ABSTRACT

Being born with disabilities is a common thing nowadays. But only the person having the disability has to endure the pain and sufferings caused by it. One of the disabilities among those is blindness. It's hard for blind people to do any work by themselves. Also it’s definitely not easy for them to identify the currency notes. And the basic idea of this project is to make it possible for them to identify currency notes easily. This is made possible with just a simple Arduino board basedon ATmega328P, UV LED and a TCS3200 color Sensor. ATMEGA328P is an 8- bit microcontroller based on AVR RISC architecture. UV LED helps to identify the legitimacy of the currency notes. The color sensor identifies the color of the currency notes and sends it to the microcontroller which identifies whether it is a two thousand or five hundred rupee note etc. The detected color is read out loud via a speaker or an earphone as its respective currency value. This is the first ever smart wallet using Arduino and a color sensor. This is very easy to build and information about the total money taken out from the wallet can be sent to mobile phones if needed.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

List of Symbols and Abbreviations

List of Symbols

V	Volt
MHz	MegaHertz
Kb	Kilobyte
Nm	Nanometer
W	Watts

List of Abbreviations

EEPROM	Electrically Erasable Programmable Read-Only Memory
GPS	Global Positioning System
GSM	Global System for Mobile communication
IC	Integrated Circuit
IDE	Integrated Development Environment
LED	Light Emitting Diode
RAM	Random Access Memory
RGB	Red Green Blue
SMS	Short Message Service
UART	Universal Asynchronous Receiver Transmitter
UV	Ultra-Violet

CHAPTERS

1. INTRODUCTION

1.1 GENERAL

Recognition of things is the most difficult task a blind person goes through. Especially in the identification of currency notes it's very true. Normally a blind person has two most important difficulties while identifying a currency note. First the person needs to know the legitimacy of the note and second they need to identify its value.

Usually a blind person identifies the legitimacy of the currency note using the raised printing of the Mahatma Gandhi portrait and the Ashoka Pillar emblem on the right side of the currency note. Also there are different shapes toidentify the value of the notes with some raised lines on the right side of the note. There are also braille markings on the side of the currency notes. But these markings tend to fade away in due course of time. In case if the person is not able to differentiate the value using the shapes and the lines, this methodcan be a life saver.

This method is implemented using embedded systems, which can simply be understood as software embedded on a hardware device. Microcontrollers are a part of this embedded system. They are like a small computer on a single IC chip. Arduino is an open source electronic platform which is an easy to use hardware and software. It is less expensive when compared to other microcontrollers and works on nearly every operating system. They are easy to code and open source. They require only 5V of power to operate. They also have both analog and digital inputs. It is the most popular Arduino.

1.2 AIMS AND OBJECTIVES OF THE PROJECT

- Using a microcontroller to design and develop a prototype of a smart walletwhich helps blind people to identify the Indian currency notes.
- Facilitating easy identification of currency notes by blind people.
- Identifying the legitimacy of currency notes.
- Providing an easy identification of the denomination or value of the currency notes for the blind people.
- Implementing a theft alert system which sends an alert message in case of emergency.

1.3 SCOPE OF THE WORK

- India has an estimated number of 12 million blind people from 2000 to 2020. According to the above data, India has around one-third blind people among the world's blind population. In a rapidly developing country like India, money is of much importance. It is even more important to the blind people than anybody else.
- Even though there are intaglio markings on the notes that can be detected by touching, these markings can fade away during the course of time. Also, the shapes and lines in the notes are not easily identifiable by everyone. This comes in handy during such cases and it is precise and user friendly as it reads the values of the currency notes through a speaker or an earphone.
- It is portable, affordable, time saving and consumes less energy and would be easily available to everyone everywhere. In future this can be enhanced sothat it makes a calculation of money spent per day and can be sent as SMS tomobile phones.
- Microcontrollers are optimized to perform a dedicated low-power application and ideal for embedded systems. Microcontroller projects are very easy touse and maintenance is very simple.

2. LITERATURE REVIEW

In the paper, “Seeing Beyond Darkness with Smart Vision Wallet” by Dr S. Balakrishnan, Dr Susan Augustine and Dr J.P. Ananth are from department of information technology, Sri Krishna College of Engineering and Technology, Coimbatore. This method uses two colour sensors in addition to white led and UV led. Since it uses 2 colour sensors it occupies more space and has more cost and it gives output using buzzer which may cause problems. In any noisy surrounding, the beeps from the buzzer can’t be heard. Since it uses different number of beeps for different currency notes, it’s hard to match it and even if the user misses one beep, they may end up identifying 100 rupee note as 2000.

In the paper, “Currency Counting Fake Note Detection” by Raj Shah, Mayank Champaneri, Pujan Sheth,Vaishali Gaikwad (Mohite) from Pacific Academy of Higher Education & Research University, Udaipur, India. This paper is a based on the Image Processing and UV LED’s to give solution for fake currency problem. This method is useful for blind people since it uses web camera and only prints the output and doesn’t give output in the form of audio. Since it also uses complex technique like machine learning and includes camera, it may increase the cost ofthe product.

S .NO	AUTHOR	TITLE OF THE PAPER / PUBLICATION	PROPOSED METHOD	DISADVANTAGES
1.	Dr S. Balakrishnan, Dr Susan Augustine and Dr J.P. Ananth are professors, department of information technology, Sri Krishna College of Engineering and Technology, Coimbatore.	Seeing Beyond Darkness With Smart Vision Wallet	This method uses two colour sensors in addition to white led and UV led	Since it uses 2 colour sensors it occupies more space and has more cost and it gives output using buzzer which may cause problems.
2.	Raj Shah,Mayank Champaneri Pujan Sheth,Vaishali Gaikwad (Mohite) Pacific Academy of Higher Education & Research University, Udaipur, India	Currency Counting Fake Note Detection	This paper is a based on the Image Processing and UV LED’s to give solution for fake currency problem.	This method is useful for blind people since it uses web camera and only prints the output and doesnt give output in the form of audio.

Table 1. Literature Review

3. MAIN TEXT

3.1 PROBLEM STATEMENT

Being born with disabilities is a common thing nowadays. But only the person having the disability has to endure the pain and sufferings caused by it. One of the disabilities among those is blindness. It's hard for blind people to do any work by themselves. Also it's definitely not easy for them to identify the currency notes. Usually while identifying currency notes, we face two problems. The firstone is to identify the legitimacy of the note and the second is to identify the denomination or value of the currency notes. Even it is very hard to differentiate between normal and fake notes, with our eyes. So we have to develop a method which solves these two problems and give an output in such a way that the blind people can make use of it.

3.2 MATERIALS

A. EMBEDDED SYSTEM PLATFORM

Embedded systems are like computer systems which have processors, memory and input/output peripheral devices. The Programming instructions are stored in read-only memory or flash memory chips.

B. ARDUINO UNO BOARD

Arduino is an open-source computer hardware and software company, project and user community that designs and manufactures kits for building digital devices and interactive objects that may sense and manage the physical world. It's an open source microcontroller based on ATmega328P developed by Arduino. It has 14 digital inputs and 6 analog input pins. It is programmed by Arduino IDE and is connected to the computer by a cable. It can also be powered by an external battery. It has a flash memory of 32kb out of which 0.5kb is used for the bootloader. Along with ATmega328P, it also contains other components like crystal oscillator, serial communication, voltage regulator, etc to support the microcontroller.

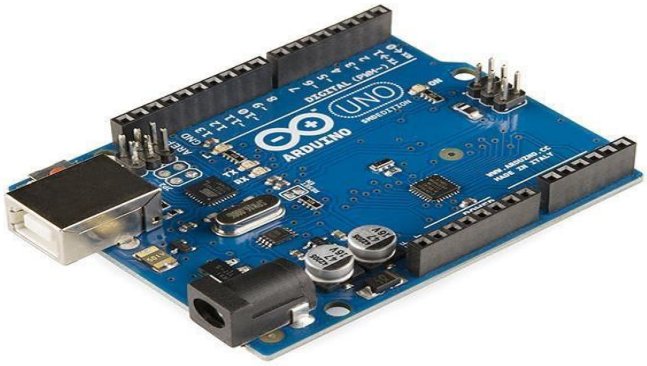

Fig 1. Arduino UNO

It has 6 analog input pins (AO - A5) where we can provide analog inputs in the range of 0-5V. It is also accompanied by 14 digital pins (D0 - D13) which can either be used as input or output. It is powered by an Atmega328 processor operating at 16MHz, includes 32KB of program memory, 1 KB of EEPROM, 2KB of RAM, has 14 digital I/O, 6 analog inputs, and both 5Vand 3.3V power rails. It's also easy to interface with the sensors and easy to code. Both C and C++ can be used for programming the microcontroller.

C. TCS3200 COLOR SENSOR

TCS3200 Color Sensor is implemented here for the identification of color from the currency notes. It is a programmable color to light frequency convertor. Voltage ranging from 2.7V-5.5V is enough for the operation ofthe sensor. It has a power down feature. The particular reason for choosing this color sensor is to avoid the filtering of UV light by in-built UV light filters in certain other color sensors.

Fig 2. TCS3200 Color Sensor

They contain four white LEDs to even detect color in the darkest surrounding. These four white LEDs illuminate the surface of the object whose color needs to be detected. It has 64 photodiodes. These photodiodes have four different types of filters Red, Green, Blue and Clear. So 16 filters for each color respectively. We have two different control pins s2 and s3 with which we can decide what color to read.

S2	**S3**	**Color**
LOW	LOW	Red
LOW	HIGH	Blue
HIGH	LOW	Clear
HIGH	HIGH	Green

Table 2. Color Sensor Photodiode Combination

With this color we can not only detect the primary colors but also wide range of colors if we fix the perfect frequency.

D. UV LED

The need for UV LED in this project is for identifying the legitimacy of the currency notes. Indian currency notes absorb UV light while normal papersor the fake currency notes used in monopoly do not absorb them. This principle is used for identification of real currency notes. The UV Led used for this project has a frequency of 390-395nm.

Fig 3. UV LED

UV LEDs can work within the range of 3V to 5V. They are also effective in sterilization and disinfection.

E. GSM MODULE (SIM808)

The module SIM808 is a dual function module which provides both GSMand GPS functions. It consumes very less power and is controlled by AT command via UART.

Fig 4. SIM808 Module

It supports a real time clock and is helpful in sending and receiving messages, real time tracking. It can be connected to the internet and the location can be sent as a message in real time. It can be used with the Arduino with the help of GSM Library.

SL.NO	Component / Item Details	Quantity	Cost (in Rs.)	Justifications
1.	Arduino UNO	1	512/-	This microcontroller acts as a mini computer, coupled with built in functions to program and interface with GSM module and Color Sensor.
2.	Bread Board and Jumper Wires	1	269/-	Bread board is used for connecting circuits without the need for wires and jumper wires help establish connection between Arduino and the other components.
3.	GSM SIM808A Module	1	1,899/-	This module consists of a GPRS SMA Antenna, GSM SMA Bluetooth Antenna, GSM SMA Antenna. It helps in providing the call feature and SMS options from the module (SIM Card included) to another mobile phone, depending upon the strength of the antenna used.
4.	TCS3200	1	399/-	As the name suggests, it is used for the identification of color.
5.	9V Battery with 2PC Connector	1	90/-	To provide the power supply for UV LEDs
6.	0.5W speaker	1	90/-	To hear the audio.
7.	UV LEDs	Required	Around 50	For the identification of fake notes.
		Total, Rs.	3309/-	

Table 3. Cost Analysis of the Materials

3.3 BLOCK DIAGRAM

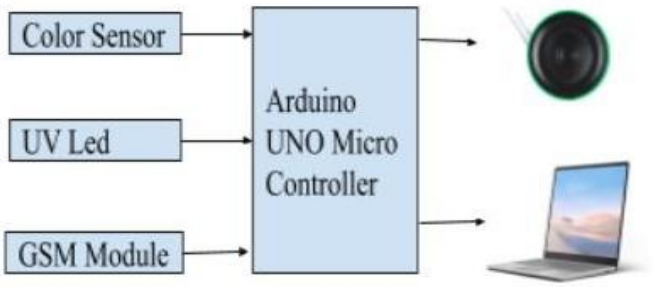

Fig 5. Simple Block Diagram

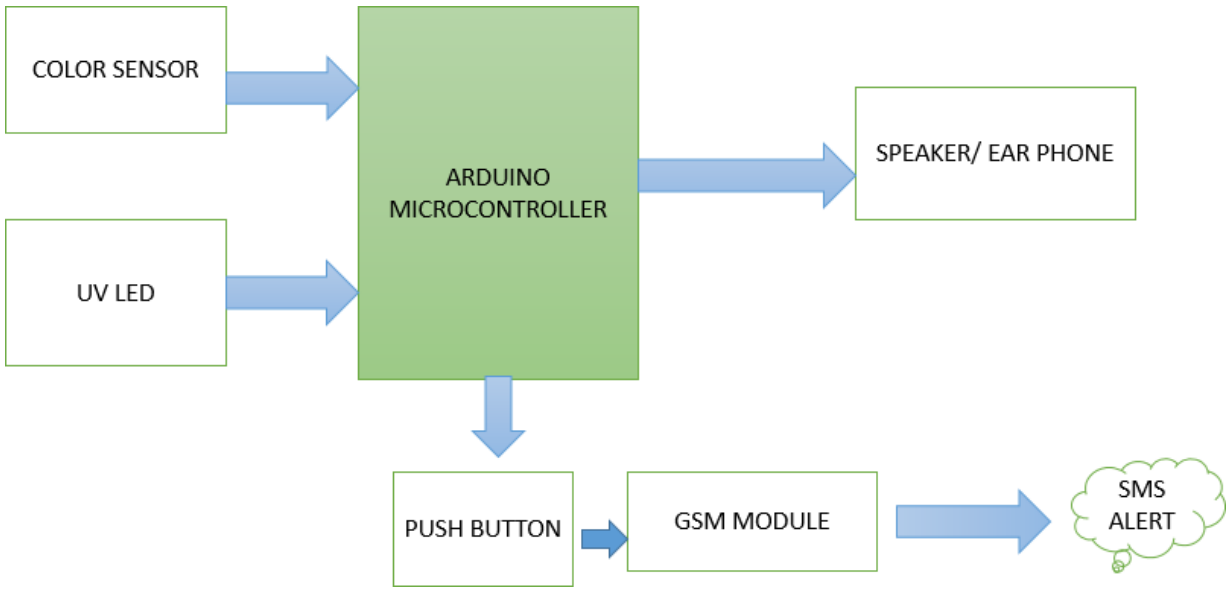

Fig 6. Block Diagram of the Project

3.4 FLOW CHART

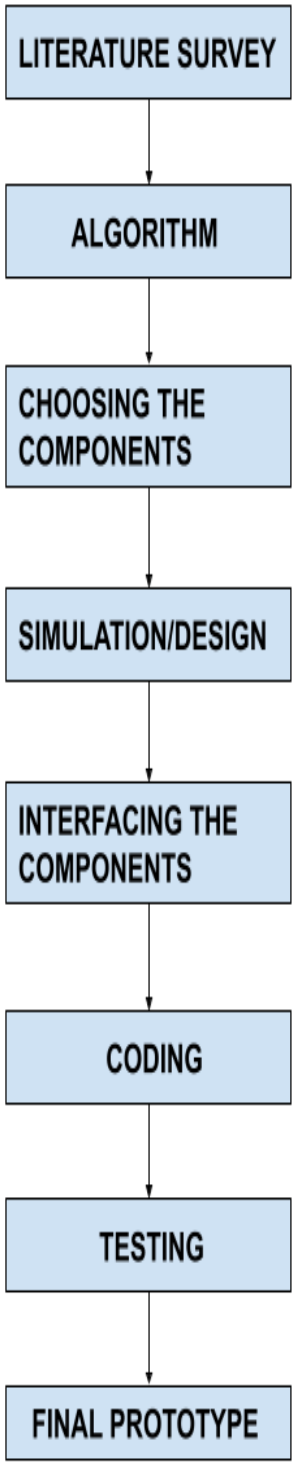

Fig 7. Flow Chart of the Project

3.5 METHODOLOGY

- Our project is designed using an Arduino UNO microcontroller which is powered by Atmega328P in the Arduino environment.
- The circuit is designed in such a way that the UV light falls on the currency note and where the color sensor can detect the color of the currency note (i.e. The UV light is placed below and the color sensoris at the top. The currency note is placed in between this setup).
- Then the code is uploaded into the board via USB cable connecting the PC and board where the color sensor is connected in its digital port.
- First the currency note is placed between the UV Led and the color sensor.
- Now first, we keep the original note and record the RGB frequency. Repeat the same for a fake note of same denomination.
- If we consider a 10 rupee note, the frequency read by the color sensor for a real note under UV light is different from the frequency of a fake note under the same. This frequency is pre coded in the Arduino software by us so that if the particular frequency is detected, the audio message can be played accordingly.
- Now we upload the main code of our project which contains the audio output part.
- If it is a legit currency note, the UV light gets absorbed by it. Then the color of the note is identified by the color sensor and then the value of the currency note is read out loud by the speaker.
- If it is not a legit currency note then the UV light doesn't get absorbed and the speaker will read it as "Fake Note".
- The frequency values and the denominated values of the currency notes can also be seen in the serial monitor.
- When there is a situation of possible theft the user can use the implemented GSM module which will send an alert message and their real time location to their friends or family.

3.6 ALGORITHM

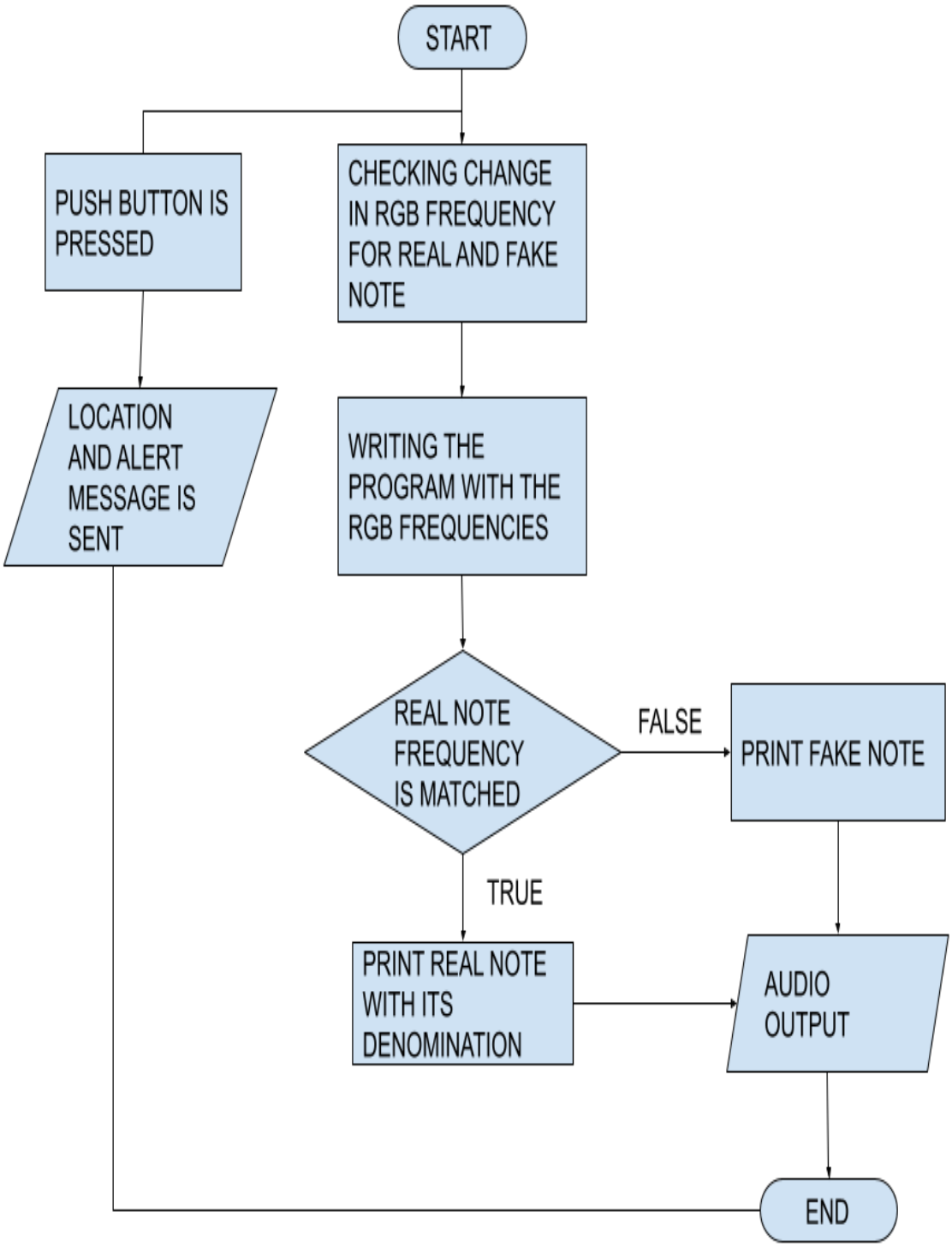

Fig 8. Algorithm of the Project

3.7 CODING

The code for checking the difference in frequencies for a real and fake note is givenbelow.

```
#define s0 4
#define s1 5
#define s2 6
#define s3 7
#define sensorOut 8
int red = 0;
int green = 0;
int blue = 0;

void setup()
{
  Serial.begin(9600);
  pinMode(s0, OUTPUT);
  pinMode(s1, OUTPUT);
  pinMode(s2, OUTPUT);
  pinMode(s3, OUTPUT);
  pinMode(sensorOut, INPUT);
  digitalWrite(s0, HIGH);
  digitalWrite(s1, HIGH);
}

void loop()
{
   digitalWrite(s2, LOW);
  digitalWrite(s3, LOW);
  //count OUT, pRed, RED
  red = pulseIn(sensorOut,LOW);
  //count OUT, pBLUE, BLUE

  digitalWrite(s2,HIGH);
  digitalWrite(s3,HIGH);
  //count OUT, pGreen, GREEN
  green = pulseIn(sensorOut,LOW);
  //Serial.println();
```

```
 digitalWrite(s2,LOW);
 digitalWrite(s3,HIGH);

 blue = pulseIn(sensorOut, LOW);

 Serial.println(red);
 Serial.println(green);
 Serial.println(blue);
```

The entire code for the identification of a 10 rupee real and fake note with theaudio output is given below.

```
#define s0 4
#define s1 5
#define s2 6
#define s3 7
#define sensorOut 8
int red = 0;
int green = 0;
int blue = 0;

void setup()
{
  Serial.begin(9600);
  pinMode(s0, OUTPUT);
  pinMode(s1, OUTPUT);
  pinMode(s2, OUTPUT);
  pinMode(s3, OUTPUT);
  pinMode(sensorOut, INPUT);
  digitalWrite(s0, HIGH);
  digitalWrite(s1, HIGH);
}

void loop()
{
   digitalWrite(s2, LOW);
  digitalWrite(s3, LOW);
  red = pulseIn(sensorOut,LOW);
```

```
  digitalWrite(s2,HIGH);
  digitalWrite(s3,HIGH);
  green = pulseIn(sensorOut,LOW);
  //Serial.println();

  digitalWrite(s2,LOW);
  digitalWrite(s3,HIGH);

  blue = pulseIn(sensorOut, LOW);

  Serial.println(red);
  Serial.println(green);
  Serial.println(blue);
  if ((red <=18 && red >=15) && (green <= 18 && green >= 15) && (blue
<= 18 && blue >= 15))
  {
   Serial.println(" TEN ");
      delay(500);
  }

 else if ((red <= 25 && red >= 15) && (green <= 38 && green >= 31) &&(blue <=
24 && blue >= 19))
  {
   Serial.println(" FAKE ");
   delay(500);
  }
  else{
  Serial.println(" FAKE ");
  delay (500);
  }
 }
```

4. RESULTS AND DISCUSSION

The above project is designed using an Arduino UNO microcontroller which is powered by Atmega328P in the Arduino environment. The simulation is completed in Arduino IDE using embedded c coding. Then the code is uploaded into the board via USB cable connecting the PC and board where the sensor is connected in its digital port.

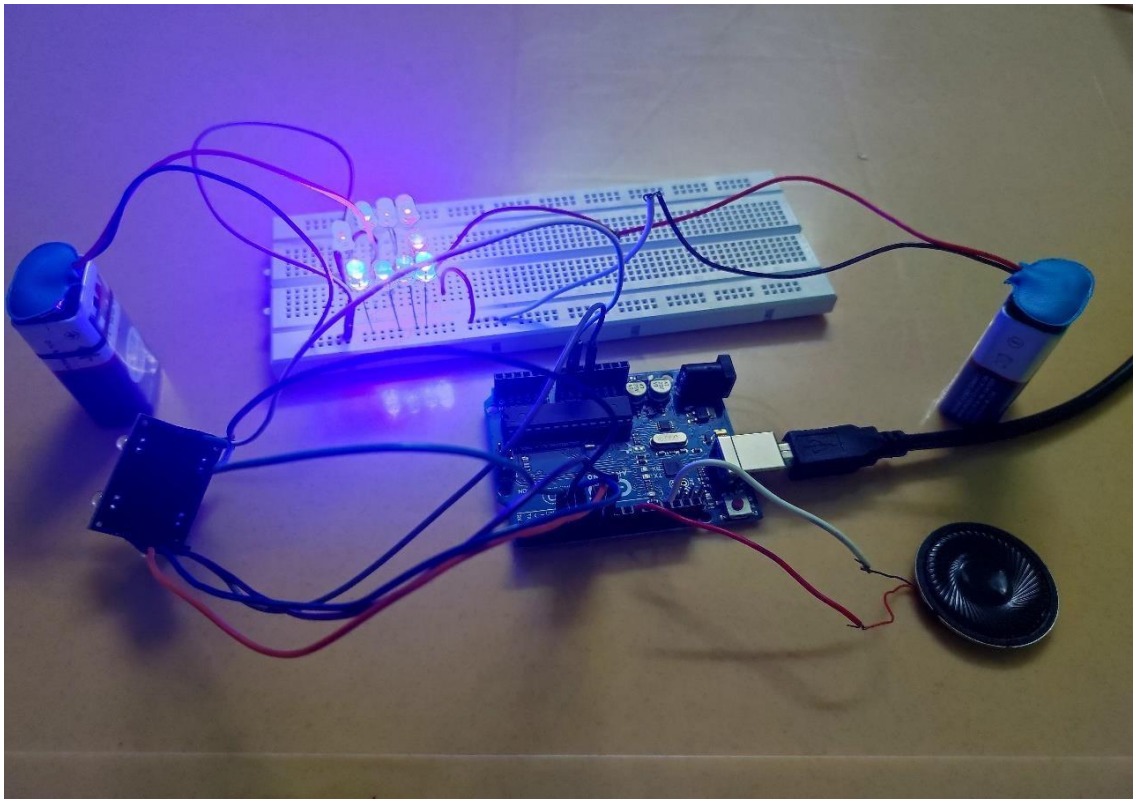

Fig 9. Hardware Connection

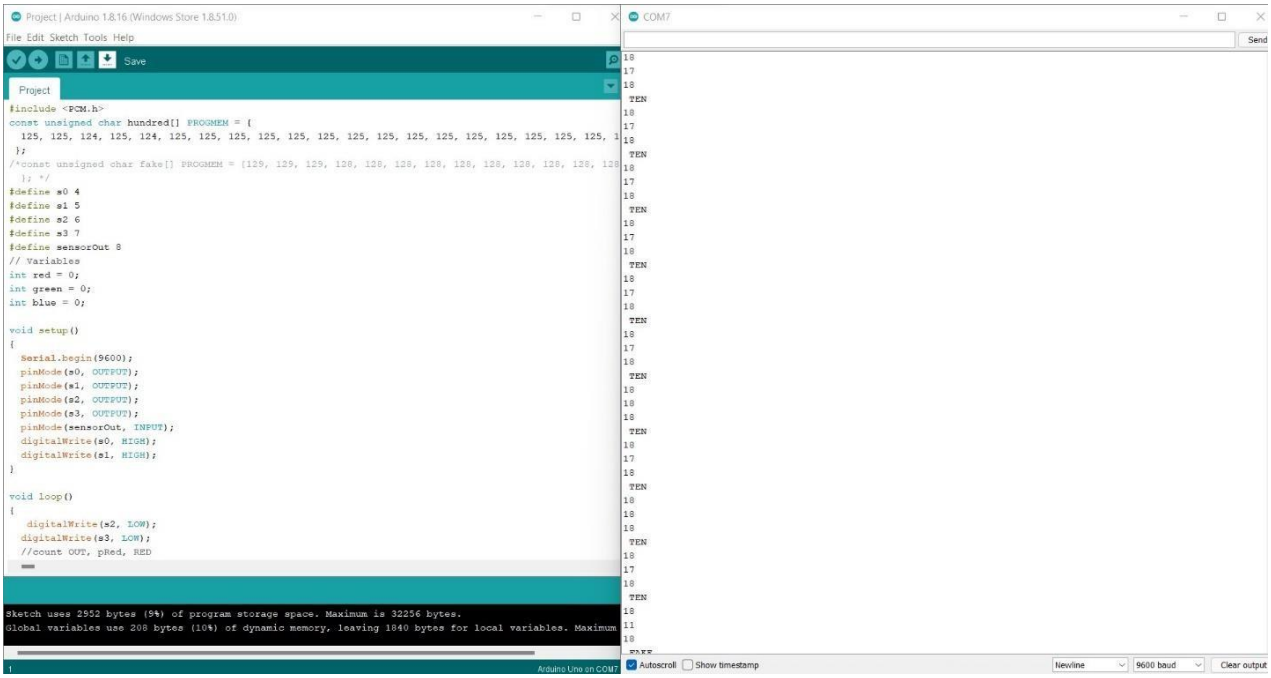

Fig 10. Serial Monitor Output for a 10 rupee real note

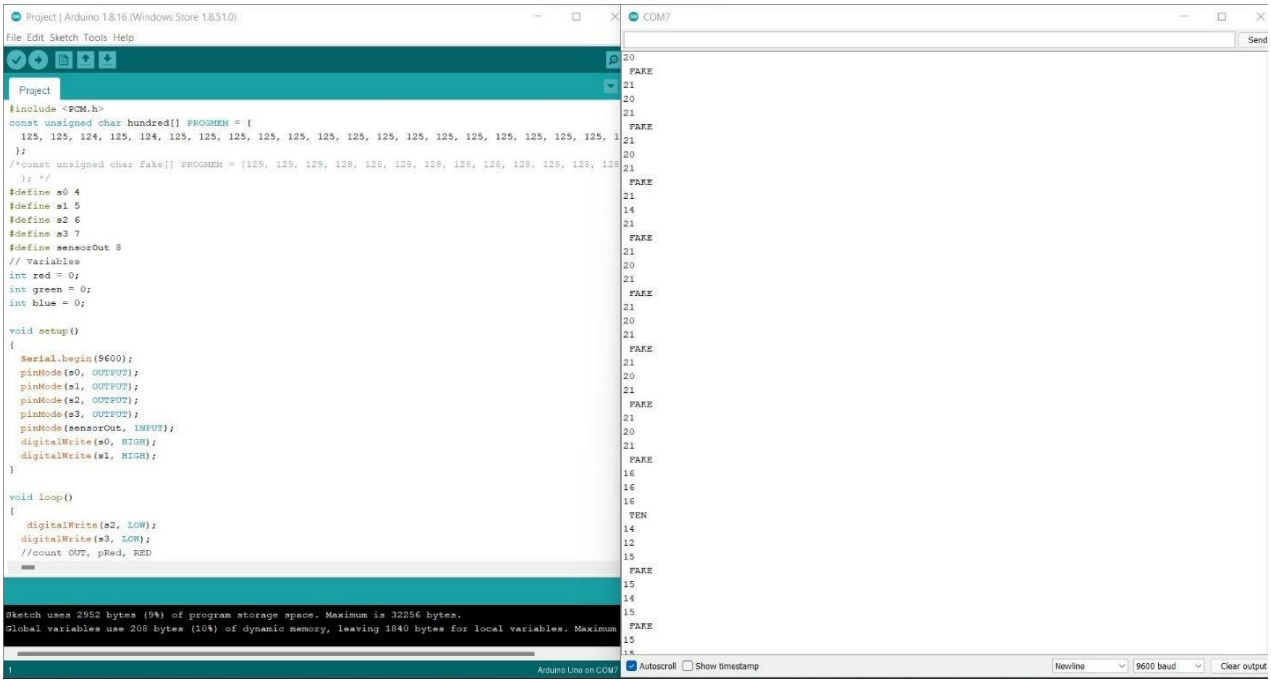

Fig 11. Serial Monitor Output for a 10 rupee fake note

The Results of the project show that the different currency notes can be indeed checked and verified with the help of UV light. The color Sensor used actually detected the frequency difference in color and it can be seen through the serial monitor. In order to facilitate the recognition of currency notes by blind people, the speakers were added in the output part. To include more audio and to identify more currency notes we can add SD card to our project to store many audio and support the program space. The GSM module can be added to help the blind people send SMS in case of theft or emergency.

If wanted, the values of the currency notes and the amount spent per day can be sent to mobile phones as SMS by GSM with the Arduino board.

5. CONCLUSION

India has an estimated number of 12 million blind people from 2000 to 2020. According to the above data, India has around one-third blind people among the world's blind population. In a rapidly developing country like India, money is of much importance. It is even more important to the blind people than anybody else. Even though there are intaglio markings on the notes that can be detected by touching, these markings can fade away during the course of time. Also, the shapes and lines in the notes are not easily identifiable by everyone. This comes in handy during such cases and it is precise and user friendly as it reads the values of the currency notes through a speaker or an earphone. It is portable, affordable, time saving and consumes less energy and would be easily available to everyone everywhere. The arduino used is very user friendly and easy to code. In future this can be enhanced so that it makes a calculation of money spent per day and can be sent as SMS to mobile phones.

6. REFERENCES

1. Dr S. Balakrishnan, Dr Susan Augustine and Dr J.P. Ananth, "Seeing Beyond Darkness With Smart Vision Wallet" Research and Development on Electronics for You, Page 36, May 2019.F

2. Raj Shah, Mayank Champaneri Pujan Sheth,Vaishali Gaikwad(Mohite), "Currency Counting Fake Note Detection" Pacific Academy of Higher Education & Research University, Udaipur, (October 30, 2018). https://dx.doi.org/10.2139/ssrn.3275068

3. Dhiraj Vasant Kapare , Sadashiv Lokhande, Sayaji Kale, "Automatic Cash Deposite Machine With Currency Detection Using Fluorescent And UV Light" International Journal Of Computational Engineering Research (ijceronline.com) Vol. 3 Issue. 3.

4. Sahana Murthy, Jayanta Kurumathur, B Roja Reddy "Design and implementation of paper currency recognition with counterfeit detection" 2016 Online International Conference on Green Engineering and Technologies (IC-GET)

5. Biswajit Halder, Rajkumar Darbar, Utpal Garain, and Abhoy Ch. Mondal , "Analysis of Fluorescent Paper Pulps for Detecting Counterfeit Indian Paper Money" December 2014
https://www.researchgate.net/publication/283349829

6. Reserve Bank of India,High Level RBI Group Suggests Steps to CheckMenace of Fake Notes, Press release number 2009-2010/232 (August 11, 2009)