Audible Tool for Color Identification Using Arduino UNO

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***Abstract*- This hardware tool is designed for assistance and training for visually impaired people to identify the surrounding colored objects. Several researches are conducted all over the world to design advanced, reliable tool and techniques to support sightless individuals. This paper describes designing of a handheld device to assist visually impaired people for color identification via generated speech. Vision is one of the five senses which is essential for a human being to survive independently. All individuals acquire the external information through the visual coding entering into the eye. The light rays penetrate and stimulate vision receptors to execute the processing of image formation. In response, the brain is able to identify the object. Unfortunately, any accidents or visual disorders with age can restrict the ability to sight the external environment. A visually impaired person can identify the texture, shape and size of an object by touching. But the sense of touch does not permit color identification. This proposed wearable tool, aid mainly focuses on individuals who are unable to observe colors due to visual disorder. A hardware device is presented which generates the speech for color detection. In this proposed work RGB sensor is used to capture the color information of the entity. An Arduino UNO card is programmed using Arduino software 1.6.3 to enhance the signal. It generates a clear audible speech for the specific color of the object. The benefit of this device is low power battery operated, portable, safe and easy to handle.**

***Index Terms*- Color Identification, Arduino UNO, Audible Tool, RGB Sensor**

I. INTRODUCTION

Eyes are the essential and most important organ for vision. The visual information from the surrounding is carried by the eyes. Light rays reflected from the objects enter into the eyes and convert it into electrical signals which are detected by brain [1]. Any disability in the transmission of the signals due to accidents or disorder may produce visual impairment or blindness. The blindness may not be treatable in some cases and lead to the life time blindness to the effective person. The difficulties in the normal daily life may occur and dependencies of the effected person also disturb the people in the surrounding. According to the survey of (World Health Organization) WHO global data the 86% of people had low vision and 13% of people are blind among a large number of people. The survey conduct under certain circumstances may vary according the condition [2].

Nathan et al conducts a survey in assistance with WHO in United States. The report indicates several causes for the blindness, depending upon the age factors. The survey indicates occurrence of cataract among the population of the age group above 40 years [3]. The report further mentions the cataracts are one of the major leading causes of visual impairment in the world [4].

In addition, accidents and trauma can also lead to vision loss [5]. Such type of disability makes an individual unable to obtain visual information from the surroundings. This deficiency limits the identification of the object shape, texture and color available in the environment.

Identification of colors plays a vital role in daily routine activity for an individual. In a normal activity a person can choose personnel belongings according to the color and style. A visually impaired person suffers from huge challenge during such activities as they are dependent on others. Such type of individuals needs assistance for various activities. Various researcher works have been done around the world and the researchers are putting the effort to design handy and reliable devices to assist the visually impaired persons, which can provide aid and easy life style for visual impaired people.

The researcher Shoval et al work on the assistive tool for the blind people and designed the portable obstacle avoidance wearable belt. The device is only able to alarm the obstacle so the person can move from one place to another without hitting the object. The drawback of the device, it is not able to identify the color of the object by the sensor placed in the belt [6].

The researcher Ibrahim Patel et al also works for the betterment for the visual impaired person, the researcher proposes the device to make the blind person able to drive as normal person. The device was also able to distinguish the reflective and non-reflective. The drawback of the device is that it can only be used in the driving and cannot assist the person to recognize the normal colored object [7].

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Another color detection device is designed by the researcher G. Mc Morrow to play a specific sound and tone according to the different colors. The drawback of the work is that the user must memorize several tones according to different colors [8].

II. METHODOLOGY

The basic idea of this work is based on the proposition of a device with improved designing concept of speech generation and color identification via an RGB sensor and the Arduino for blind people. This device is subdivided into two parts, hardware and software. Fig. 1 represents the basic diagram of the device.

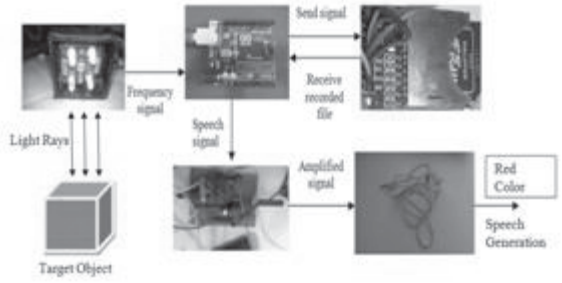

Fig. 1. Basic idea of the research.

Hardware

The hardware design of the device is subdivided into several stages; several components and module are used in the device to work in a specific manner to produce required output.

The hardware consists of RGB sensor, Arduino UNO card, Audio filter, SD card with shield and headphones. Each part of the hardware is used for the specific task. The set of instructions is written in Arduino software version 1.6.3 to program Arduino UNO card for respective color speech generation via headphones. Fig. 2 shows the connected components and functional diagram of the device.

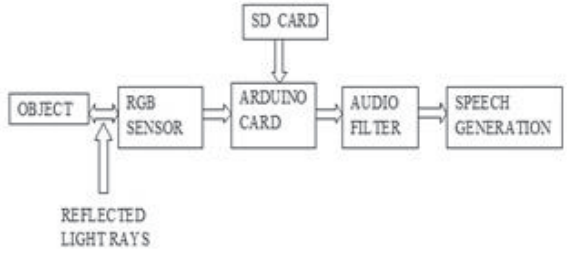

Fig. 2. Functional block diagram of hardware.

RGB Sensor

The RGB TCS3200 sensor is low powered color to frequency converter; it is the main component of the device. It can detect approximately all ranges of visible colors and converting light into specific frequency as output. It captures the amount of reflected light from the object and generates a particular range of frequencies [9]. The darkness and brightness of the color create variation in the generated frequencies. The module is accurate and generates a particular digital frequency for specified colors.

Arduino Uno Card

Arduino UNO card is microcontroller based kit used for designing of battery operated digital device which can sense information from physical environment via sensor [10]. A significant feature of the Arduino is its typical connectors, which allow the users to connect the CPU board to a variety of add-on modules known as shields. Some shields communicate with the Arduino board directly over various pins. A RGB sensor is connected to the reprogrammable Arduino UNO.A digital frequency from the RGB sensor made input to the digital I/O pin of Arduino board. Input is given to the UNO card from the sensor and it produces a digital output according to the set of program stored in the memory.

SD Card Shield Module

An SD (Secure Digital) card shield is one of the module which can be connected to Arduino card for application devices. As a card is used externally a number of wav file is recorded. In this device, Speech regarding the particular color name is recorded on the SD card for audio playback. This audio recording is generated for the user aid in identification of color for respective frequency ranges.

Audio Filter

The audio filter and amplifier is designed specially to modify the output signal of the Arduino. Output from the Arduino card is transferred to audio filter. The audio filter is a frequency dependent amplifier circuit, working in the audio frequency range 0 Hz to beyond 20 k Hz. In this device Integrated Circuit LM386 is used to design a Low pass filter which filters the audio output from UNO card as well as amplifies the generated output to make it audible [11].

Software

A designed set of instruction can be written on the microcontroller on Arduino board to perform a particular task [12]. In this work an algorithm is designed in Arduino software 1.6.3 to compare the generated frequency via an RGB sensor and play respective audio recording stored in SD card for a particular color. The logical operation of this work is performed on Arduino UNO card. It allows the device to be used as a small stand-alone tool. Comparison logical instruction is used to compare the data generated from RGB sensor and play

the sound from SD card. The flowchart of the project is represented in fig.3.The loop and logical instruction is compared according to the range of frequencies and selects the particular wav file automatically.

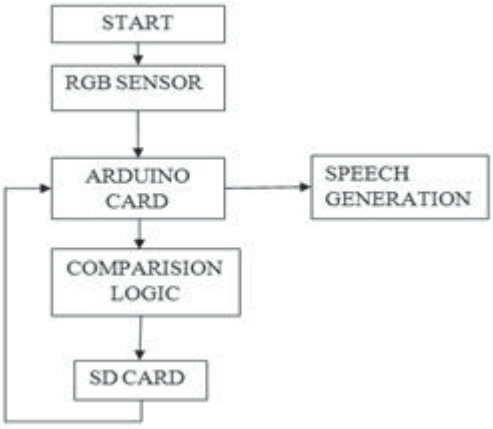

Fig. 3. Work flow of the logical program.

III. RESULT AND DISCUSSION

The designed hardware is able to generate the speech, according to the input color shown to the RGB sensor. The device is low weight, battery operated, easy to handle and the person can identify the colors of the object when needed. Fig.4. (a) shows the output waveform of the RGB sensor recorded on the digital oscilloscope when the sensor is exposed to the Blue colored object. Fig.4. (b) shows the Arduino UNO output according to the same input object and RGB output waveform. Fig.4. (c) is the final speech generation of the word 'blue color', the wave file stored in the SD card played according to the set of frequency given by the Arduino to the SD card module.

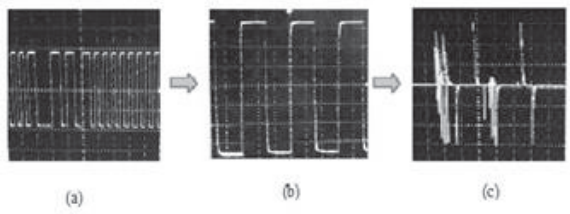

Fig. 4. Output waveform of the RGB sensor, Arduino UNO and speech generation.

The significance of the output is experimented on 10 different volunteers. Fig.5. shows the graphical representation of the comfort and the accuracy level from the 0 to 10 scale.

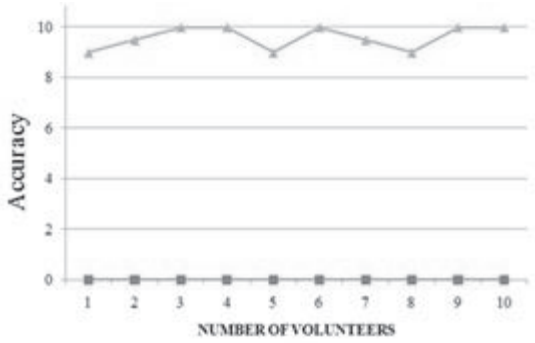

Fig. 5. Graphical representation of the accuracy scale.

The designed hardware assists the blind individual and they can easily carry the wearable device and identify the colors in the surrounding speech generated creates ease for the user to recognize colors in the environment and perform daily activity all alone. This device is easy to handle, portable, user-friendly and compact.

IV. CONCLUSION

The hardware and the speech generation of the devices work accurately and defined output is observed. The device is very unique and different to detect the colors. When interfaced with red color, the device generates the speech saying "RED Color". The same pattern is observed for all the colors defined in the device. The device is simple, configurable and an easy to handle electronic assistance, support for blind and visually impaired persons. The finest part about this device is that it can be used by the individual independently. User can adjust the volume level of sound to ease using the volume control. In addition, the user has the opportunity to operate the device using an adaptor or rechargeable batteries placed with the device. The Arduino UNO made able the user to reprogram the device in any other language required by the user of different areas and regions. The future enhancement in this device is that it can be modified into a wireless device.

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