COLOUR DETECTION DEVICE

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Abstract-- **This colour detection device is designed to help the blind people in identifies the colour of objects to recognize the four basic colours and speak the recognized colour. This project is one of the alternatives for use by vision-impaired people to allow them to perform basic colour recognition tasks and to handle their problem relies on colours to enjoy their activities and do the tasks or perform their jobs. This project uses a red, green, blue and yellow LED to illuminate a surface. The intensity of reflected light from each colour is measured with a photoresistor (LDR). The operation of the system is controlled by an Arduino Uno R3 microcontroller and the determined colour is spoken through an Emic 2 Talk-to-Speech module. This project is one of the ways to help the blind people's life simpler and practical in which they can be supported to lead independent and fulfilling lives.**

Index Terms— **colour sensor, light sensor, photoresistor (LDR)**

I. INTRODUCTION

Blindness is lacking visual perception due to physiological or neurological factors. Living in modern and developing world is not easy for blind people to deal with each day in their life since there is lot of challenges they have to face. One of the challenges is dealing with the colour. Therefore, this project is intended to develop a device which can detect four main colours and pronounce the determined colour. The main reason for the colour detection devices are:

i. *Help blind people distinguish colors.* It is a big problem for the blind people when dealing with the colour in order to recognize or identify the colour matching and colour sorting. The common way a blind people does colour matching is by getting someone's help or in other words, they need sighted assistance. Some of the blind people use to tag washable Braille stickers in inner parts of clothing as a way to help them to identify it. Tagging Braille sticker in clothing may take a long time to complete and this done by getting help from sighted people to place Braille stickers to the clothes.

ii. *Compact and easy to carry.* The hardware for this device is designed from plastic and polymorph which is it is easy to carry along and handle. This colour detection device will make their life simpler and practical. This device will flashes one LED once when an object appear the most reflect colours and it will send the colour had been recognize, into a voice through the headphone to the user. This will help the blind people during the time they went for shopping and outdoor usage.

iii. *Low cost.* There are already different device on the market, but it is very expensive and not useful for affordable. This colour detection device is developing using a minimum of parts for the lowest possible cost. It is combination of two module which is use colour sensor and Emic 2 module. Besides, it is also easy to use and practical to blind people to face and dealing with the world.

There are many existing colour detection in the market. Among others is Colorino. It is one of the assistive technologies that are designed for colour identifier which it can detect about 150 nuances of colour. This device is available to announce the nuance of colour in 20 different languages with a clear voice. [7] Colorino device is a better assistive technology since it can identify more colours. However, it is quite costly for the blind to own this device. Furthermore, by comparing these devices in pronouncing the determined colour, the colour detection device is better since it is designed to speaks the determined colour via headphone which is it can help more in outdoor usage.

Another colour identifier device exists in the market is rainbow color reader. This device can identifies approximately 38 colours. This device is a quite difficult to use because the user need to be properly place an article flat against the plastic window. Then the button on the top is pressed. When held up to a light, the unit reads "light." [9] The colour detection device is

easy to use in which the user need to point the device to the object and the recognized colour is spoken via headphone through Emic 2 module. It makes their life more simple and practical.

II. THEORY

The colour sensor in this project is build using four different LED colours and a light dependent resistor (LDR). The LED is used to point the object and the reflecting light from it will hit the LDR. LDR is to measure the intensity of reflected light.

A light dependent resistor (LDR) is a semiconductor product either cadmium sulphide or cadmium selenide arranged in a zigzag pattern. [6] The resistance of the material varies with incident light. Current will flow depending on the light intensity when it is connected to an external battery. The current is controlled by incident light. There is no pn junction in LDR as in the case of diode, solar cell or LED. It is a surface phenomenon.

Figure 2.1: 20mm LDR

The light photons falling on LDR surface excite electrons in the valence band. The electrons move to the conduction band by absorbing energy. [6] The resistance of the material is decreased by this movement. The light intensity increases with the current. As the light intensity increases and more electrons move to the conduction band increasing the current or decreasing LDR resistance. [6] The effect of light intensity is seen as resistance variation in LDR. The LDR resistance is given by

RLDR = Rdark L-b …1
Where

RLDR is LDR resistance
Rdark is the LDR dark resistance (Resistance without light)
L is the light intensity at the surface of the LDR in Lux
b is a constant depends on the material

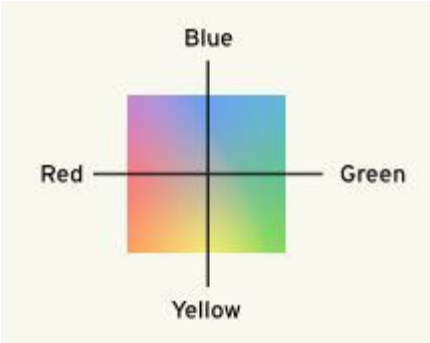

Figure 2.2: A modern representation of color space. This is conceptually similar to Hering's circles, but the middle fades to gray.

Colour is simply light of different wavelengths and frequencies and light is just one form of energy that can actually see that is made up from photons. [8] The wavelength and frequency of each colour is different. Although white could be said to be a colour, it is generally not included in the scientific spectrum as it is in fact made up of all the colours of the spectrum, but it is often referred to being a colour. [8]

The amount of energy in a given light wave is proportionally related to its frequency. [8] Thus, a high frequency light wave has a higher energy than that of a low frequency light wave.

III. PROJECT DESCRIPTION

Figure 3 shows the operations of the colour detection device. Once the supply is on, all four colours of the LEDs blinking continuously and the pointed object is illuminated by each LED colour. The most colours that are reflected from the object pointed will fall on the photoresistor (LDR). Then, the photo resistor (LDR) measures the intensity of the reflected light from object pointed. The value of light intensity will be showed in the serial monitor. The decision to determine the colour detected is depending on the highest intensity of reflected light from the object pointed. When the sensor recognizes the correct colour and one of the LED colour will flashes depend on the decision made. Then, the determined colour is spoken through an Emic 2 Talk-to-Speech module.

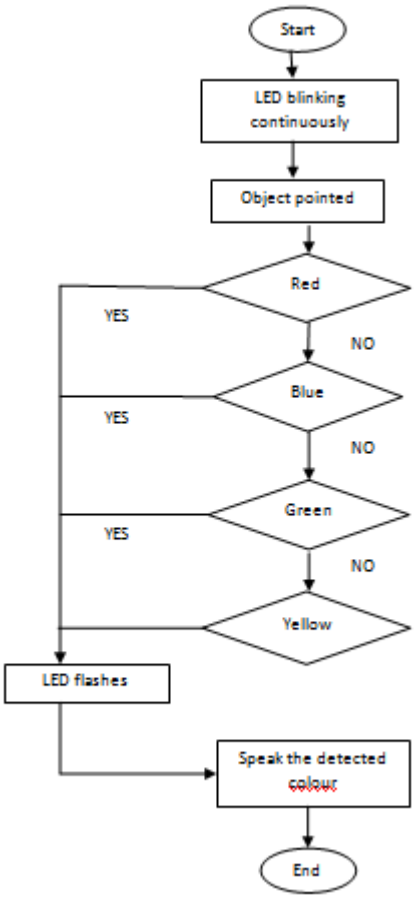

Figure3: Flowchart of the colour detection device

IV. CIRCUIT DESCRIPTION

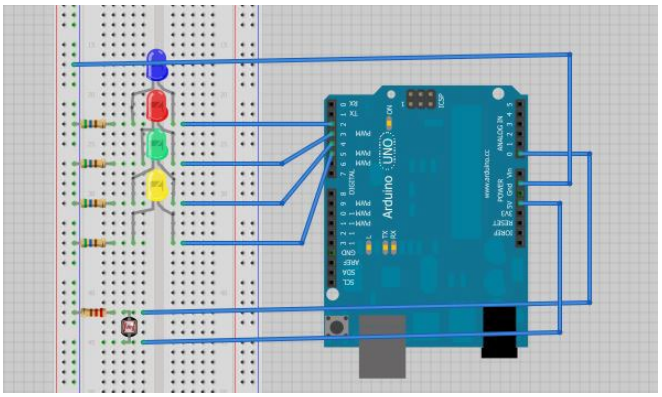

Figure 4.1: Colour sensor

Figure shows that the schematic circuit for colour detector which is uses Arduino Uno as a microcontroller. This colour sensor used LDR to measure light intensity that reflected from the object pointed. LDR is connected to analog pin A0. Each of the four colours of the LEDs is connected in series with resistors 560 Ohms. All of the LEDs are connected to digital pin D2 until D5.

The Emic 2 module uses only four connections which are ground and 5V connect to power pin of the Arduino. SOUT and SIN pin are connected to digital pin D2 and D3 of the Arduino. For audio output, the SP+ and SP- pin direct interfacing to an 8Ω speaker connection.

V. SOFTWARE AND HARDWARE

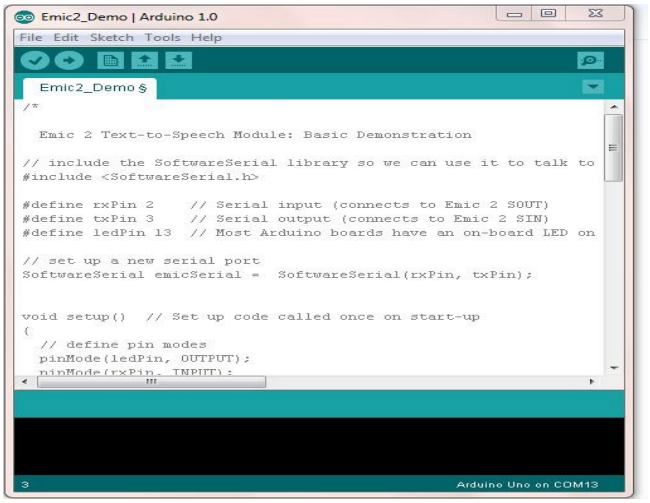

Figure 5.1: Arduino Software

The software that is used in this project is Arduino software. The microcontroller on the board is programmed using the Arduino programming language and the Arduino development environment. [10] This software is an open source Arduino environment that is easy to write code for the hardware functioned. The colour sensor will perform the task according to the command that is uploaded into the memory of the microcontroller on the board using a serial or USB connection.

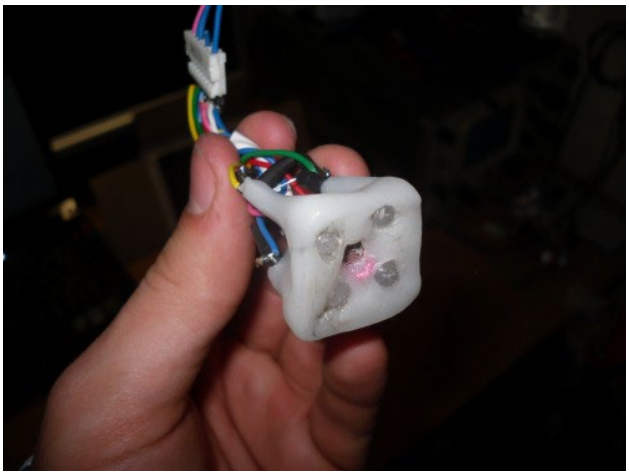

Figure 5.2: An example hardware of colour sensor

The hardware design for the colour sensor is designed like torchlight. It consists of LDR in the middle and it is surrounded with all four LEDs colour. Therefore, the reflected light rays from the object pointed fall on the LDR, and the LDR can measure the intensity of light accurately. This device is designed small and simple from plastic or polymorph. It is easy to use and practical to carry along for blind people to perform their daily life.

VI. RESULT AND DISCUSSION

A particular colour can be represented as a combination of other colours. The white colour is a representation of seven distinct colours of the visible spectrum, red, orange, yellow, green, blue, indigo and violet. Light sensors have different sensitivities towards different wavelengths of the visible spectrum.

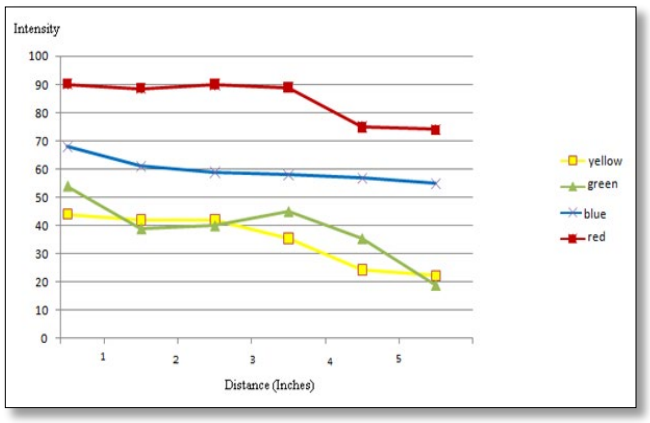

Figure 6.1: Light intensity versus distance.

Figure 6.1 shows the light intensity versus distance. Each colour has different light intensity. It shows that red has the highest light intensity, second highest is green colour, followed by the blue and yellow colour. From the graph, it shows that the maximum distance that the most reflected light is captured is at 1 inch. When the distance is increased, the light intensity is decreased. However there are a few samples that are pointed do not reach the high level of light intensity within range 1 inch. It is because when the angle between an object and the sensor is not perpendicular, the reflected light will not all be captured and fall onto the target surface of the LDR. The intensity of reflected light will change when the angle of the object pointed is changed. Therefore, the best result is to keep the sensor perpendicular to sample surface.

When the distance between the colour sensors to reflective surface is increased, the light intensity is decreased. This is because of the ambient light of sunlight coming in through the object is distracted the reflected light to fall onto the surface of the LDR. Therefore, it needs to shield the sensors from this light in order to get the right and accurate measurement for the intensity of reflected light.

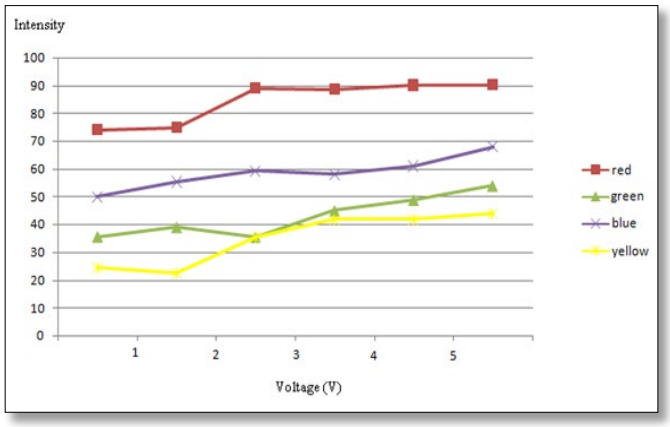

Figure 6.2: Light intensity versus voltage.

From the graph in figure 6.2, it shows that light intensity is proportional to voltage. The voltage increase linearly with the intensity of the reflected light and the resistance of the photoresistor (LDR) will be low.

Voltage = sensorValue*(5.0/1023.0)

The voltage is measure between 0V to 5V. The equation is use to measure the value voltage at each pin of LEDS.

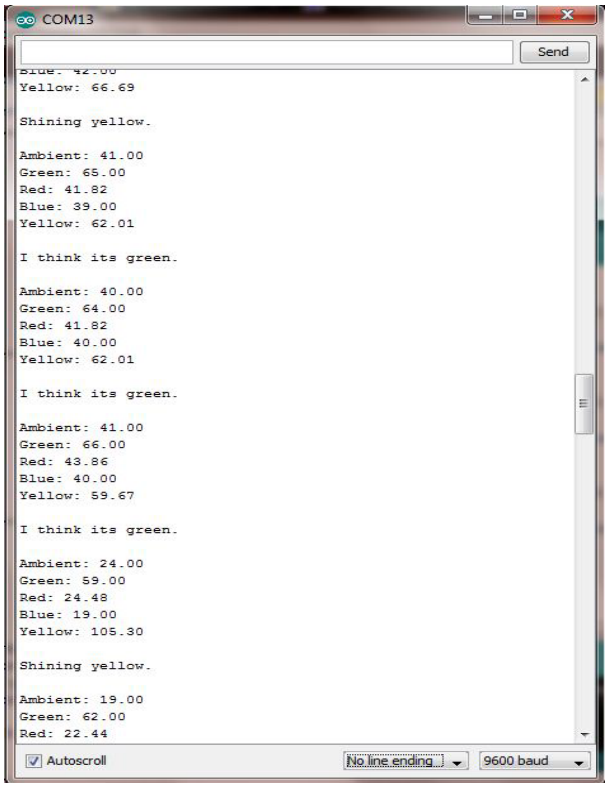

Figure 6.3: Arduino serial monitor.

	Colour of LEDs					Result
	Ambient	Green	Red	Blue	Yellow	LEDs blink the detected colour
Value	157	157	160.14	158	183.69	Yellow
	159	158	160.14	167	184.86	Yellow
	41	65	41.02	39	62.01	Green
	101	92	68.34	210	120.51	Blue
	65	84	66.3	227	104.13	Blue
	72	88	69.36	231	106.47	Blue
	15	53	17.34	14	17.55	Green
	4	51	9.18	4	5.85	Green
	152	153	516.12	515	177.84	Red
	154	154	518.16	157	177.84	Red

Figure 6.4: Data of the different samples object pointed.

Figure 6.4 shows the data that was collected from testing on a few samples of objects and the measurements of the light intensity are compared with data set in the command uploaded in to the software to conclude the resulting colour of the surface. By comparing these values to the ambient colour, the sensor will determine the colour of the object. There also a few times that the sensor fails to recognize the correct colour. This is because of the distracted in the reflected light. Once it has been recognized the reflected colour of the object, the determined colour is spoken through an Emic 2 Talk-to-Speech module and send via headphone or speaker to user.

VII. CONCLUSION

As the conclusion, all four different LEDs are able to detect the colour from the object pointed by using the LDR. The decision is made when the highest intensity of reflected light is captured. The objective of this project achieved whereby the Emic 2 module will pronounce the determined colour when the colour sensor detect the colour of the object pointed. The maximum distance to capture the light intensity is approximately at 1 inch. The advantage of this project is low cost maintenance since this device using a minimum of components for the lowest possible cost. It is also designed easy to carry around.

For future improvements, it is recommended to use TCS3200 colour sensor module since it has high resolution conversion of light intensity to frequency and it standoffs to set the optimum sensing distance.

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