Mehran University of Engineering and Technology (MUET), Jamshoro

DEPARTMENT OF TELECOMMUNICATION ENGINEERING

ARDUINO BASED COLOR DETECTION FOR VISUALLY IMPAIRED PROJECT REPORT:

PROJECT BY THIRDYEAR STUDENTS

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1. EXECUTIVE SUMMARY

Visual impairment is a widespread condition, affecting a significant portion of the global population. According to the World Health Organization, approximately 285 million individuals worldwide experience varying degrees of visual impairment, with 39 million suffering from complete blindness and 246 million having low vision.

While proper training enables blind individuals to lead fulfilling lives, there remain certain aspects that can significantly enhance their quality of life. This project focuses on addressing one such aspect: color detection.

The ability to detect and differentiate colors holds substantial importance for the visually impaired. It aids in various daily activities, including identifying the colors of clothing and recognizing distinctively colored objects such as paper currency. Moreover, it enriches their appreciation of art. This project aims to alleviate the challenges faced by visually impaired individuals by introducing a system for color detection that provides unique biofeedback for each color detected.

The proposed embedded system integrates an Arduino microcontroller, which interacts with the TCS230 color sensor to obtain RGB data. This data is then processed to classify the detected color based on a programmed lookup table within the controller. The identified color is displayed alongside its RGB combination, and an audio feedback system, facilitated by the DF player interfaced with the Arduino, informs the user about the detected color. Through rigorous testing, the embedded system demonstrated an impressive color identification success rate of 93%. This project not only offers a practical solution to enhance the lives of visually impaired individuals but also showcases the potential of embedded systems and technology in addressing real-world challenges.

2. GENERAL DESCRIPTION

Human vision is undeniably a crucial aspect of our physiology, serving as the primary channel through which we gather approximately 83% of environmental information. However, the number of individuals grappling with visual impairments continues to escalate annually. According to the 2011 statistics

compiled by the World Health Organization (WHO), the global population includes a staggering number of people facing visual impairments, with 39 billion experiencing complete blindness and 246 billion having varying degrees of low vision.

In a distinct development, a groundbreaking system emerges in , proposing a smart electronic aid tailored for the visually impaired. This innovative system aims to provide comprehensive artificial vision, real-time object detection, and assistance via a global positioning system (GPS), all orchestrated through a PIC microcontroller. Notably, the microcontroller circuit resides externally on the walking stick, fortified with robust security measures, with user feedback conveyed exclusively through a discreet vibration motor.

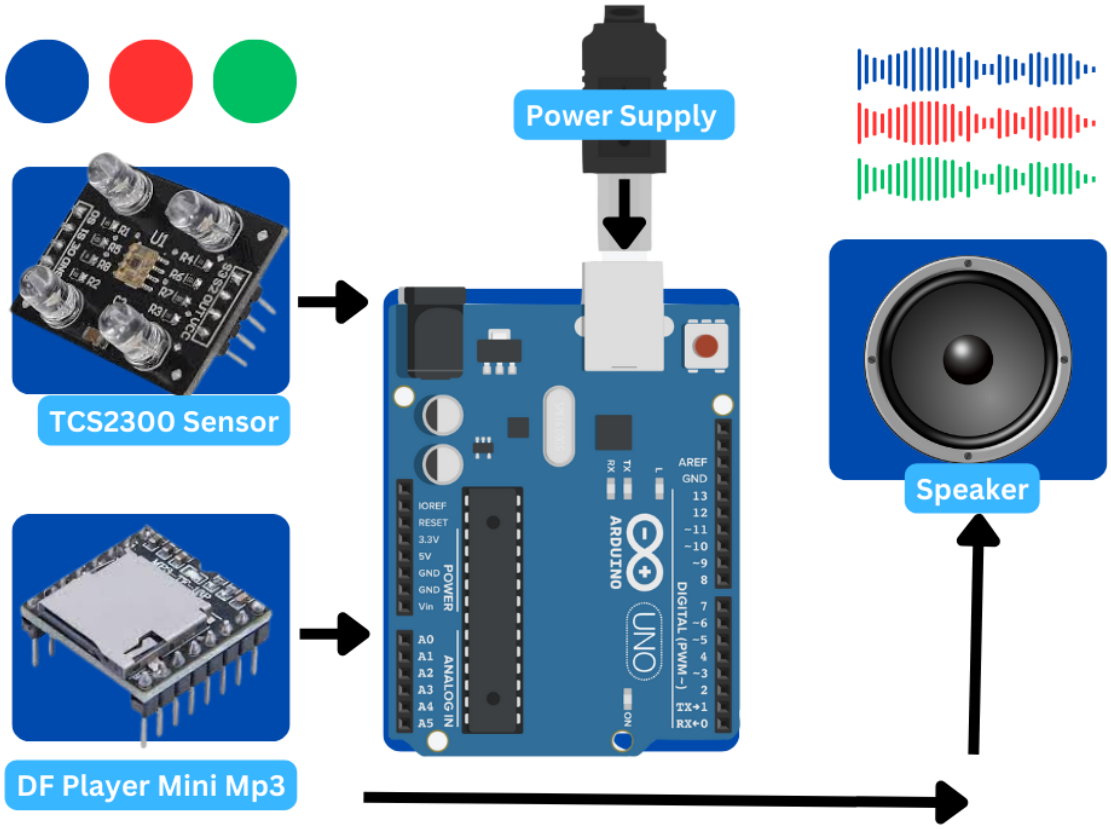
Further advancing this technological endeavor in, the implementation incorporates three distinct sensors, including a ping sonar sensor for detecting distant objects and a wet detector for water detection, all managed by a PIC microcontroller. Concurrently, the rapid proliferation of devices like Arduino in the evolving tech landscape gains prominence. The simplicity of Arduino programming not only enhances cost-effectiveness but also widens accessibility to individuals of varying programming aptitudes and age groups.

Drawing on localized statistics from 2012, it becomes evident that Turkey grapples with a substantial number of individuals facing diverse obstacles, encompassing 1,559,222 people. Among this cohort, approximately 213,077 individuals contend with blindness, constituting 14% of those dealing with general disabilities. This global challenge encompasses 284 million individuals, with a significant 80% of these obstacles being either treatable or preventable.

Within the realm of innovation, this study centers on the creation of a wearable device, comprising a lightweight blind stick augmented with an obstacle detection circuit relying on sensor technology. The primary objective is to enhance the navigational experience of visually impaired individuals by facilitating the tracking of distinctive yellow paths on the ground, ultimately making their road finding more comfortable.

3. TECHNICAL SOLUTION AND PROJECT DETAILS

Block diagram of proposed concept:

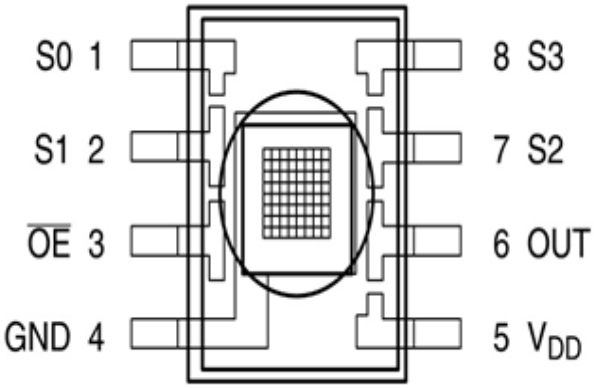


Components Used:

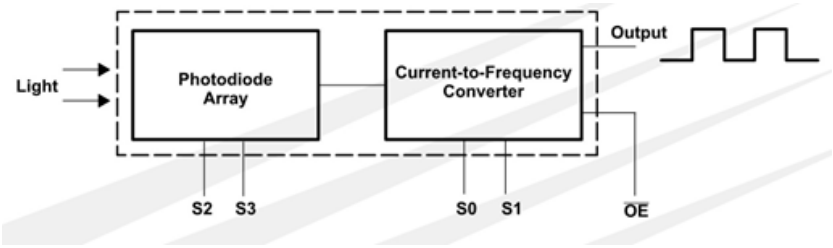
1. Arduino Uno
2. TCS2300 Color Sensor
3. DF Player Mini Mp3
4. 3W Speaker
5. 1K Resistor
6. Jumper Wires
7. Arduino IDE (Software)

Arduino Interference with TCS2300 Color Sensor:

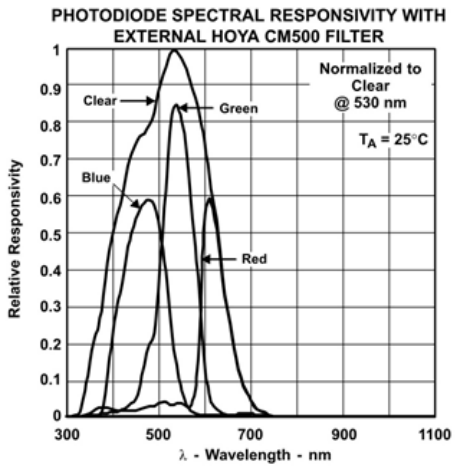
In this project we are going to **interface TCS3200 color sensor with Arduino UNO**. TCS3200 is a color sensor which can detect any number of colors with right programming. TCS3200 contains RGB (Red Green Blue) arrays. As shown in figure on microscopic level one can see the square boxes inside the eye on sensor. These square boxes are arrays of RGB matrix. Each of these boxes contain Three sensors, One is for sensing RED light intensity, One is for sensing GREEN light intensity and the last in for sensing BLUE light intensity.

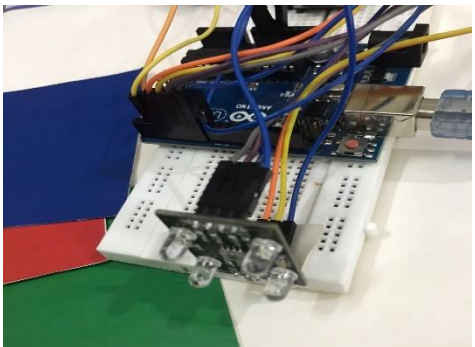


The control system inside the module is shown in figure. The light intensity measured by array is sent to current to frequency converter. What it does is, it puts out a square wave whose frequency is in relation to current sent by ARRAY.



The frequency scaling is done by two bits S0 and S1. For convenience we are going to limit the frequency scaling to 20%. This is done by setting S0 to high and S1 to LOW. This feature comes in handy when we are using the module on system with low clock.

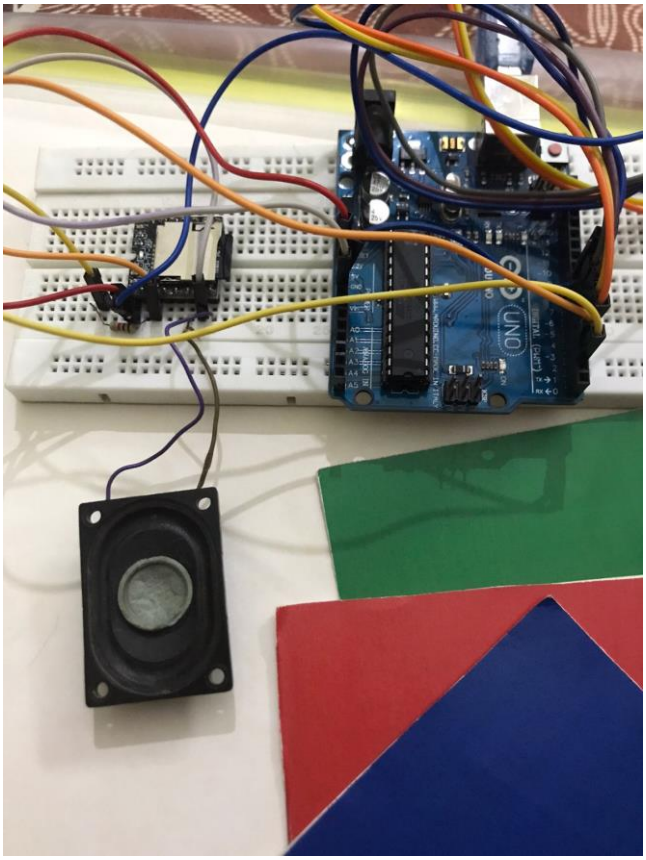


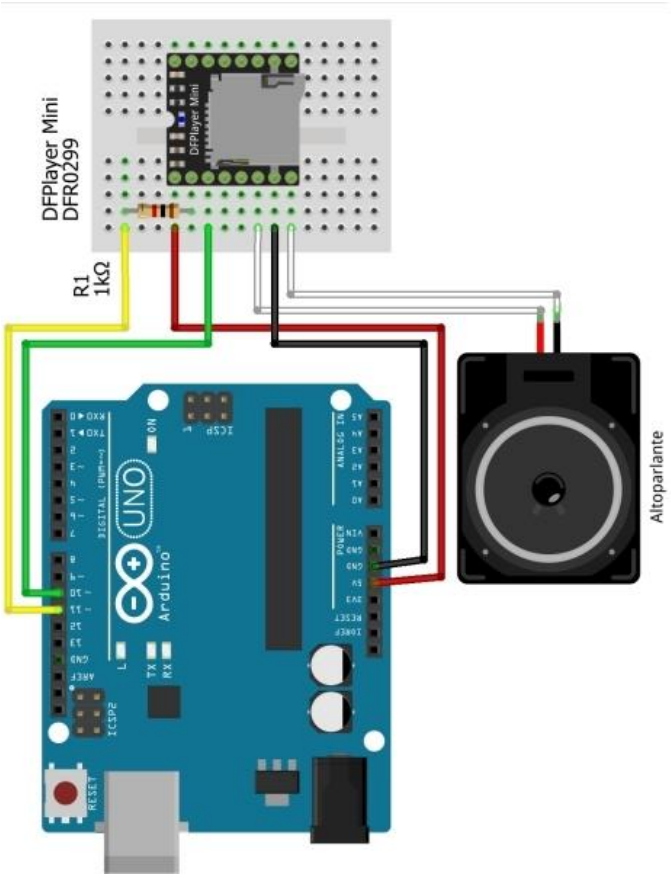


Arduino Interference with DF Player Mini Mp3 and Speaker:

The **DFplayer** mini is a small, low-cost mp3 module with a simplified audio output that can be connected directly to a speaker or an earphone jack. The module can be used as a stand-alone module with attached battery, speaker, and push buttons or used in combination with a microcontroller or development board like the Arduino, enabled for RX/TX (Serial) communication, thus through simple serial commands we can play music and perform other functions like playing the next and previous song, shuffle, pause the song currently being played etc. The module comes with an SDcard slot and supports both FAT16, FAT32 file system.

The DF Player perfectly integrates hard decoding module, which supports common audio formats such as MP3, WAV and WMA.





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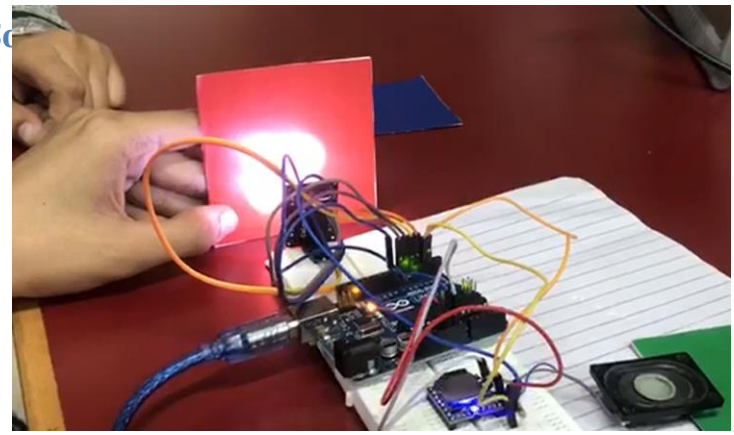
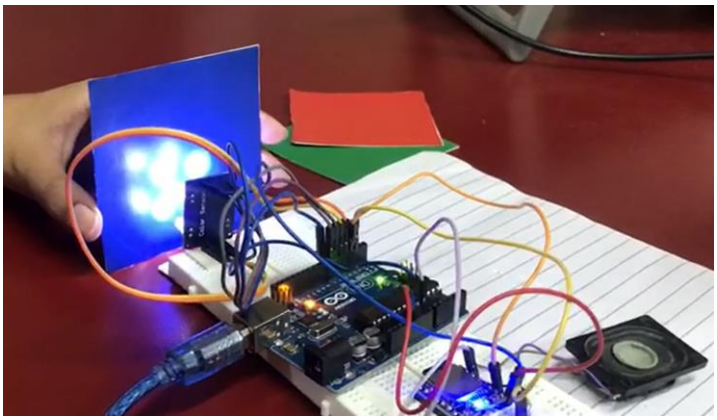


```
Arduino_Color_Sensor.ino   DFPlayer_Mini_Mp3.h
 6   static const uint8_t PIN_MP3_TX =
 7   static const uint8_t PIN_MP3_RX =
 8   SoftwareSerial softwareSerial(PIN_
 9
10   // Create the Player object
11   DFRobotDFPlayerMini player;
12
13   #define S0 4
14   #define S1 5
```

Output Serial Monitor ×

Not connected. Select a board and a port to connect aut

```
R = 293 G = 202 B = 94 - RED detected!
OK
```

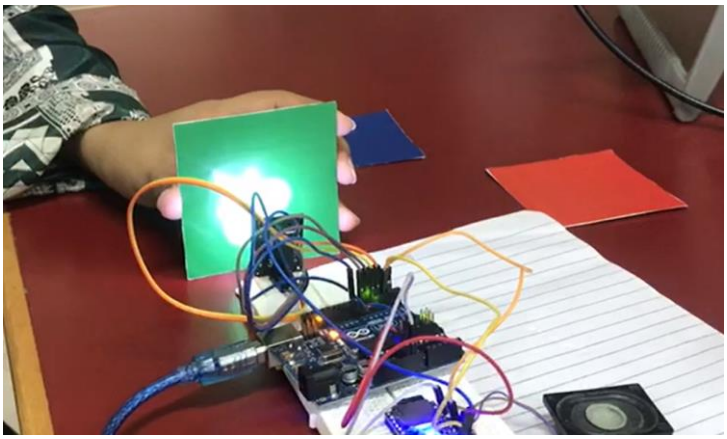


```
Arduino_Color_Sensor.ino   DFPlayer_Mini_Mp3.h
 6   static const uint8_t PIN_MP3_TX = 2; /
 7   static const uint8_t PIN_MP3_RX = 3; /
 8   SoftwareSerial softwareSerial(PIN_MP3_
 9
10   // Create the Player object
11   DFRobotDFPlayerMini player;
12
13   #define S0 4
14   #define S1 5
```

Output Serial Monitor ×

Not connected. Select a board and a port to connect automati

```
R = 376 G = 482 B = 520 - BLUE detected!
OK
```



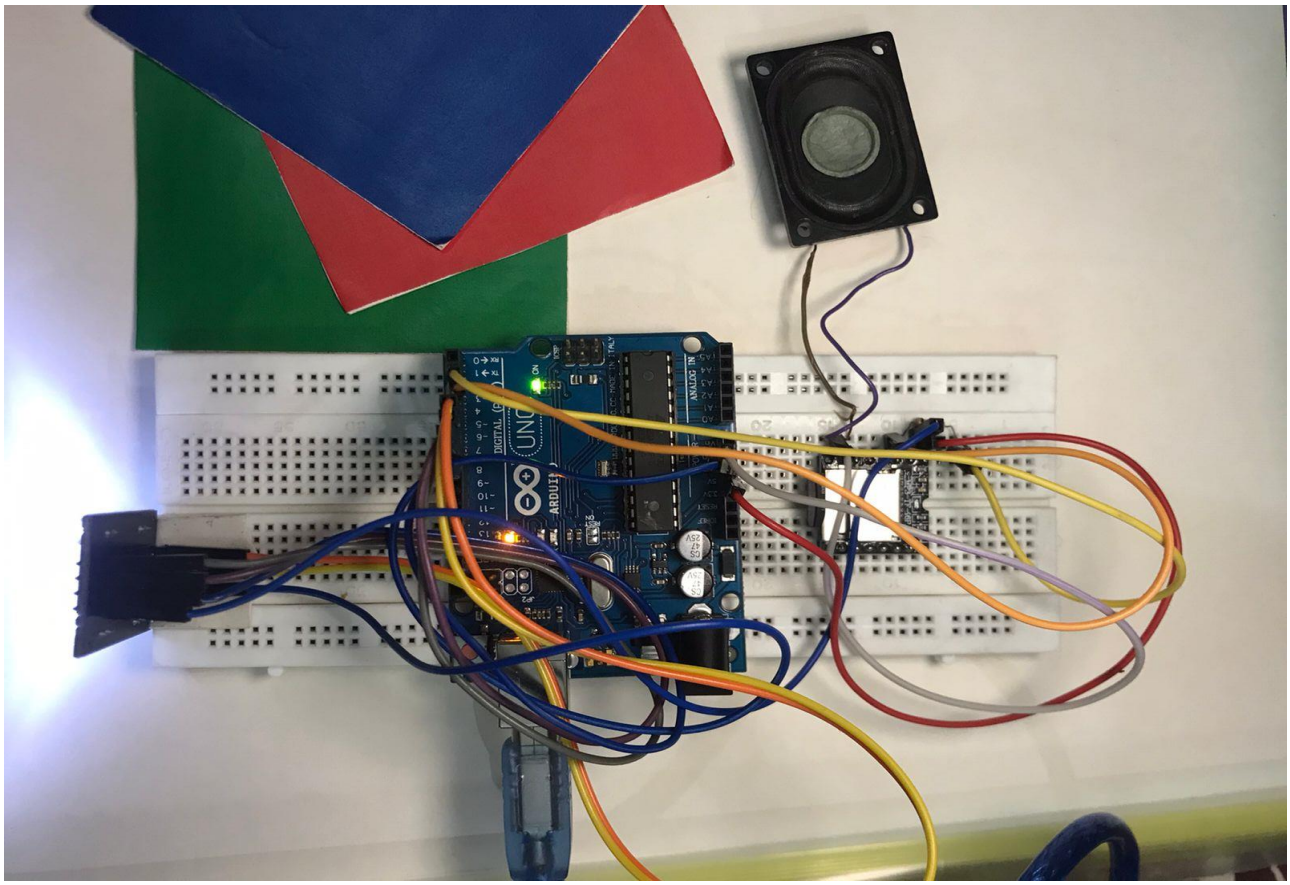
```
Arduino_Color_Sensor.ino   DFPlayer_Mini_Mp3.h
 6   static const uint8_t PIN_MP3_TX = 2; //
 7   static const uint8_t PIN_MP3_RX = 3; //
 8   SoftwareSerial softwareSerial(PIN_MP3_R
 9
10   // Create the Player object
11   DFRobotDFPlayerMini player;
12
13   #define S0 4
14   #define S1 5
```

Output Serial Monitor ×

Not connected. Select a board and a port to connect automatica

```
Connecting to DFPlayer Mini failed!
R = 129 G = 253 B = 27 - GREEN detected!
OK
```

Combined Working



The Arduino-based color sensor for the visually impaired project combines the power of the TCS2300 color sensor module and the DFMini player to create an innovative assistive device. The TCS2300, equipped with an array of light-sensitive photodiodes, captures the color of an object when placed in front of it. The Arduino microcontroller processes this data and converts it into audio feedback using the DFMini player, which can produce customized voice instructions or sound cues to help visually impaired individuals distinguish colors. The circuit consists of the TCS2300 color sensor interfaced with the Arduino, with the DFMini player connected to the Arduino for audio output. The Arduino code interprets the sensor data and triggers corresponding audio responses, making it an invaluable tool for enhancing the independence and accessibility of visually impaired individuals in perceiving and distinguishing colors.

4. SOCIAL IMPAWHATCT ON HUMANITY OR LOCAL COMMUNITY

Arduino Based Color Detection for Visually Impaired" helps blind people recognize and distinguish colors, making everyday tasks like choosing clothes, identifying food, and understanding traffic lights easier. It enhances safety by identifying warning signs and promotes independence by reducing their reliance on others.

This project can have several significant social impacts on society:

- **Good Health and Well-being (SDG:3)**

One of the social development goals related to the Arduino Based Color Detection for Visual Impaired project is "Good Health and Well-being" (SDG 3). Our project aims to improve the quality of life for visually impaired individuals by using Arduino technology to detect colors and provide them with important visual information. It promotes inclusivity and accessibility, contributing to the overall well-being of visually impaired individuals.

- **Gender Equality (SDG:5)**

Gender Equality aims to achieve equal rights, opportunities, and economic empowerment for all genders, while eliminating discrimination and violence against women and girls. It emphasizes their full participation in decision-making processes, fostering an inclusive and equitable society.

- **Reduced Inequalities (SDG:10)**

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Our project also aligns with SDG 10: Reduced Inequalities, which aims to diminish disparities in income, social protection, and access to basic services. By promoting equal opportunities and inclusivity, we strive to create a more just and fair society for all individuals.

- **Sustainable Cities and Communities (SDG:11)**

In our Arduino Based Color Detection for Visually Impaired project, we are also addressing SDG 11: Sustainable Cities and Communities. By developing a system that helps visually impaired individuals detect colors, we contribute to creating inclusive and safe urban environments. Our project aligns with SDG 11's goal of making cities and human settlements accessible, resilient, and sustainable for all.

In short, the project supports these global goals by making life better and more equal for visually impaired individuals.

CONCLUSION: An Arduino-based color detector for blind people is a commendable project that can significantly improve the lives of visually impaired individuals by providing them with a tool to interact more independently with their environment. It embodies the principles of accessibility, affordability, and customization, and its continued development and refinement hold the promise of further assisting the visually impaired community in their daily lives. This device can help them in various daily tasks, such as sorting clothes, identifying objects, or even appreciating art.