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A SYSTEM TO CONVERT ELECTRONIC MESSAGE TO BRAILLE FOR VISUALLY IMPAIRED

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***Abstract*— The visually impaired are the people who can have permanent or temporary loss of vision. Such people cannot see, read or write as normal human beings. There are several substituting equipment's and aid to help them to lead a normal life. Similarly to read, Braille notations are used. These Braille notations These Braille editions are available for each language. This paper introduces design of a new independent electronic device which enables a visually impaired person to read messages from cell phones. Despite of technological these persons are unable to utilize the opportunity to share messages through modern gadgets without help from normal persons. Here the message received in a mobile phone is converted into Braille format using Arduino Due. This is also an initiative to reduce the difficulties faced by visually challenged persons to read messages from modern gadgets autonomously with ease and comfort.**

***Index Terms*— Braille letters, Arduino Due, ARM Cortex M3, vibration motor, Bluetooth HC-05 kit.**

I. INTRODUCTION

Blindness is one of the largest disabilities in the world. From the statistics of world health organization 285 million people are visually challenged worldwide, 39 million people are blind and 246 have low vision. Visually challenged people can play an effective role in the society with the help of many assistive devices. In the modern world with rapid advancement in communication process, gadgets like cell phones and emails have become an inseparable part of modern lives. One of device was a reading aid[6] with a lens system to form a 1.6 x magnified image on a 24 x 6 array of 10-mil diameter fibers. The fibers were bundled into a flexible cable, which transmits the image to the phototransistors and electronics and each fiber were connected to a corresponding phototransistor. These arrangement enable to build a probe small enough to be moved very close to the binding of most books to scan the complete line that was printed. The image was send to the phototransistors and electronics and each fiber being connected to a corresponding phototransistor. These arrangements enable to build a probe small enough to be moved very close to the binding of most books to scan the complete line that was printed. It consists of a photo sensor whose aperture was equal to or smaller than the line width of the letters for sampling the image. After recognition, the corresponding characters were given as the tactile output to the user. In this work, the scanning of text and recognition of the text was not very efficient and they were not able to resolve the characters every time. In another work [2][10], it describes an aid to read the hand printed documents for the visually impaired people. It follows a structural rule-based character recognition system using topological analysis of character's profile. This was used to obtain the character's profile from boundaries of individual characters within the digitized image and thus character classification, which will be difficult to identify the varying patterns of hand written documents. The four profile analysis was not efficient to detect the character. After recognition, it is more difficult to apply text to speech because it need too large database. Recently, an electronic pen [4][8] aiding visually impaired to read the text was proposed. They suggest for the use of a pen which consists of a camera, conversion software, word repository, text-to-audio converter .Using multicast or broadcast modes such as wi-fi or unicast the message using ZigBee protocol, the audio stream can be shared among peers. The text to audio conversion requires huge database. The system has to recognize the each character and thus the word then find the word's appropriate audio file from the huge database and then transmit them.

Another electronic reading aid [3] where the printed text was captured and it will recognize the character using the OCR system. The ARDUINO UNO board receives the ASCII representation of the character OCR system which correspondingly actuates the Braille display. The visually impaired person could understand the printed text when they touches the Braille setup. Other handheld devices that are developed for visually impaired people are web browser[9], ultrasonic sensor for range measurement [8]etc.,

II. DETAILED VIEW OF DEVICE

A. *Braille*

Braille is a series of raised dots that can be read with the fingers by people who are blind or whose eyesight is not sufficient for reading printed material. Teachers, parents, and others who are not visually impaired ordinarily read braille with their eyes. Braille is not a language, but it is a code by which other languages may be written and read. device. The standard cells have one to six dots. The dots are arranged in two parallel columns of three positions each [6]. Fig. 1 shows the representation of the English alphabet in Braille. Thus the Basic requirement for a person to use this device is that he/she should have a basic knowledge of the Braille letters. Braille symbols are formed within units of space known as braille cells. A full braille cell consists of six raised dots arranged in two parallel rows each having three dots. The dot positions are identified by numbers from one through six. Sixty-four combinations are possible using one or more of these six dots. A single cell can be used to represent an alphabet letter, number, punctuation mark, or even a whole word.

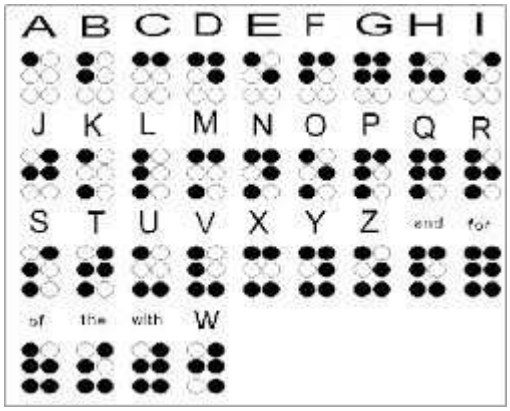

Figure 1:Braille letters

B. *Arduino Due*

The Arduino Due is a microcontroller board based on the Atmel SAM3X8E ARM Cortex-M3 CPU. It is the first Arduino board based on a 32-bit ARM core microcontroller. It has 54 digital input/output pins (of which 12 can be used as PWM outputs), 12 analog inputs, 4 UARTs (hardware serial ports), a 84 MHz clock, an USB OTG capable connection, 2 DAC (digital to analog), 2 TWI(Two Wire Interface), a power jack, an SPI header,a JTAG header, a reset button and an erase button. The board contains everything needed to support the microcontroller; simply connect it to a computer with a micro-USB cable or power it with a AC-to-DC adapter or battery to get started. The Due is compatible with all Arduino shields that work at 3.3V. The Due has a 32-bit ARM core that can outperform typical 8-bit microcontroller boards. The most significant differences includes a 32-bit core, that allows operations on 4 bytes wide data within a single CPU clock. ,CPU Clock at 84Mhz,96 KBytes of SRAM, 512 KBytes of Flash memory for code,a DMA controller, that can relieve the CPU from doing memory intensive tasks. The bootloader is preburned in factory from Atmel and is stored in a dedicated ROM memory. The available SRAM is 96 KB in two contiguous bank of 64 KB and 32 KB. All the available memory (Flash, RAM and ROM) can be accessed directly as a flat addressing space.It is possible to erase the Flash memory of the SAM3X with the onboard erase button. This will remove the currently loaded sketch from the MCU. To erase, press and hold the Erase button for a few seconds while the board is powered.

C. *Programming of Arduino*

The Arduino Due can be programmed with the Arduino software .Uploading sketches to the SAM3X is different than the AVR microcontrollers found in other Arduino boards because the flash memory needs to be erased before being re-programmed. Upload to the chip is managed by ROM on the SAM3X, which is run only when the chip's flash memory is empty. Either of the USB ports can be used for programming the board, though it is recommended to use the Programming port.

Programming port can be used by selecting "Arduino Due (Programming Port)" as your board in the Arduino IDE. Connect the Due's programming port (the one closest to the DC power jack) to your computer. The programming port uses the 16U2 as a USB-to-serial chip connected to the first UART of the SAM3X (RX0 and TX0). The 16U2 has two pins connected to the Reset and Erase pins of the SAM3X. Opening and closing the Programming port connected at 1200bps triggers a “hard erase” procedure of the SAM3X chip, activating the Erase and Reset pins on the SAM3X before communicating with the UART. This is the recommended port for programming the Due. It is more reliable than the "soft erase" that occurs on the Native port, and it should work even if the main MCU has crashed.

Native port can be used by selecting "Arduino Due (Native USB Port)" as your board in the Arduino IDE. The Native USB port is connected directly to the SAM3X. Connect the Due's Native USB port (the one closest to the reset button) to your computer. Opening and closing the Native port at 1200bps triggers a 'soft erase' procedure: the flash memory is erased and the board is restarted with the bootloader. If the MCU crashed for some reason it is likely that the soft erase procedure won't work as this procedure happens entirely in software on the SAM3X. Opening and closing the native port at a different baud rate will not reset the SAM3X.

D. *Vibration motors*

The Vibration motors are arranged in a 3x2 matrix which form a refreshable Braille display. Vibrations are produced in these motors corresponding to the Braille alphabet Vibration motor is a compact size coreless DC motor used to informs the users of receiving the signal by vibrating, no sound. Vibration motors are widely used in a

variety of applications including cell phones, handsets, pagers, and so on. The main features of vibration motor is the magnet coreless DC motor are permanent, which means it will always have its magnetic properties (unlike an electromagnet, which only behaves like a magnet when an electric current runs through it); another main feature is the size of the motor itself is small, and thus light weight. Moreover, the noise and the power consumption that the motor produce while using are low. Based on those features, the performance of the motor is highly reliable. The vibration motors are configured in two basic varieties: coin (or flat) and cylinder (or bar).Vibration used here is cylinder type. The rotor is the non-stationary part of a rotary electric motor. The wires and magnetic field of the motor are arranged so that a torque is developed about the rotor's axis. The stator is the stationary part of a rotary electric motor. It could be worked as the magnet field and interact with the armature to create motion. Another function of the stator is it could act as the armature, which receives its influence from moving field coils on the rotor. A commutator is a rotary electrical switch in certain types of electric motors or electrical generators that periodically reverses the current direction between the rotor and the external circuit. In a motor, it applies power to the best location on the rotor, and in a generator, picks off power similarly. As a switch, it has exceptionally long life, considering the number of circuit makes and breaks that occur in normal operation. The armature in this motor is a set of thin metal plates stacked together, with thin copper wire coiled around each of the three poles of the armature. The main function of the armature is to convert the magnetic energy into the kinetic energy. In order to make a vibrating alert, a weight mass need to be attached to the shaft. Through the high speed displacement of weight, the vibration can be achieved.

The cylinder shape is also called bar-type vibration motor. This vibrating motor is essentially a motor that is improperly balanced. In other words, there is an off-centered weight attached to the motor's rotational shaft that produces a centrifugal force while rotating. This unbalanced force displaces the motor. Its high speed displacement makes the motor to wobble, which is known as the “vibrating”. The wobble can be changed by the weight mass you attach, the weight's distance to the shaft, and the speed at which the motor spins. What’s more, the centrifugal force, which is generated by the rotating an unbalanced weight, causes the motor vibrate in 2 axis (Z axis and X axis). Besides, the centrifugal force can be calculated through the equations on figure 3. According to the relationship of each components in this equation, it is easy to tell that a larger weight mass with a bigger offset from the shaft will produce more force and hence more vibration amplitude. Moreover, increasing the voltage supplied to the motor will increase its speed, and therefore the vibration frequency, as well as the vibration amplitude. The input voltage of cylinder vibration motor is from 3.3V to 5V.

Figure 2: Vibration motor

E. HC-05 Bluetooth module

Bluetooth is a wireless technology standard for exchanging data over short distances. Bluetooth was standardized as IEEE 802.15.1, but the standard is no longer maintained. Bluetooth operates in the range of 2400–2483.5 MHz (including guard bands) [5]. This is in the globally unlicensed Industrial, Scientific and Medical (ISM) 2.4 GHz short-range radio frequency band. Bluetooth uses a radio technology called frequency-hopping spread spectrum. The transmitted data is divided into packets and each packet is transmitted on one of the 79 designated Bluetooth channels. Each channel has a bandwidth of 1 MHz. The first channel starts at 2402 MHz and continues up to 2480 MHz in 1 MHz steps. It usually performs 1600 hops per second, with Adaptive Frequency-Hopping (AFH) enabled. The transmitted data is divided into packets and each packet is transmitted on one of the 79 designated Bluetooth channels. Each channel has a bandwidth of 1 MHz. The first channel starts at 2402 MHz and continues up to 2480 MHz in 1 MHz steps. It usually performs 1600 hops per second, with Adaptive Frequency-Hopping (AFH) enabled. HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 2Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Bluecore 04-External single chip Bluetooth system with CMOS technology and with AFH(Adaptive Frequency Hopping Feature).

Figure 3: HC-05 Bluetooth module

The input voltage required for Bluetooth HC-05 is 3.3V. The pins available in this module are Vcc, Key, Reset, ground (Gnd), transmitter (Tx) and receiver(Rx). The transmitter (Tx) should be connected to receiver pin and receiver pin should be connected to the transmitter pin of Arduino Due respectively [5].

III. WORKING OF DEVICE

The Braille format is generated using Braille format setup connected to Arduino Due. Braille format setup consists of six cylinder type vibration motor which is arranged in a 3x2 format. The visually impaired person can sense the Braille alphabets using his two fingers which will be according to the universal Braille code. The materials such as sponges which will not transmit the vibrations are chosen and the vibrators are mounted over it. Bluetooth device in the mobile phone act as the master which is used to transmit message and HC-05 Bluetooth device act as slave which is used to receive the message. Baud rate of HC-05 should be set as 9600bps for data transfer. HC-05 is powered from the controller and the receiver pin used to receive the message. The Bluetooth device available in the mobile phone should be paired with HC-05 for Bluetooth communication to take place. An android application is used to send the message received in the mobile phone to controller using Bluetooth communication, so the mobile should support the android application. The figure.5 shows the block diagram of the working of the device.

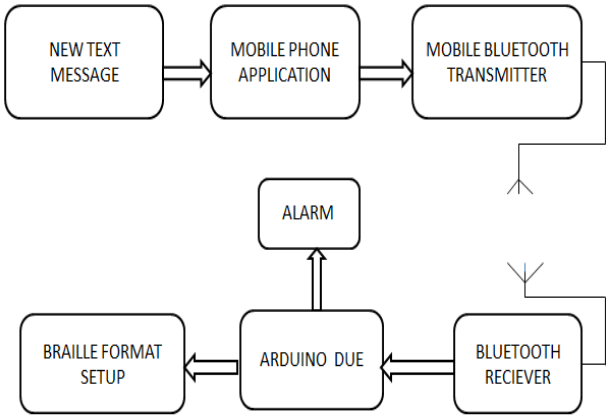

Figure 4: Block Diagram

When a new message is arrived in the mobile phone, the android application used will transfer the message to Arduino Due controller using Bluetooth communication. The HC-05 Bluetooth module used in the controller will receive the message from the mobile phone. Then the message received will be used to generate corresponding Braille code according to Universal Braille Code. The vibration motors arranged in 3x2 format is used to generate the Braille format. The visually impaired person can sense the Braille code using their fingers.

IV. CONCLUSION

This portable device will generate Braille format using vibration motor. The visually impaired person can sense the Braille letters using their fingers. Now, this device will generate Braille letters for English language only. In future, the system can be implemented to generate Braille letters for any languages.

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