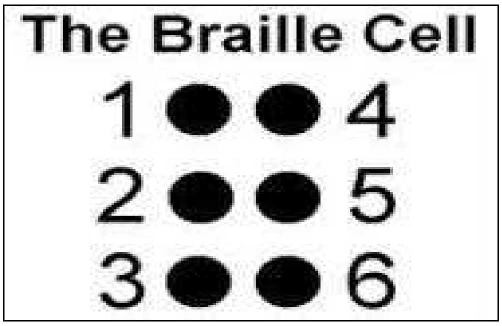

Fig 1. The Braille Cell

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II. System Design

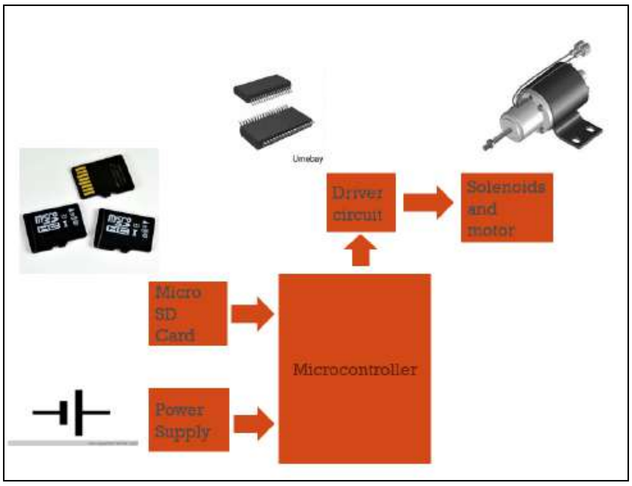

Fig 2. Flowchart representation

A. Solenoids

It is a coil and a ferromagnetic substance (plunger), aligned in such a way that a magnetic force is developed on the plunger on the passage of an electric current through the coil. This force pushes the plunger, creating a linear motion. For our project, we use Door-lock solenoids. The solenoids were tested to find out the electrical parameters and to check the suitability of the device.

The electrical characteristics of the solenoid are

- Voltage 12V DC
- Current 0.7A
- Inductance 0.6mH
- Resistance 40Ω
- The physical characteristics are:
- Height 50mm
- Length 20mm
- Breadth 15mm
- Force 1-2 N

The counter is that we would be attaching a metal wire on the tip of the solenoid bending all 6 metal wires attaching a small metal ball on top of the wire and trying to reduce the overall surface area to the size of a thumb.

Fig 3. A Door Lock Solenoid

B. ULN2003A IC.

Solenoids, which are commonly used in various applications including locking mechanisms, pneumatic valves, and robotic actuators, can be efficiently driven using the ULN2003A. The ULN2003A can also be used to drive multiple relays simultaneously. This is particularly useful in applications where you need to control several electrical devices or switches, such as in-home automation systems or industrial control panels. Overall, the ULN2003A is a versatile and cost-effective IC for driving various types of inductive loads in electronic circuits, making it a popular choice among hobbyists, students, and professionals.

C. ATMEGA32 (Microcontroller)

A 10-bit A/D converter with eight channels, 32KB of programmable flash memory, 2KB SRAM, 1KB EEPROM, and a JTAG port for on-chip debugging are all included in this high-performance, low-power Atmel 8-bit AVR RISC microcontroller. The gadget runs between 4.5 and 5.5 volts and supports throughput of 16 MIPS at 16 MHz. The device balances power consumption and processing speed by achieving throughputs approaching 1 MIPS per MHz by executing instructions in a single clock cycle. The following functions are offered by the ATmega32: A JTAG interface for boundary-scan, on-chip debugging support and programming, three programmable timer/counters with compare modes, 16 Kbytes of In-System Programmable Flash Programme memory with Read-While-Write capabilities, 512 bytes of EEPROM, 1 Kbyte of SRAM, 32 general purpose I/O lines, 32 general purpose working registers, internal and external interrupts, a serial programmable USART, Two-wire interface, A/D Converter, SRAM, Timer/Counters, SPI port, and interrupt system to continue functioning. All other chip operations are rendered inoperable until the next External Interrupt or Hardware Reset in the Power-down mode, which preserves the contents of the registers but freezes the oscillator. While the remainder of the device sleeps, the user can still maintain a timer base by using the Asynchronous Timer in Power-save mode. To reduce switching noise during ADC conversions, the ADC Noise Reduction mode turns off the CPU and all other I/O modules save for the Asynchronous Timer and ADC. While the rest of the device is sleeping, the oscillator is operating. This enables reduced power usage and extremely quick startup. Both the Asynchronous Timer and the main oscillator continue to operate in Extended Standby mode. This device is made with high-density non-volatile memory technology from Atmel.

D. SD Card

A memory card reader is a device for accessing the data on a memory card such as a Secure Digital (SD). Along with the card, the majority of card readers provide writing capabilities that can be used as a pen drive. A built-in card reader is available in certain printers and personal computers. Multiple flash memory card types can be communicated using a multi-card reader. The controller reads the text file from an SD card letter by letter. The ASCII code is recognized by the ATMEGA board, which is configured to translate it to Braille code. To actuate the Braille dots appropriately at the actuator, it generates a parallel output.

E. Software(Arduino IDE)

Arduino IDE (Integrated Development Environment) is a software platform used for programming Arduino microcontroller boards. It provides a simple interface for writing, compiling, and uploading code to Arduino devices. With a user-friendly interface and extensive libraries, it enables easy creation of projects for beginners and advanced users alike in the realm of electronics and embedded systems. In order to make interacting with different sensors, actuators, and other peripherals easier, it offers a large library of pre-written code in addition to the C/C++-based Arduino programming language. Furthermore, users may simply install other board definitions using the Arduino IDE, enabling support for a variety of microcontrollers outside of the basic Arduino lineup. All things considered, the Arduino IDE is an effective tool for designing embedded projects and prototyping, providing a streamlined workflow for both experts and enthusiasts.

F. Power Supply

A 12V power supply is required for the whole system. 5v supply is required for the microcontroller.

III. Braille Conversion

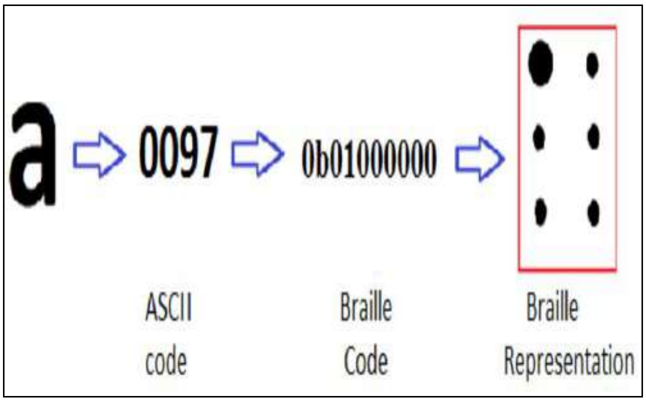

Fig 4. Conversion of English alphabet into Braille Representation

The text file stored in an SD card is processed letter by letter by the controller. The ATMEGA board is programmed to detect the ASCII code and convert it to the Braille code. In order to actuate the Braille dots appropriately at the actuator, it generates a parallel output. Figure 3 above provides an illustration of the procedure used in the suggested reading aid. The character ‘a’ is read by the controller and detects the alphabet as the 0097 ASCII code which is already assigned to every alphabet in the program. The micro-SD card interfaces the output to the ATMEGA board where the Braille code 0b01000000 to be produced is determined and the Braille cell is actuated which is made up of 6 solenoids.

IV. Proteus Simulation

A. Circuit Diagram

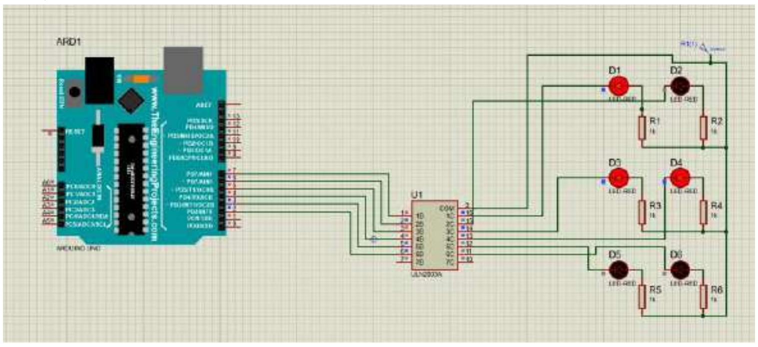

Fig 5. Proteus Simulation giving output for English alphabet character ‘H’

B. Code

The code snippet for the above proteus simulation is given below in Fig 6.-

```
#define PIN_1 7
#define PIN_2 6
#define PIN_3 5
#define PIN_4 4
#define PIN_5 3
#define PIN_6 2
char letter_1='b';

void setup() {
  pinMode(PIN_1, OUTPUT);
  pinMode(PIN_2, OUTPUT);
  pinMode(PIN_3, OUTPUT);
  pinMode(PIN_4, OUTPUT);
  pinMode(PIN_5, OUTPUT);
  pinMode(PIN_6, OUTPUT);
  Serial.begin(9600);
}

void func(char letter){
  if(letter=='a'){
    digitalWrite(PIN_1, HIGH);
  }else if(letter=='b'){
    digitalWrite(PIN_1, HIGH);
    digitalWrite(PIN_3, HIGH);
  }else if(letter=='c'){
    digitalWrite(PIN_1, HIGH);
    digitalWrite(PIN_2, HIGH);
  }else if(letter=='d'){
    digitalWrite(PIN_1, HIGH);
    digitalWrite(PIN_2, HIGH);
    digitalWrite(PIN_4, HIGH);
  }else if(letter=='e'){
```

Fig 6. Code Snippet for the Arduino IDE

V. Hardware and Working

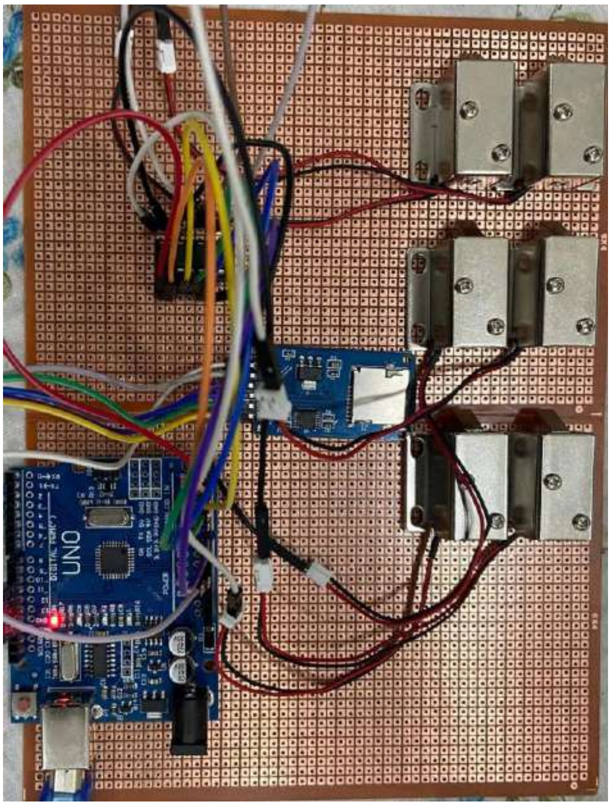

Fig 7. Hardware

A. After completing the first step of proteus simulation of our braille writer, we get the basic idea on how to implement it using hardware.

B. Micro SD card stores e-books, which are to be converted into braille codes, by the micro controller.

C. We give a power supply of 5V to the ATMEGA 32.

D. The micro controller reads the e-books from the SD card.

E. ATMEGA 32 (microcontroller) is coded in the embedded C language in the AVR Studio software. Its purpose is to convert the characters in the e-book into its respective ASCII values, and then converted into Braille codes. All of this will be done character by character.

F. For a single character in the e-book, let's say 'a'. Its ASCII value is 0097. The braille code produced for it is 0b01000000, by the microcontroller. This braille code is then sent to the driver circuit.

G. The driver circuit based on the braille code decides the dots which are to be raised.

H. The ULN 2003A receives the input from Atmega328 and then sends the output, and depending on the output, the solenoids move and form a letter according to braille language.

I. According to the control signals sent, out of 6, some or all the control signals will start working and the solenoids will push the beads at the the top of each of them, to raise it on the braille character dots. This character is then read by a visually impaired person.

J. The entire process will be taking place at a high refresh speed of around 7.5 characters per second.

Acknowledgment

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