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COLOR TO SOUND CONVERTER FOR BLIND PEOPLE

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Abstract - *This paper represents a system which explores the reality of color in relation to sound and dedicated firstly to blind people, the challenges they live with, their psychology and their emotions. It's an exploration of the infinite range of colors that they have either never been able to see or that they have lost the possibility to see. The system developed is based on the concept of synesthesia: a 'liaison' between color and sound, color that becomes sound. This paper synthesizes a wider range of study regarding people with diverse psychological and movement conditions. Finally we conclude with a portable prototype device that has been validated and patented. It is capable of detecting color and transforming it into sound: a color sensor identifies colors and transforms this data into musical notes. The prototype is totally adaptable to the requirements of the end user meaning that the user can choose the best combination between color and sound in order to improve their communication with the environment. We are now developing a mathematical theoretical background in order to formalize the correspondence between color and musical space.*

Key Words: **Color detector, audio player, PIC controller, max 232**

1. INTRODUCTION:-

Blindness is the condition of poor visual perception, estimation from World Health Organization state that 285 million people are visually impaired worldwide, 39 million are blind and 246 million have low vision.

A Blind person with proper training can function like any person with perfect vision, but there are the small things that can improve the quality of a blind person life, like color detection which is the focus of this project.

Being able to detect color can help in many ways, like identifying colors of clothes or even identifying uniquely colored objects (e.g. paper money) and appreciating art.

The project will help overcome challenges that visually impaired people face in daily basis, by creating a way to detect colors and providing unique biofeedback for each color.

Color represents one of the most important and conditioning aspects of the reality that surrounds us. It has the great capability of moving us, impressing us and of creating meanings and symbolic values which, consequently, play a part in the culture and traditions of each one of us. In general color isn't perceived uniquely through our eyes but also thanks to other aspects of a cultural type, through our conscience and subconscious.

Aspects like primordial images, symbolism, cultural influences and traditions as well as personal experiences all form part of our singular and personal way of perceiving color. Color is associated to feelings and basic life concepts such as romance, tranquility, hate, happiness, sadness, etc. as concluded by the many studies that have been made on the subject: the symbolism which belongs to color walks hand in hand with common imagination .Color, associated with either hearing or touch, represents one of the most common combinations in this field. Color is connected to other senses besides sight.

Blind people create concepts based on their personal experience and according to their point of view and imagination. They associate descriptive words and every day conversation to feelings, things they read, tactile experiences, hearing, taste and smell. Just because a blind person cannot 'see' color, this does not take away from the fact that they can interpret it in their own personal way. It is a device capable of detecting colors and transforming them in to musical notes or melodies inspired by the concept of synaesthesia which plays a fundamental role in the whole of the project. It represents an innovative study from a theoretical and technological point of view and it includes all the important ingredients in a proposal of social credibility as it encloses a wide range of problematic situations and disabilities. It counts on an important technological component, with the programming of the software of the device and the modeling of an original color/sound concept.

2. LITERATURE SURVEY:-

Assistive systems are being developed for different kinds of visually impaired people to improve the life quality and safety of such people including indoor navigation and way finding, display reading, banknote recognition, rehabilitation, and many more. Xuedong Yang developed a system for blind people to select clothes based on cloth pattern and colors in a cloth shop independently. This is a camera based system that can handle clothes with complex pattern and recognize clothes into four categories (plaid, stripped, pattern less, and irregular) and identify 11 colors : red, orange, yellow, green, cyan, blue, purple, pink, black, grey and white.

FAIZ .M. HASANUZZAMAN proposed a system to automatically recognize banknote of any currency to assist visually impaired people. This is also a camera based

computer vision technology. This system has features like high accuracy, robustness, high efficiency, ease of use. This system is robust to conditions like occlusion, rotation, scaling, cluttered background, illumination change, wrinkled bills, and also eliminating false recognition and can guide the user to properly and correctly focus at the bill to be recognized using speed up robust features (SURF).We created a device that determines the RGB content of a surface and then speaks the color or plays a musical tone according to the color. In this project, an application is going to be developed using Color Sensor for detecting RGB color. A Color sensor has a LDR as a photo detector, each with either a red, green, or blue filter, or no clear. The applications of this sensor include sorting by color, and color matching. We have selected this project because the blind people does not have the sense of color and these people cannot identify the color. So to identify the color by these blind people, we design a circuit that detect the color by the color sensor and convert it into sound. So these people hear the sound and they identify the color.

3. METHODOLOGY:-

HARDWARE AND SOFTWARE REQUIREMENTS

- *ICs and Modules Selection*
- Power supply Unit
- Color Sensor
- Controller / Processor
- Sound Recorder/Playback IC
- Audio Amplifier
- 16x2 LCD assembly
- Oscillator Circuit
- Speaker with 7Ω
- Serial Bus Driver MAX 232

3.1 Detail Specification of ICs/Modules

3.1 a) Power supply Unit:-

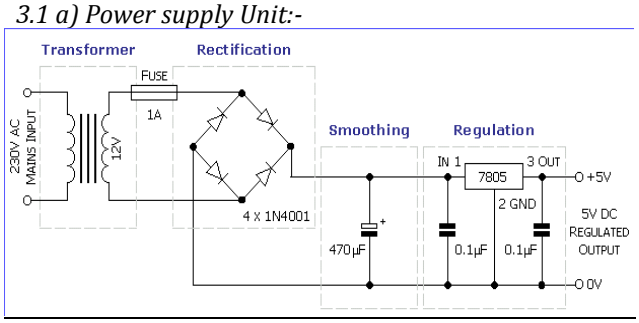

Fig No.1Power supply unit

Fig. shows the block diagram of a typical power supply. The AC main is given to the transformer primary to get the required voltage at the secondary. Then it is applied to the bridge rectifier, which converts the sinusoidal input into full wave rectified output. The output of the rectifier contains some ripple voltage. To remove this voltage filter circuit is used. A ripple voltage is nothing but a small value of AC over DC signal. Then a pure DC is given to the regulator. The function of the regulator is to give the constant or stable output DC in spite of changes in the load current. The reasons for choosing IC regulator is that they are versatile in operation and relatively inexpensive with features like programmable output, current/voltage boosting, internal short circuit current limiting, thermal shutdown.

3.1 b) Bridge Rectifier Circuit:

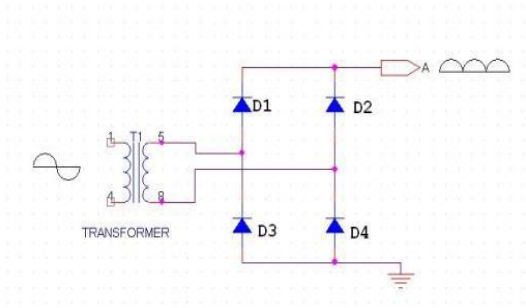

Fig No.2 Bridge rectifier

As the name suggests it converts the full wave i.e. both the positive & the negative half cycle into DC thus it is much more efficient than Half Wave Rectifier & that too centre using a centre tapped transformer thus much more cost effective than Full Wave Rectifier. Full Bridge Wave Rectifier consists of four diodes namely D1, D2, D3 and D4. During the positive half cycle diodes D1 & D4 conduct whereas in the negative half cycle diodes D2 & D3 conduct thus the diodes keep switching the transformer connections so we get positive half cycles in the output. If we use a centre tapped transformer for a bridge rectifier we can get both positive & negative half cycles which can thus be used for generating fixed positive & fixed negative voltages.

3.1 c) Color Sensors: -

This color sensor identifies color and gives serial output of RBG value. It can identify 16.7 million color shades giving RGB value for the detected color. The detected color is identified as amount of three primary color values namely Red, Green& Blue with 8 bit accuracy for each primary color. Any color can be separated or combined into three primary colors Red Green and Blue using the RBG values.

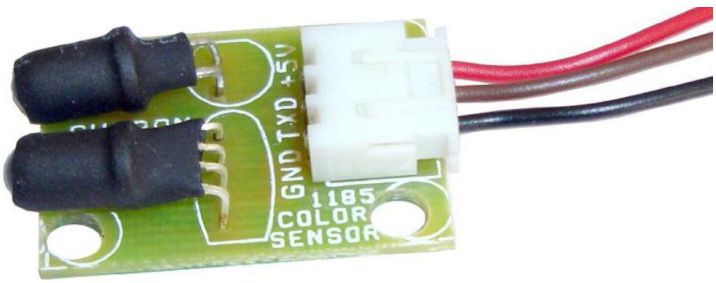

Fig No.3 Color sensor

FEATURES

- Individual RGB color detected
- Simple 5V operation
- Serial data output for complete RGB values

- UART interface for direct connection to any MCU or USB-TTL convertor.

Features of color sensor sunroom 1185.

Table No. I: Features of color sensor sunroom 1185

Parameter	Value	Unit	Notes
Operating Voltage	5 V	DC	Provide regulated 5V supply
Current	20	MA	
Color Detecting Capacity	16.7 millions	RGB	R=8 bit (2^8=256 levels) G=8 bit (2^8=256 levels) B=8 bit (2^8=256 levels) 256x256x256=16.7 millions shades detection
Color measuring	range 350-750	Nm	
Luminance	range 100	Lux	
Response time	500	MS	
Output Data baud	9600	Bps	5V level output UART Properties (8-N-1) Start bit:1 bit Data bit: 8 bits Parity: None Stop bit: 1 bit

Serial data Output Format:-

The serial data at 9600 baud rate consist of 25 bytes for each 500ms interval. When RED shade of color is detected you would get following type of data in terminal R=130 G=030 B=030 L=010. Here value of RED is 130 while Green and Blue are 30 both L=10 means the amount of Light reflected by surface, White surface will reflect most and black the least, This L value you can use to detect the darkness of surface. We recently added this L parameter since it was difficult to detect white and black surface from only RGB values. The sample code of microcontroller and VB software does not implement L value processing but it works with only RGB values. L value can be used to detect white/black surface.

Table No. II: Comparison of color sensors

SPECIFICATION	TCS34725	TCS230	SUNROM 1185
NO OF COLOUR DETECTION	2 MILLIONS	8.3 MILLIONS	16.7 MILLIONS
SIZE	SMALL	SMALL	SMALL
IR BLOCKING	YES	YES	NO
INTERFACING	I2C	I2C	DIRECT TO MCU
AVAILABILITY	LESS	LESS	MORE
COST	HIGH	HIGH	HIGH

3.2 Controller / Processor:-

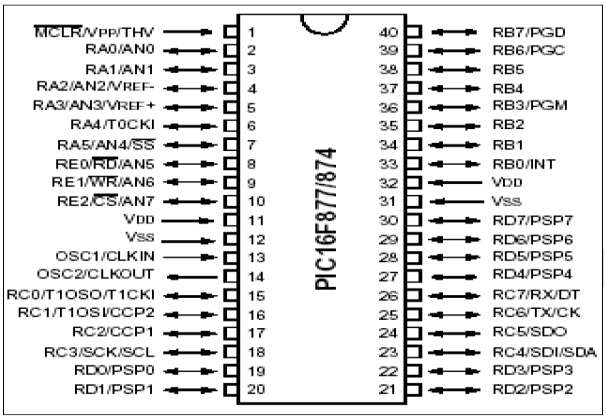

Fig No.4 PIC16F877A

Table No. III : Comparison of Controller / Processor

SR NO	SPECIFICATION	LPC2148	PIC16F677xA	8051uc
1	TIMER COUNTER	2-32 BIT TIMER	2-8 BIT TIMER 1-16 BIT TIMER	3-16BIT TIMER
2	POWER CONSUMPTION	LOW	LOW	LOW
3	ADC	10 BIT 6/14 CHANNEL	10 BIT 5 CHANNEL	10 BIT 6 CHANNEL
4	ARCHITECTURE	ARM ARCHITECTURE	HARVARD ARCHITECTURE	HARVARD ARCHITECTURE
5	INTERRUPT	NO INTERRUOT	14	8
6	OPERATING VOLTAGE	3.0 TO 3.6 VOLT	2.2 TO 5.5 VOLT	4.4 TO 5 VOLT

3.3 WTV-SR Voice Recording Module:-

i) Up to 7 kinds of operating modes : MP3 mode, one to one key mode, parallel mode, one record one play key mode , Audio-book mode, two-wire serial mode and three-wire serial mode

ii) Support MIC and LINE-IN recording.

iii) Support plug-in 64M bit SPI-FLASH, recording time up to 1600 seconds

iv) Support upload and download voice via USB;

v) Support playback the high-quality voice which downloaded from computer

vi) Can record up to 252 segments voice (including fixed voice);

vii) With function of power-down data protection

viii) Support audio recording at 10KHz or 14KHZ sample rate

ix) Adopt a separate document management system, recording without debris, more reasonable distribution of SPI-FLASH space;

x) Support key and MCU control;

xi) 8-level controllable volume;

xii) Operating voltage: DC2.6 ~ 3.6V, sleep current: 10uA (typical).

xiii) Module package: DIP28, can be defined, reference value: 18.30mm * 36.00mm

xiv) WTV-SR using SPI-FLASH store voice messages, the current version supports the largest of 64M. Specific as following table, the table data is from audio recording at 10KHz sample rate (unit: sec)

Diagram:

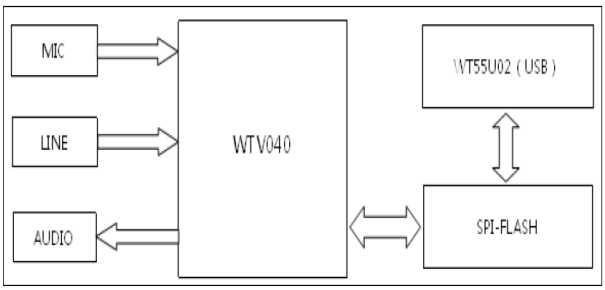

Fig No.5 Sound recorder and playback

Recording interval:-

WTV-SR using SPI-FLASH to store voice messages, Duration is in connection with the storage of SPI-FLASH. The latest version support up to 64M SPI-FLASH. Specific as following table, the table data is from audio recording at 10 KHz sample rate (unit: sec).

Working Modes:-

WTV-SR Working Modes:MP3 mode , Pushbutton one on one mode , Parallel mode , One record one play key mode , e-book mode, two-wire serial mode and three-wire serial mode. These control modes make WTV-SR can be applied in many cases. And you can change different control modes by setting the short contact at the bottom of WTV-SR.

Working modes	Pad status		Connection
	M0	M1	M2

Fig No.6 WTV-SR

Two-wire Serial Control Mode Application Circuit:-

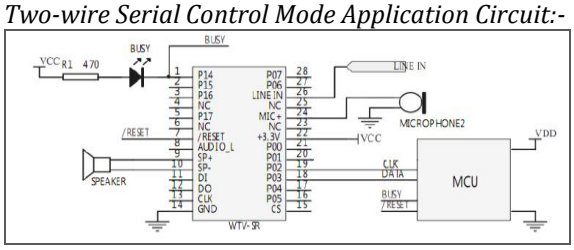

Fig No.7 Connection diagram of MCU and voice record module

3.4 AUDIOAMPLIFIER:-

The Class C Amplifier design has the greatest efficiency but the poorest linearity of the classes of amplifiers mentioned here. The previous classes, A, B and AB are considered linear amplifiers, as the output signals amplitude and phase are linearly related to the input signals amplitude and phase.

However, the class C amplifier is heavily biased so that the output current is zero for more than one half of an input sinusoidal signal cycle with the transistor idling at its cut-off point. In other words, the conduction angle for the transistor is significantly less than 180 degrees, and is generally around the 90 degrees area.

While this form of transistor biasing gives a much improved efficiency of around 80% to the amplifier, it introduces a very heavy distortion of the output signal. Therefore, class C amplifiers are not suitable for use as audio amplifiers.

Due to its heavy audio distortion, class C amplifiers are commonly used in high frequency sine wave oscillators and certain types of radio frequency amplifiers, where the pulses of current produced at the amplifiers output can be converted to complete sine waves of a particular frequency by the use of LC resonant circuits in its collector circuit.

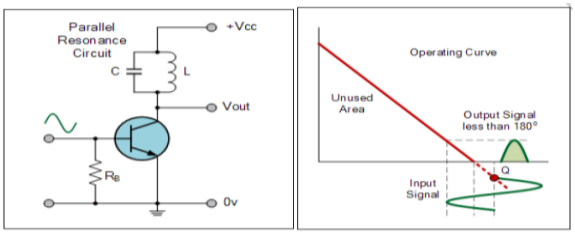

Fig No.8 Class C Amplifier and waveform

3.5 16x2 Lcd Assembly:-

Alphanumeric displays are used in a wide range of applications, including palmtop computers, word processors, photocopiers, point of sale terminals, medical instruments, cellular phones, etc. The 16 x 2 intelligent alphanumeric dot matrix display is capable of displaying 224 different characters and symbols. A full list of the characters and symbols is printed on pages 7/8 (note these symbols can vary between brand of LCD used). This booklet provides all the technical specifications for connecting the unit, which requires a single power supply (+5V).

3.6 Oscillator Circuit:-

X1 and X2 can be connected to a crystal or resonator in oscillator applications. The device provides an additional buffered inverter (Y) for signal conditioning. The additional buffered inverter improves the signal quality of the crystal oscillator output by making it rail to rail. NanoSta and Nano Free package technology is a major breakthrough in IC packaging concepts, using the die as the package.

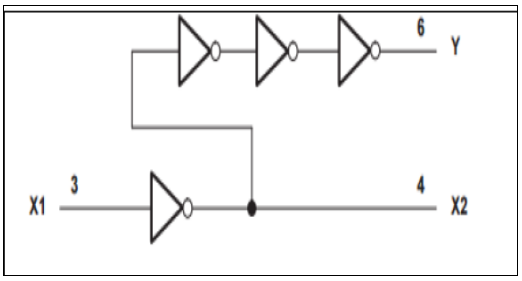

Fig No.9 BUFFERED INVERTER.

3.7 Serial Bus Driver MAX 232:-

Serial to TTL Convertor:-

The MAX232 is an IC, first created in 1987 by Maxim Integrated Products that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. The MAX232 is a dual driver/receiver and typically converts the RX, TX, CTS and RTS signals. The drivers provide RS-232 voltage level outputs approx. 7.5 V from a single + 5 V supply via on-chip charge pumps and external capacitors. This makes it useful for implementing RS-232 in devices that otherwise do not need any voltages outside the 0 V to + 5 V range, as power supply design does not need to be made more complicated just for driving the RS- 232 in this case. The receivers reduce RS-232 inputs which may be as high as 25V, to standard 5 V TTL levels. These receivers have a typical threshold of 1.3V, and a typical hysteresis of 0.5 V.

The MAX232 device is a dual driver/receiver that includes a capacitive voltage generator using four capacitors to supply TIA/EIA-232-F voltage levels from a single 5-V supply. Each receiver converts TIA/EIA-232-F inputs to 5- V TTL/CMOS levels. These receivers have a typical threshold of 1.3 V, a typical hysteresis of 0.5 V, and can accept ±30-V inputs. Each driver converts TTL/CMOS input levels into TIA/EIA-232-F levels. The driver, receiver, and voltage-generator.Functions are available as cells in the Texas Instruments LinASIC library. Outputs are protected against shorts to ground.

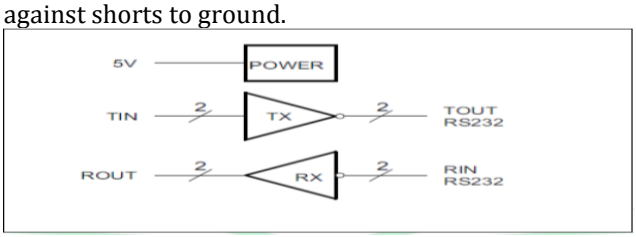

Fig No.10 Max 232 Output

3.8 Software Platforms:

Keil an ARM Company makes C compilers, macro assemblers, real-time kernels, debuggers, simulators, integrated environments, evaluation boards, and emulators for ARM7/ARM9/Cortex-M3, XC16x/C16x/ST10, 251, and 8051 MCU families. The Keil 8051 Development Tools are designed to solve the complex problems facing embedded software developers Keil development tools for the 8051 Microcontroller Architecture support every level of software developer from the professional applications engineer to the student just learning about embedded software development.

When starting a new project, simply select the microcontroller you use from the Device Database and the Vision IDE sets all compiler, assembler, linker, and memory options for you. Numerous example programs are included to help you get started with the most popular embedded 8051 devices. TheKeil Vision Debugger accurately simulates on-chip peripherals IC, CAN, UART, SPI, Interrupts, I/O Ports, A/D Converter, D/A Converter, and PWM Modules of your pic 16f877xA device. Simulation helps you understand hardware configurations and avoids time wasted on setup problems. Additionally, with simulation, you can write and test applications before target hardware is available.

3.8 a) Platform:

There are many different CPU architectures used in embedded designs such as ARM, MIPS, Colder/68k, PowerPC, X86, PIC, 8051, Atmel AVR, H8, SH, V850, FR-V, M32R etc. This in contrast to the desktop computer market, which as of this writing (2003) is limited to just a few competing architectures, mainly the Intel/AMD x86, and the Apple/Motorola/IBM PowerPC, used in the Apple Macintosh. With the growing acceptance of Java in this field, there is a tendency to even further eliminate the dependency on specific CPU/hardware (and OS) requirements. Standard PC/104 is a typical base for small, low-volume embedded and ruggedized system design. These often use DOS, Linux or an embedded real-time operating system such as QNX or Inferno.

A common configuration for very-high-volume embedded systems is the system on a chip, an application specific integrated circuit, for which the CPU was purchased as intellectual property to add to the IC's design. A related common scheme is to use a field programmable gate array,

and program it with all the logic, including the CPU. Most modern FPGAs are designed for this purpose.

Tools

Like typical computer programmers, embedded system designers use compilers, assemblers, and debuggers to develop embedded system software. Software companies that specialize in the embedded market Ported from the GNU software development tools. Sometimes, development tools for a personal computer can be used if the embedded processor is a close relative to a common PC processor. Embedded system designers also use a few software tools rarely used by Typical computer programmers.

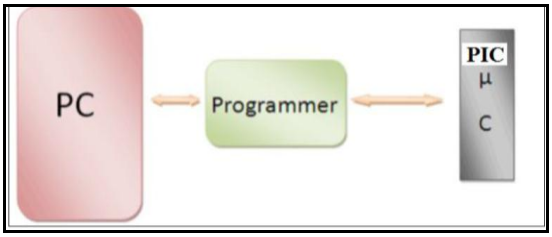

Fig No.11 Interfacing of PC with Microcontroller

One common tool is an in circuit emulator (ICE) or, in more modern designs, an embedded debugger. This debugging tool is the fundamental trick used to develop embedded code. It replaces or plugs into the microprocessor, and provides facilities to quickly load and debug experimental code in the system. A small pod usually provides the special electronics to plug into the system. Often a personal computer with special software attaches to the pod to provide the debugging interface. Another common tool is a utility program often home grown to add a check sum or CRC to a program, so it can check its program data before executing it.

An embedded programmer that develops software for digital signal processing often has a math workbench such as Math Cad or Mathematical to simulate the mathematics. Less common are utility programs to turn data files into code, so one can include any kind of data in a program. A few projects use Synchronous programming languages for extra reliability or digital signal processing.

4. CIRCUIT DESIGN:-

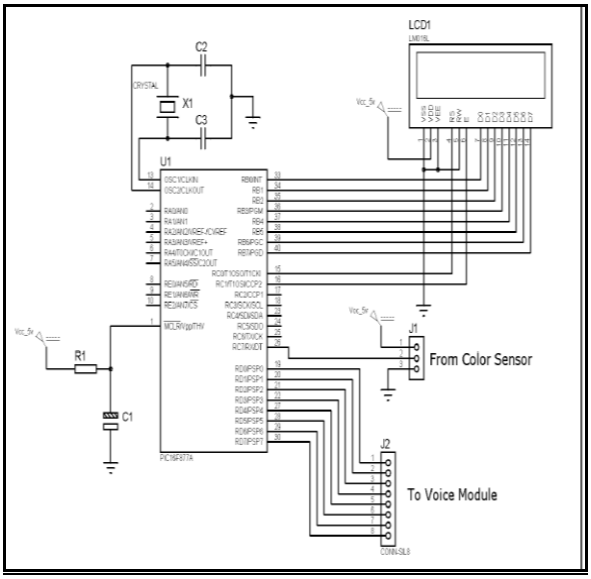

Fig No.12 Circuit Design

4.1SYSTEMWORK-FLOW DESCRIPTION

System Algorithm:-

1. Start.
2. Initialize sensor.
3. Monitor color.
4. Output detected colors.
5. Generate sound depending on colors.
6. Go to step-3.
7. Stop.

5. Flowchart:-

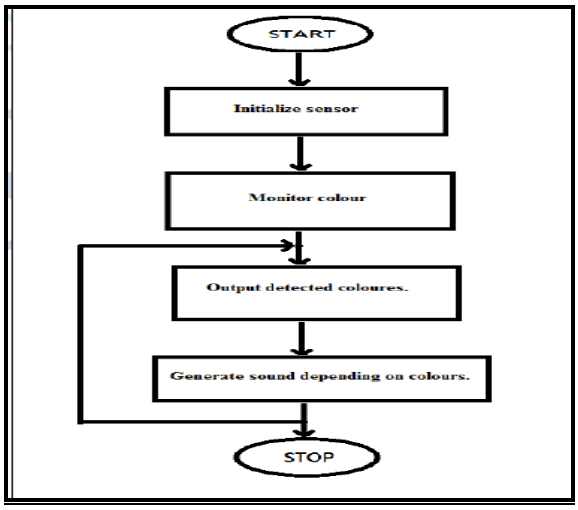

Fig No.13 Flow chart

6. Future Scope:-

This is a musical device that combines the visual and auditory senses by translating color to instrument sounds to speech. This project is selected because the blind person does not have the sense of color and these people cannot identify the color. So, In the future the main aim of the project is to identify the color by these blind peoples.

This is done by designing a circuit that detect the color by thecolor sensor and convert it into sound. So, in the future, the blind people who cannot see the color but by listening the sound, they can detect the color.

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