

PROFESSIONAL TRAINING REPORT

at

Sathyabama Institute of Science and Technology

(Deemed to be University)

Submitted in partial fulfillment of the requirements for the award
of Bachelor of Technology Degree in Information Technology

By

ABHISHEK SINGH (Reg. No.38120003)



DEPARTMENT OF INFORMATION TECHNOLOGY

SCHOOL OF COMPUTING

SATHYABAMA INSTITUTE OF SCIENCE AND

TECHNOLOGY

JEPPIAAR NAGAR, RAJIV GANDHI SALAI,

CHENNAI – 600119, TAMILNADU

OCTOBER 2020



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with Grade “A” by NAAC

(Established under Section 3 of UGC Act, 1956)

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI– 600119

www.sathyabamauniversity.ac.in



SCHOOL OF COMPUTING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **ABHISHEK SINGH (Reg.no.38120003)** who carried out the project entitled “**Colour Detection using Data-Science**” under my supervision from August 2019 to November 2020.

Internal Guide

Dr. Senduru Srinivasulu, M.E.,Ph.D.

Head of the Department

Dr.R.Subhashini, M.E.,Ph.D.

Submitted for Viva voce Examination held on

Internal Examiner

External Examiner

DECLARATION

I **ABHISHEK SINGH** hereby declare that the Project Report entitled done by me under the guidance of **Dr. Senduru Srinivasulu** at **SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY** is submitted in partial fulfillment of the requirements for the award of Bachelor of Technology degree in Information Technology

DATE:

PLACE:

SIGNATURE OF THE CANDIDATE:

ACKNOWLEDGEMENT

I am pleased to acknowledge my sincere thanks to **Board of Management of SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. I am grateful to them.

I convey my thanks to **Dr. T.Sasikala M.E., Ph.D., Dean, School of Computing** and **Dr.R.Subhashini, M.E.,Ph.D., Heads of the Department, Department of Information Technology** for providing me necessary support and details at the right time during the progressive reviews.

I would like to express my sincere and deep sense of gratitude to my Project Guide **Dr. Senduru Srinivasulu, M.E.,Ph.D.** for his valuable guidance, suggestions and constant encouragement paved way for the successful completion of my project work.

I wish to express my thanks to all Teaching and Non-teaching staff members of the **Department of Information Technology** who were helpful in many ways for the completion of the project.

TRAINING CERTIFICATE



05/30/2020

Abhishek Singh

has successfully completed

Programming for Everybody (Getting Started with Python)

an online non-credit course authorized by University of Michigan and offered through Coursera

A handwritten signature in black ink, appearing to read 'Charles', followed by a horizontal line.

Charles Severance
Clinical Professor, School of Information
University of Michigan

COURSE
CERTIFICATE



Verify at coursera.org/verify/6JCQE3QVZ2C6
Coursera has confirmed the identity of this individual and
their participation in the course.

TRAINING CERTIFICATE



TRAINING CERTIFICATE



HasoTechnology

To Whomsoever It May Concern,

This is to certify that Abhishek Singh has worked at our organization HasoTechnology from **03rd February, 2020 to 31st July, 2020** as Web Developer Intern

He has worked on languages such as HTML, CSS, JavaScript and is capable of designing and developing Web applications to cater to diverse needs. His work reflects his thoroughness in understanding and implementing his knowledge of Web Development. His communication skills, leadership qualities, and his thorough knowledge on Web Platforms are his most valuable assets.

We wish him good luck and success in his future endeavors.

Sincerely,

Dilip Kumar K K

HasoTechnology

Website: www.hasotech.com | Mail: info@hasotech.com | Ph: +91 70106 62317 | +91 88701 03196 | 0452 – 4950116

ABSTRACT

The color detection project, will detect the color and give me the name of the respective shade. This can be obtained by clicking on 3D space, we get the corresponding coordinates with their respective colors by using basic mathematics coordinate analysis. Sometimes in daily life we need to get the exact shade of color from a picture for our understanding and analysis, hence the color detection theme comes into play. This can be recognized by Robots and implementing with data science and AI technology for advanced operations. We take data file that contains the color name and value mapping wherein we calculate the distance of each color .This project will have successful implementation for Image security passcodes and drawing Apps and by Robots for handicapped (visually impaired especially).

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE NO. NO.
	ABSTRACT	vii
	LIST OF FIGURES	3
LIST OF TABLES	4	
1	INTRODUCTION	5
	1.1 OUTLINE OF THE PROJECT	5
	1.2 TECHNOLOGIES USED	6
	1.2.1 IMPORTANCE OF DATA SCIENCE	7
	1.2.2 FUTURE OF DATA SCIENCE	7
2	LITERATURE SURVEY	8
	2.1 AIM AND SCOPE	15
	2.2 EXISTING SYSTEM	15
	2.3 CYBER PHYSICAL SYSTEM	17
	ADVANTAGES & DIS-ADVANTAGES	
3	METHODOLOGY	18
	3.1 PROPOSED SYSTEM	18
	3.2 ANALYSIS WORK	18
	3.2.1 COLOUR SPACE	18
	3.3 IMAGE CAPTURE	21
	3.4 SOFTWARE DESCRIPTION	22
	3.4.1 VIRTUAL MACHINE	22
	3.4.2 PYTHON IDLE CODE EDITOR	23
	3.5 HARD REQUIREMENTS	25
	3.6 SOFTWARE REQUIREMENTS	26

	3.7 PROJECT DESCRIPTION	26
	3.8 COLOUR DETECTION FLOW CHART	26
	3.9 MODULES DESIGN	27
	3.9.1 RGB IMAGE	27
	3.9.2 ILLUMINANT	28
	3.9.3 COLOUR SPACE SELECTION	28
	3.9.4 EDGE DETECTION	29
	3.9.5 INTEGRATING MICROSOFT EXCEL WITH PYTHON USING PANDAS	33
4	RESULTS AND DISCUSSION	35
5	CONCLUSION AND FUTURE WORKS	42
	5.1 CONCLUSION	42
	5.2 FUTURE WORKS	42
	REFERENCES	45
	APPENDIX	46
	# SOURCE CODE	46

LIST OF FIGURES

FIG NO.	NAME OF THE FIGURE	PAGE NO.
Fig 1.2	INTRODUCTION TO DATA SCIENCE	6
Fig 3.2	RGB MODEL	19
Fig 3.2	HSI COLOUR MODEL	20
Fig 3.4	VIRTUAL MACHINE OUTLOOK	23
Fig 3.4	PYTHON IDLE OUTLOOK	24
Fig 3.8	COLOUR DETECTION FLOWCHART	26
Fig 3.9	2-DIMENSIONAL GRID OF RGB	27
Fig 3.9	COMPOSITION OF RGB	29

Fig 3.9	HSV COLOUR MODEL	29
Fig 3.9.a	REAL IMAGE VIEW	30
Fig 3.9.a	EDGE DETECTED IMAGE VIEW	30
Fig 3.9.b	REAL IMAGE VIEW	31
Fig 3.9.b	EDGE DETECTED IMAGE VIEW	31
Fig 3.9	COLOUR GRADIENT	32
Fig 3.9	HISTOGRAM FOR COLOUR GRADIENT	32
Fig 3.9	EXCEL DATA SHEET	34
Fig 4.1	COLLECTED DATA SET	35
Fig 4.2	SEPARATED DATA SET	36
Fig 4.3	MOVING INSIDE THE CODING FOLDER FOR EXECUTION	37
Fig 4.4	EDITING AND RUNNING THE MODEL	37
Fig 4.5	DISPLAYING THE COLOUR IMAGE TO BE DETECTED	38
Fig 4.6(a,b,c, d,e,f)	COLOURS BEING DETECTED WITH THEIR PRESPECTIVE COORDINATES	(38-41)
Fig 4.7	READING THE COLOUR COORDINATES USING DATA EXCEL	41

LIST OF TABLES

TABLE NO.	NAME OF THE TABLE	PAGE NO.
Table 2.1	SERIES BASIC FUNCTIONALITY	14
Table 2.3	ADVANTAGES AND DISADVANTAGES OF CPS	17

CHAPTER 1

INTRODUCTION

1.1 OUTLINE OF THE PROJECT

In our everyday life we come through lots of colorful wonders, which fills our eyes with glitters. Now here the question arrives “HOW CAN WE DISTINGUISH BETWEEN THESE COLORS?” “WHAT ARE THE COORDINATES OF THESE COLOUR MIXTURE?” “WHICH ARE ALL THE COLOR MIXTURES BEING USED UP BEHIND THESE COLORS?” So here, Computer vision (CV) plays an important role in the world of data science, it is the science that means to give a comparative, if not better, capacity to a machine or PC. Computer vision is worried about the programmed extraction, investigation and comprehension of valuable data from a single picture or a grouping of pictures. Some of the basic image processing capabilities include filtering, edge detection, corner detection, sampling and interpolation, color conversion, morphological operations, histograms and many more. Color detection using OpenCV has many advantages like, it allows the detection of a specific color in a livestream video content. In this OpenCV color detection system there are four major modules, activated webcam, scan object, match frame parts and system results. Users can open webcam by clicking the webcam button. Then the algorithm analysis the pattern of the framed part of webcam. Pattern is matched with defined color pattern by RGB color model. If the pattern matched with the potential pattern of RGB color model then the system results with the correct output.

1.2 TECHNOLOGIES USED

Data science is an inter-disciplinary field that uses scientific methods, processes, algorithms and systems to extract knowledge and insights from many structural and unstructured data. Data science is related to data mining, machine learning and big data. Data science is a "concept to unify statistics, data analysis, machine learning, domain knowledge and their related methods" in order to "understand and analyze actual phenomena" with data. It uses techniques and theories drawn from many fields within the context of mathematics, statistics, computer science, domain

knowledge and information science. Turing award winner Jim Gray imagined data science as a "fourth paradigm" of science (empirical, theoretical, computational and now data-driven) and asserted that "everything about science is changing because of the impact of information technology" and the data deluge.

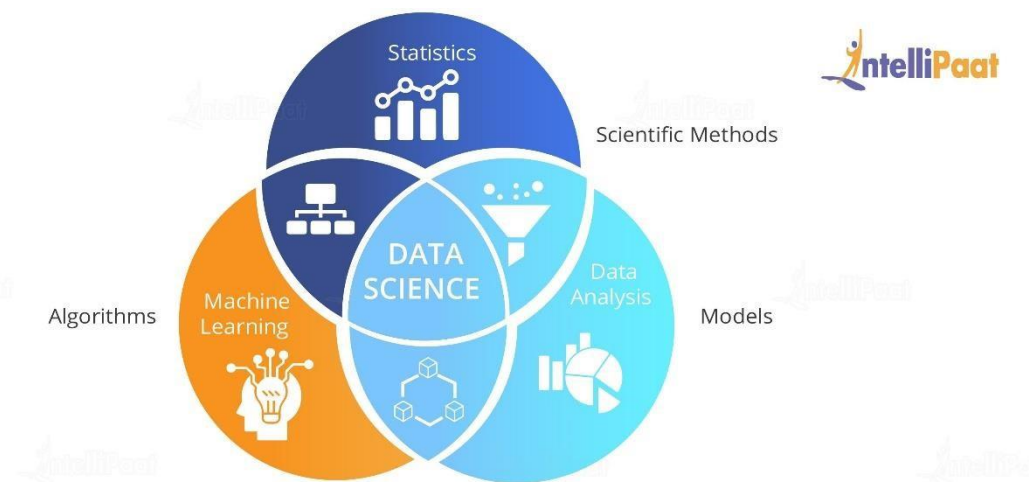


Fig 1.2 INTRODUCTION TO DATA SCIENCE

1.2.1 IMPORTANCE OF DATA SCIENCE

Data is one of the important features of every organization because it helps business leaders to make decisions based on facts, statistical numbers and trends. Due to this growing scope of data, data science came into picture which is a multidisciplinary field. It uses scientific approaches, procedure, algorithms, and framework to extract the knowledge and insight from a huge amount of data. The extracted data can be either structured or unstructured. Data science is a concept to bring together ideas, data examination, Machine Learning, and their related strategies to comprehend and dissect genuine phenomena with data. Data science is an extension of various data analysis fields such as data mining, statistics, predictive analysis and many more. Data Science is a huge field that uses a lot of methods and concepts which belongs to other fields like information science, statistics, mathematics, and computer science. Some of the techniques utilized in Data Science encompasses machine learning, visualization, pattern recognition, probability model, data engineering, signal processing, etc.

1.2.2 FUTURE OF DATA SCIENCE

As most of the fields are emerging continuously, the importance of data science is also increasing rapidly. Data science has influenced various areas. Its effect can be observed in multiple sectors such as the retail industry, healthcare, and education. In

the healthcare industry, new medicines and techniques are being discovered continuously and there is a requirement of better care for patients. With the help of data science techniques, the healthcare sector can find a solution that help to take care the patients. Education is another field where the benefits of data science can be seen clearly. The latest technologies such as smartphones and laptops have now become an important part of the education system. With the help of data science, better opportunities are created for the students which enable them to enhance their knowledge.

CHAPTER 2

LITERATURE SURVEY

OpenCV-Python is a library of Python bindings designed to solve computer vision problems. Python is a general purpose programming language started by **Guido van Rossum** that became very popular very quickly, mainly because of its simplicity and code readability. It enables the programmer to express ideas in fewer lines of code without reducing readability. Compared to languages like C/C++, Python is slower. That said, Python can be easily extended with C/C++, which allows us to write computationally intensive code in C/C++ and create Python wrappers that can be used as Python modules. This gives us two advantages: first, the code is as fast as the original C/C++ code (since it is the actual C++ code working in background) and second, it easier to code in Python than C/C++. OpenCV-Python is a Python wrapper for the original OpenCV C++ implementation. OpenCV-Python makes use of **Numpy**, which is a highly optimized library for numerical operations with a MATLAB-style syntax. All the OpenCV array structures are converted to and from Numpy arrays. This also makes it easier to integrate with other libraries that use Numpy such as SciPy and Matplotlib.



OpenCV is a cross-platform library using which we can develop real-time computer vision applications. It mainly focuses on image processing, video capture and analysis including features like face detection and object detection.

Let's start the chapter by defining the term "Computer Vision".

Computer Vision : Computer Vision can be defined as a discipline that explains how to reconstruct, interpret, and understand a 3D scene from its 2D images, in terms of the properties of the structure present in the scene. It deals with modeling and replicating human vision using computer software and hardware.

Computer Vision overlaps significantly with the following fields –

- Image Processing – It focuses on image manipulation.
- Pattern Recognition – It explains various techniques to classify patterns.
- Photogrammetry – It is concerned with obtaining accurate measurements from images.

Computer Vision Vs Image Processing Image processing deals with image-to-image transformation. The input and output of image processing are both images.

Computer vision is the construction of explicit, meaningful descriptions of physical objects from their image. The output of computer vision is a description or an interpretation of structures in 3D scene.

Applications of Computer Vision

Here we have listed down some of major domains where Computer Vision is heavily used.

Robotics Application

- Localization – Determine robot location automatically
- Navigation
- Obstacles avoidance
- Assembly (peg-in-hole, welding, painting)
- Manipulation (e.g. PUMA robot manipulator)
- Human Robot Interaction (HRI) – Intelligent robotics to interact with and serve people

Medicine Application

- Classification and detection (e.g. lesion or cells classification and tumor detection)
- 2D/3D segmentation
- 3D human organ reconstruction (MRI or ultrasound)
- Vision-guided robotics surgery

Industrial Automation Application

- Industrial inspection (defect detection)
- Assembly
- Barcode and package label reading
- Object sorting
- Document understanding (e.g. OCR)

Security Application

- Biometrics (iris, finger print, face recognition)
- Surveillance – Detecting certain suspicious activities or behaviors

Transportation Application

- Autonomous vehicle
- Safety, e.g., driver vigilance monitoring

Features of OpenCV Library

Using OpenCV library, you can –

- Read and write images
- Capture and save videos
- Process images (filter, transform)
- Perform feature detection
- Detect specific objects such as faces, eyes, cars, in the videos or images.
- Analyze the video, i.e., estimate the motion in it, subtract the background, and track objects in it.

OpenCV was originally developed in C++. In addition to it, Python and Java bindings were provided. OpenCV runs on various Operating Systems such as windows, Linux, OSX, FreeBSD, Net BSD, Open BSD, etc.

OpenCV Library Modules

Following are the main library modules of the OpenCV library.

Core Functionality

- This module covers the basic data structures such as Scalar, Point, Range, etc., that are used to build OpenCV applications. In addition to these, it also includes the multidimensional array **Mat**, which is used to store the images. In the Java library of OpenCV, this module is included as a package with the name **org.opencv.core**.

Image Processing

- This module covers various image processing operations such as image filtering, geometrical image transformations, color space conversion, histograms, etc. In the Java library of OpenCV, this module is included as a package with the name **org.opencv.imgproc**.

Video

- This module covers the video analysis concepts such as motion estimation, background subtraction, and object tracking. In the Java library of OpenCV, this module is included as a package with the name **org.opencv.video**.

Video I/O

- This module explains the video capturing and video codecs using OpenCV library. In the Java library of OpenCV, this module is included as a package with the name **org.opencv.videoio**.

calib3d

- This module includes algorithms regarding basic multiple-view geometry algorithms, single and stereo camera calibration, object pose estimation, stereo correspondence and elements of 3D reconstruction. In the Java library of OpenCV, this module is included as a package with the name **org.opencv.calib3d**.

features2d

- This module includes the concepts of feature detection and description. In the Java library of OpenCV, this module is included as a package with the name **org.opencv.features2d**.

Objdetect

- This module includes the detection of objects and instances of the predefined classes such as faces, eyes, mugs, people, cars, etc. In the Java library of

OpenCV, this module is included as a package with the name **org.opencv.objdetect**.

Highgui

- This is an easy-to-use interface with simple UI capabilities. In the Java library of OpenCV, the features of this module is included in two different packages namely, **org.opencv.imgcodecs** and **org.opencv.videoio**.

Pandas

Pandas is an open-source, BSD-licensed Python library providing high-performance, easy-to-use data structures and data analysis tools for the Python programming language. Python with Pandas is used in a wide range of fields including academic and commercial domains including finance, economics, Statistics, analytics, etc. In this tutorial, we will learn the various features of Python Pandas and how to use them in practice.



Prior to Pandas, Python was majorly used for data munging and preparation. It had very little contribution towards data analysis. Pandas solved this problem. Using Pandas, we can accomplish five typical steps in the processing and analysis of data, regardless of the origin of data — load, prepare, manipulate, model, and analyze.

Python with Pandas is used in a wide range of fields including academic and commercial domains including finance, economics, Statistics, analytics, etc.

Key Features of Pandas

Fast and efficient DataFrame object with default and customized indexing.

Tools for loading data into in-memory data objects from different file formats.

Data alignment and integrated handling of missing data.

Reshaping and pivoting of data sets.

Label-based slicing, indexing and subsetting of large data sets.

Columns from a data structure can be deleted or inserted.

Group by data for aggregation and transformations.

High performance merging and joining of data.

Time Series functionality.

Python Pandas - Environment Setup

Standard Python distribution doesn't come bundled with Pandas module. A lightweight alternative is to install NumPy using popular Python package installer, **pip**.

```
pip install pandas
```

If you install Anaconda Python package, Pandas will be installed by default with the following –

Windows

Anaconda (from <https://www.continuum.io>) is a free Python distribution for SciPy stack. It is also available for Linux and Mac.

Canopy (<https://www.enthought.com/products/canopy/>) is available as free as well as commercial distribution with full SciPy stack for Windows, Linux and Mac.

Python (x,y) is a free Python distribution with SciPy stack and Spyder IDE for Windows OS. (Downloadable from <http://python-xy.github.io/>)

Linux Package managers of respective Linux distributions are used to install one or more packages in SciPy stack. **For Ubuntu Users**

```
sudo apt-get install python-numpy python-scipy
```

```
python-matplotlib python-ipynb python-notebook python-pandas python-sympy python-nose
```

For Fedora Users

```
sudo yum install numpy scipy python-matplotlib python-pandas sympy python-nose atlas-devel
```

Sr.No.	Attribute or Method & Description
1	axes Returns a list of the row axis labels
2	dtype Returns the dtype of the object.
3	empty Returns True if series is empty.
4	ndim Returns the number of dimensions of the underlying data, by definition 1.
5	size Returns the number of elements in the underlying data.
6	values Returns the Series as ndarray.
7	head() Returns the first n rows.
8	tail() Returns the last n rows.

Table 2.1 :Series Basic Functionality

2.1 AIM AND SCOPE

In this color detection Python project, we are going to build an application through which you can automatically get the name of the color by clicking on them. So for this, we will have a data file that contains the color name and its values. Then we will calculate the distance from each color and find the shortest one. Colour detection is necessary to recognize objects, it is also used as a tool in various image editing and drawing apps. The target group of the device are blind persons or persons who cannot detect different colors. There are already different systems on the market, but they are very expensive and not useful for affordable. The new device should be a compact, simple and a cheap solution.

2.2 EXISTING SYSTEM

Cyber physical systems (CPS), as a computing process and the physical process of unity, is integrated computing, communication, and control in one of the next generation of intelligent systems. It interacts with the physical process through the human-computer interaction interface and uses the network space to manipulate a physical entity in a remote, reliable, real-time, secure, and cooperative way.

CPS includes future ubiquitous environment awareness, embedded computing, network communication, and network control system engineering that enable physical system with computing, communication, precise control, remote collaboration, and autonomous capabilities. It focuses on computing resources and physical resources in close integration and coordination, mainly for some intelligent systems such as robots, and intelligent navigation. At present, the information physics system is still a relatively new research field.

With the continuous development of computer technology, network technology, and mathematical theory, the research of digital image processing in real-time systems which has become an important component of CPS has been widely applied in various fields, such as biomedicine, satellite remote sensing, and image communication. As a part of the image processing, image segmentation plays an important role. Image segmentation in real-time systems is a technology and process of which divides image into a number of specific and unique section and extracts the interested section. Video image segmentation is an important issue in the field of computer vision and also a classic puzzle .Its researches have been applied in face identification system, fingerprint identification system, fire detection and identification system, machine vision, and medical imaging, and so on. As is known to all, CT (computed tomography) is widely used in hospitals, which uses the result of image segmentation to help diagnose patients effectively and rapidly in real time. Now, face identification system and machine vision are the most concern of scholars.

There are many video image segmentation algorithms of different applications. But so far, there is no uniform solution or standard for video image segmentation, and there is also no complete theory for guidance on how to select the appropriate segmentation method based on image characteristics. Under normal conditions, in order to more effectively solve a specific problem in the field of image segmentation, it is combined with the knowledge of the relevant areas.

According to the image gray level, image segmentation can be divided into gray scale image segmentation and color image segmentation. Compared to the gray scale images, color images include not only the brightness but also the color information, such as hue and saturation. In many cases, we can not extract the target information from the image by simply using the gray information while the human eye can recognize thousands of colors, so we can quickly obtain the segmentation with color information. Therefore, it is essential to study the color image segmentation which has broad prospects.

There are many splitting methods in color image segmentation, such as histogram threshold-based method, region-based methods, and fuzzy clustering segmentation and edge detection methods. These methods also combine different color spaces according to the needs of segmentation. Therefore, in the process of color image segmentation, we should firstly determine the color space, then select the appropriate segmentation method.

The image is very vulnerable to the effects of light and noise, so not only the noise but also the light changes should be taken into consideration when segmenting. Image color appearance would change when the light was changed. It will lead to inaccuracy of segmentation by only using the color information, regardless of the brightness information. In order to obtain the good segmentation, it uses the color information and the brightness information concurrently. In this paper, a novel image segmentation method is proposed which can segment the foreground and background in RGB color space by using the color information and the brightness information. The segmentation result of this method is better.

With modern industrial production develops toward the high speed and automatic direction, color recognition has been widely used in various industrial detection and automatic control field. And the work of color identification which is led by the human eye in the long-term production has been replaced by more and more color sensors. Color sensor detects color with comparison the object color with the reference color, and if they are consistent in a certain error range, then output the detection results. Color sensor can be applied in many fields, such as monitoring the production process and product quality in the industry; the realization of the true color copy without affected by environmental temperature, humidity, paper and toner influence in the electronic reproduction aspects; a disease indicator to study a sickness in the Medical; and automatic control in detection two adjacent label colors of a paper and automatically count the number of all sorts of color by auto-counter in the commodity packaging. There are many kinds of color sensors so far. The typical color sensor is TCS230 color sensor, the latest color sensor of TAOS Company. It can recognize and detect colors and has many good new features in comparison with other color sensors. It is adequate for colorimeter measurement applications, such as medical diagnosis, color printing, computer color monitor calibration, and cosmetics, paint, textile and the process control of printing materials. According to the working principle of color sensor and image segmentation method, we will design a similar color sensor function by using the thermal ink characteristic in this paper. The characteristic of thermal ink is that its color value will change in real time as the temperature changes. Therefore, the segmentation results of thermal ink can be used as a real-time color sensor. We get the color information from the segmentation area (thermal ink); through the ink color

value of correction and the comparison of the standard color, the right color value is concluded, and finally, temperature is output by the relevance of the thermal ink color and temperature. This design can be used for measuring the indoor, outdoor temperature, and food labels, etc. It can also be used to control the temperature of greenhouse plants. We identify the change of temperature through real-time monitoring of the color change, thereby adjust the temperature to obtain a better yield. This method is real time and fast and without multiple sensor nodes.

2.3 CYBER PHYSICAL SSYSTEMS: Advantages and Disadvantages

Cyber Physical systems are computers that perform functions in real time as a result of stimuli in the physical world. They are prevalent in various parts of everyday life. Please comment about any uses you have made with Cyber Physical Systems.

ADVANTAGES	DIS-ADVANTAGES
☐ Fast way to ensure safety in various real world processes	Possible Terminator type scenario
☐ Ensures efficiency in various real world processes	Unemployment
☐ Improvement in life quality for countless people	Unpredictability
☐ Potential to bring a positive revolution to the world	Loss of purpose in life
☐ Can perform countless calculations instantaneously	Computers gaining self awareness

Table 2.3 Advantages and Disadvantages of CPS

CHAPTER 3

METHODOLOGY

3.1 PROPOSED SYSTEM

Color information plays an important role in the color image segmentation and realtime color sensor, which affects the result of video image segmentation and correct real-time temperature value. In this paper, a novel real-time color image segmentation method is proposed, which is based on color similarity in RGB color space. According to the color and luminance information in RGB color space, the dominant color is determined at first, and then color similarity can be calculated with the proposed calculation method of color component, which creates a color-class map. Next, the

information of the corresponding color-class map is utilized to classify the pixels. Due to the characteristic that thermal inks feature color values that change in real time as

the temperature changes, the segmentation results of thermal ink can be used as a real-time color sensor. Then, we also propose a method of color correction and light source compensation for the sake of potential inaccuracy of its measures. We discuss the proposed segmentation method application combining with color sensor (thermal ink) in real-time color image segmentation for Cyber physical system (CPS) by the application in fire detection and summarize a new method in identifying fire in a video based on these characteristics. The experiments showed that the proposed method in vision-based fire detection and identification in videos was effective; the results were accurate and can be used in real-time analysis.

3.2 THE ANALYSIS WORK

3.2.1 Color space

In the color image segmentation, the first step is to choose a color space. The color model we know contains RGB, HSI, HSV, CMYK, CIE, YUV, and so on. RGB model is the most commonly used for hardware color model while the HSI model is the most commonly used color model for color processing. They are often used in image processing technology. RGB space is represented by the three primary colors of red, green, blue; other colors are made up with the three primary colors. The RGB model is represented by the Cartesian coordinate system, as shown in Fig. 1. The three axes stand for R, G, B, respectively, and every point in the three-dimensional space means the three components of brightness value. The brightness value is between one and zero.

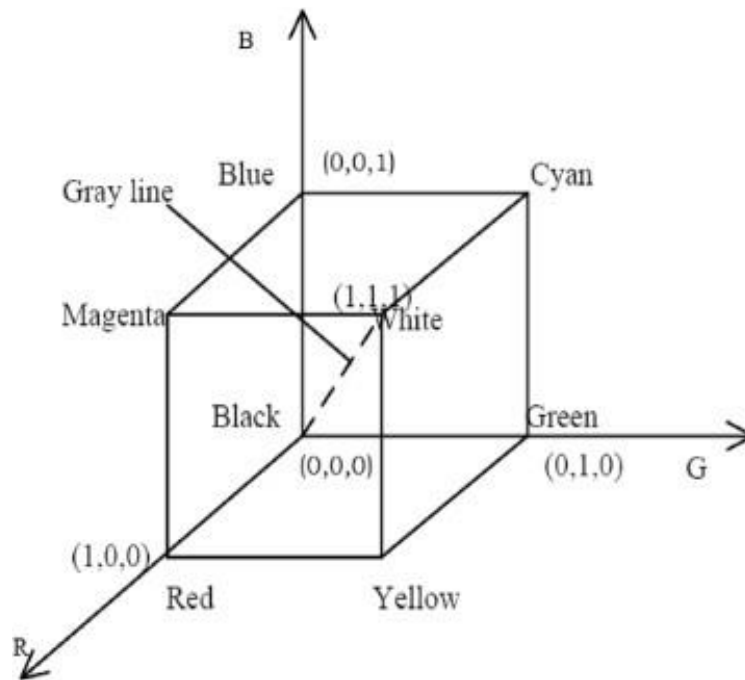


Fig 3.2 RGB color model

In Fig 3.2, the origin is black, which value is $(0,0,0)$; while the farthest vertex with a value of $(1,1,1)$ from the origin is white. The straight line between black and white called gray line means that the gray value changes from black to white. The remaining three corners represent the complementary color of the three primary colors - yellow, cyan, magenta.

The three components in the RGB color space, which is highly relevant. And it will be changed accordingly as long as the brightness is changed. RGB is a non-uniform color space, so the perception of differences (color) between the two colors cannot stand for the distance that between two points in the color space. Thus, the RGB color space is often converted to the other color spaces, such as HSI, HSV, the CIE, and Lab, by using linear or nonlinear transform in image processing. However, the original image we have collected usually is the RGB space, color space conversion will increase the amount of computation. And there are many segmentation methods using RGB color space, for example, license location [16] gets the license plate area accurately by calculating the contrast in the RGB components, reducing the calculated amount.

HSI color model is put forward by Munsell, which is suitable for human visual characteristics. The H (hue) means the different colors, S (saturation) means the depth of color, and I (brightness) mean the light and shade of color. This model has two important characteristics: I component has nothing to do with the color information of the image and H and S component are closely linked to the feelings. They are suitable for image processing with the visual system to perceive the color characteristics, and we often take advantage of the H component to segment the color image.

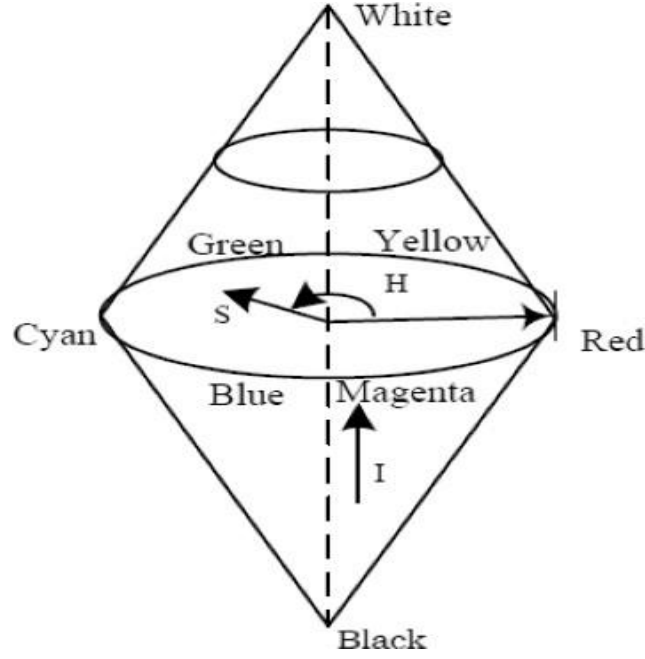


Fig 3.2 HSI color model

To deal with the image in the HSI space, image must be converted to the HSI mode. The conversion formula (geometric derivation method) as follows Equation.

$$H = \begin{cases} \theta, & G \geq B \\ 2\pi - \theta, & G < B \end{cases}$$

$$\text{when } \theta = \cos^{-1} \left(\frac{(R - G) + (R - B)}{2\sqrt{(R - B)(G - B) + (R - G)^2}} \right).$$

$$I = \frac{R + G + B}{3},$$

$$S = 1 - \frac{3 \min(R, G, B)}{R + G + B} = 1 - \frac{\min(R, G, B)}{I}.$$

In the conversion Equation transformation from the RGB model to the HSI model needs more computation. When brightness was zero, saturation was meaningless and when the saturation was zero, hue made no sense. In the conversion, the hue will generate a singularity that cannot be eliminated. The singularity may lead to the discontinuous of the nearby tonal value in value, which will ignore the low saturation pixels in the image processing and lead to the incorrect segmentation. As is known to us, HSI is suitable for human visual characteristics. Therefore, many scholars have put forth a lot of research for color image segmentation in the HSI model. Reference

used the saturation and brightness information of HSI model to get texture image segmentation, which is a combination of fractal theory and BP neural network.

3.3 Image capture

Generally, there are two ways in video image capture:

- ✓ the use of video capture card with the SDK development tools. This method relies on the Video capture card and the type of camera, not flexible and universal and
- ✓ the use of Microsoft's Windows operating system and VFW (Video For Window) software Development Kit of Visual C++. It is a pure software way to realize the collection of video streaming, input, and output. This method does not depend on the type of vision sensors, with better flexibility and versatility [20, 21].

This paper uses OpenCV's CVCAM technology to realize the collection of video stream of visual sensor, processing, and playback (display) at the same time, and realize the file streaming reading, processing, and broadcasting (display).

OpenCV is an open source computer vision library that was funded by Intel, composed of a series of C functions and the C++ class, and provides easy-to-use computer vision framework and rich library. The functions include the field of image processing, computer vision, pattern recognition, and artificial intelligence. With the realization of image processing, signal processing, structure analysis, motion detection, camera calibration, computer graphics, 3D reconstruction, and machine learning, a large number of generic algorithms have higher efficiency.

OpenCV library has the following advantages:

- The cross-platform: Windows, Linux, Mac OS, iOS, Android, independent of the operating system, hardware and graphics manager;
- Free: open source, does not matter if for business applications or for noncommercial applications;
- The high speed: uses the C/C++, suitable for the development of real-time applications;
- Easy to use: has a general image/video to load and a save and retrieve module;
- Flexible: has good scalability, with low-level and high-level application development kit.

OpenCV 1.0 version consists of the following six modules:

- The CXCORE module: basic data structures and algorithms function;
- The CV module: main OpenCV functions;
- CVAUX module: experimental auxiliary functions;
- The HighGUI module: graphics interface functions; □ The ML module: machine learning function; □ CVCAM modules: camera interface function.

Because the OpenCV library functions by optimizing the C code, not only is the code simple and efficient but also can make full use of the advantages of multi-core processors. Therefore, this paper uses Visual C++ development environment and OpenCV technology for video image capture, processing and display.

3.4 SOFTWARE DESCRIPTION

The purpose of the Software Requirement Specification is to produce the specification of the analysis task and also to establish complete information about the requirement, behavior and also the other constraint like functional performance and so on. The main aim of the Software Requirement Specification is to completely specify the technical requirements for the software product in a concise and in unambiguous manner.

3.4.1 Virtual Machine

A virtual machine is a program that acts as a virtual computer. It runs on your current operating system (the host operating system) and provides virtual hardware to guest operating systems. The guest OS runs in a window on your host OS, just like any other program on your computer. From the guest operating system's perspective, the virtual machine is a real, physical computer.

The virtual machine's emulation engine, called a hypervisor, handles the virtual hardware, including a central processing unit, memory, hard drive, network interface, and other devices. The virtual hardware devices provided by the hypervisor map to real hardware on your physical machine. For example, a virtual machine's virtual hard disk is stored in a file located on your hard drive.

It has several virtual machines installed on your system. They are only limited by the amount of storage you have available for them. Once you've installed several operating systems, you can open your virtual machine program and choose which virtual machine you want to boot. The guest operating system starts up and runs in a window on your host operating system, although you can also run it in full-screen mode. A virtual machine, known as a guest, is created within a computing environment, called a host. Multiple virtual machines can exist in one host at one time. Key files that make up a virtual machine include a log file, NVRAM setting file, virtual disk file, and configuration file, they run applications and an operating system. However, virtual machines are computer files that run on a physical computer and behave like a physical computer. In other words, virtual machines behave as separate computer systems.

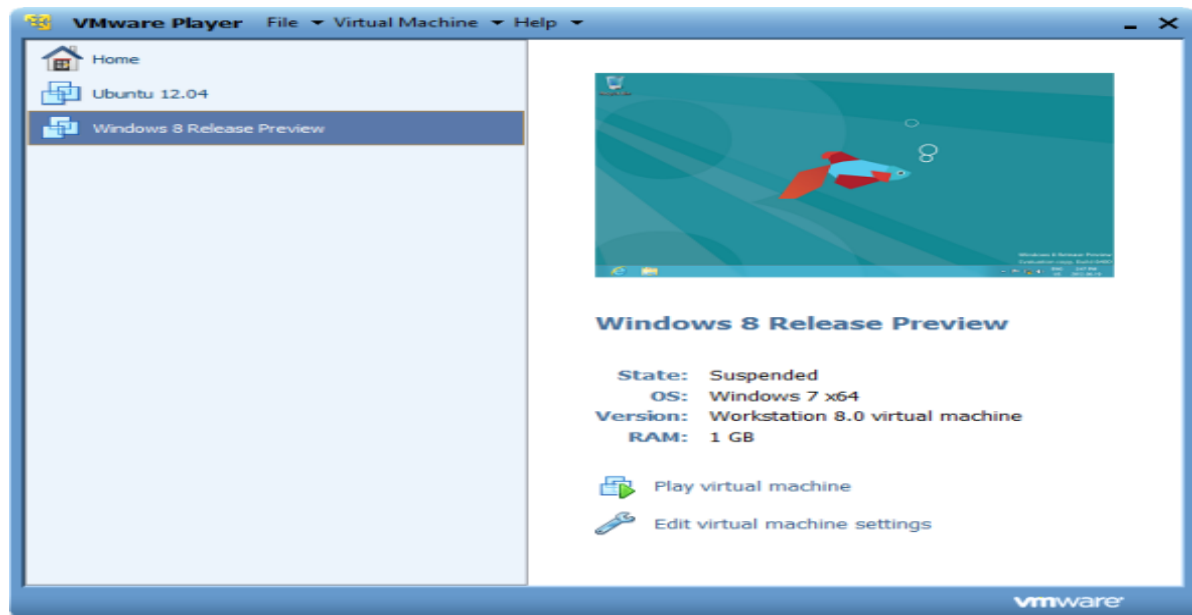


Fig 3.4 Virtual Machine Outlook

3.4.2 Python IDLE code editor

IDLE stands for Integrated Development and Learning Environment. The story behind the name IDLE is similar to Python. Guido Van Rossum named Python after the British comedy group Monty Python while the name IDLE was chosen to pay tribute to Eric Idle, who was one of the Monty Python's founding members. IDLE comes bundled with the default implementation of the Python language since the 01.5.2b1 release. It is packaged as an optional part of the Python packaging with many Linux, Windows, and Mac distributions.

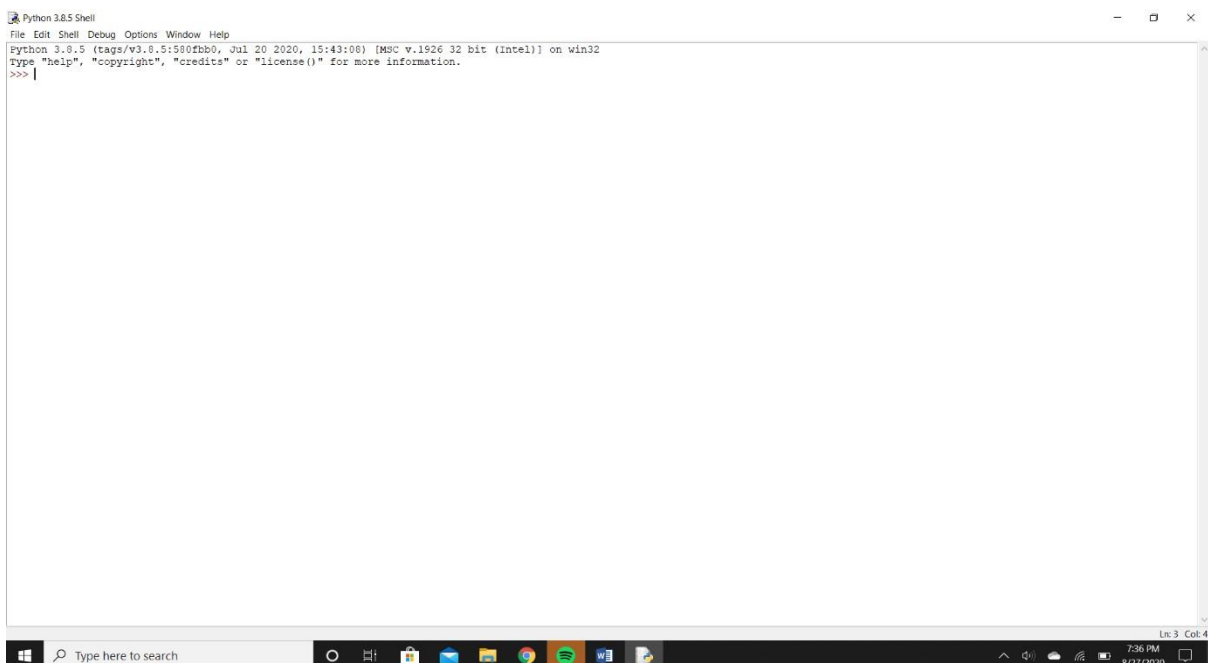
IDLE, as shown above, is a very simple and sophisticated IDE developed primarily for beginners, and because of its simplicity, it is highly considered and recommended for educational purposes. It offers a variety of features that you will look in detail along with examples later in this tutorial.

Some of the key features it offers are:

- Python shell with syntax highlighting,
- Multi-window text editor,
- Code autocompletion,
- Intelligent indenting,
- Program animation and stepping which allows one line of code to run at a time helpful for debugging,
- Persistent breakpoints,
- Finally, Call stack visibility.

IDLE has the following features:

- coded in 100% pure Python, using the `tkinter` GUI toolkit
- cross-platform: works mostly the same on Windows, Unix, and macOS
- Python shell window (interactive interpreter) with colorizing of code input, output, and error messages
- multi-window text editor with multiple undo, Python colorizing, smart indent, call tips, auto completion, and other features
- search within any window, replace within editor windows, and search through multiple files (grep)
- debugger with persistent breakpoints, stepping, and viewing of global and local namespaces
- configuration, browsers, and other dialogs



3.4 Python IDLE Outlook

IDLE can be used to execute a single statement just like Python Shell and also to create, modify and execute Python scripts. IDLE provides a fully-featured text editor to create Python scripts that includes features like syntax highlighting, autocompletion and smart indent. It also has a debugger with stepping and breakpoints features.

Supported languages #

Python 2: version 2.7

Python 3: from the version 3.5 up to the version 3.8

In addition, in the Professional edition, one can develop Django, Flask and Pyramid applications. Also, it fully supports HTML (including HTML5), CSS, JavaScript, and XML: these languages are bundled in the IDE via plugins and are switched on for you by default. Support for the other languages and frameworks can also be added via plugins (go to Settings | Plugins or PyCharm | Preferences | Plugins for macOS users, to find out more or set them up during the first IDE launch).

Supported platforms #

- Python IDLE is a cross-platform IDE that works on the following platforms.
- Windows (Windows 10, Windows Server, Windows XP)
- Mac OS □ Linux.

The AWS Toolkit for Python IDLE is an open source plug-in for the Python IDE that makes it easier to create, debug, and deploy Python applications on Amazon Web Services. With the AWS Toolkit for Python IDLE, you can get started faster and be more productive when building applications with PyTHON IDLE on AWS. The toolkit provides an integrated experience for developing serverless applications, including assistance for getting started, step-through debugging, and deploying from the IDE. PyCharm's huge collection of tools out of the box includes an integrated debugger and test runner, Python profiler, a built-in terminal, integration with major VCS and built-in database tools; remote development capabilities with remote interpreters; an integrated SSH terminal; and integration with Docker and Vagrant. Python IDLE provides smart code completion, code inspections, on- the-fly error highlighting and quick-fixes, along with automated code refactoring and rich navigation capabilities. In today's fast-paced world having an edge over the other programmers is probably a good thing. Making use of an IDE can help make the life of a programmer very easy and ensure focus is at prime to push out a better code and not worry about the dependencies or many other factors.

3.5 HARDWARE REQUIREMENTS

- PC
- RAM: 8GB
- Processor: i5
- Hard Disk: 1TB

3.6 SOFTWARE REQUIREMENTS

- OS: WINDOWS
- Python IDLE (code editor)
- Python (Language)

- Microsoft Excel

3.7 PROJECT DESCRIPTION

In this color detection Python project, we are going to build an application through which you can automatically get the name of the color by clicking on them. So for this, we will have a data file that contains the color name and its values. Then we will calculate the distance from each color and find the shortest one. Colors are made up of 3 primary colors; red, green, and blue. In computers, we define each color value within a range of 0 to 255. So in how many ways we can define a color? The answer is $256 \times 256 \times 256 = 16,581,375$. There are approximately 16.5 million different ways to represent a color. In our dataset, we need to map each color's values with their corresponding names. But don't worry, we don't need to map all the values. We will be using a dataset that contains RGB values with their corresponding names. [click here](#) to download csv file. csv file includes 865 color names along with their RGB and hex values.

3.8 COLOUR DETECTION FLOWCHART

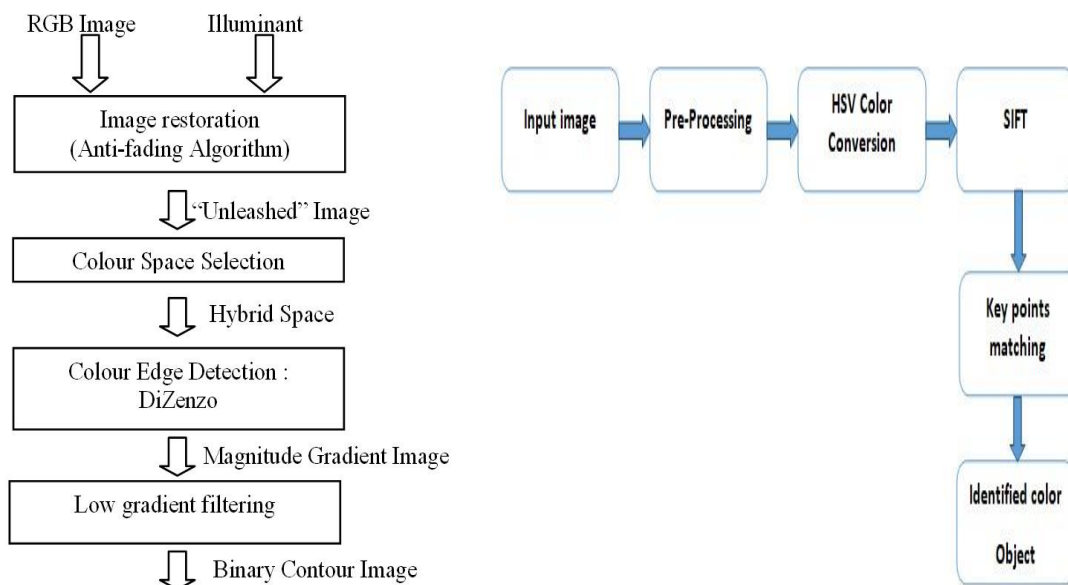


Fig 3.8 Colour detection flowchart

3.9 MODULES DESIGN

- RGB Image
- Illuminant
- Colour space selection
- Colour edge detection

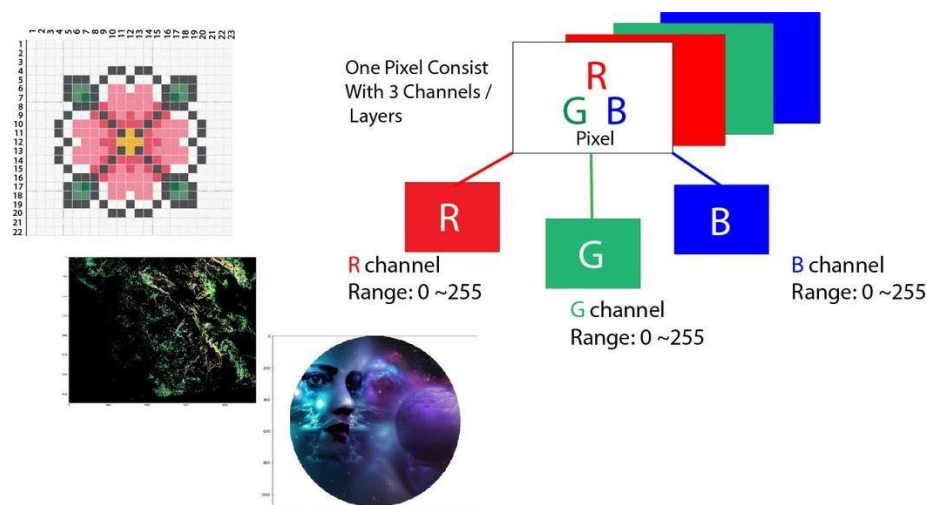
- Low gradient filtering

3.9.1 RGB IMAGE

Computer store images as a mosaic of tiny squares. This is like the ancient art form of tile mosaic, or the melting bead kits kids play with today. Now, if these square tiles are too big, it's then hard to make smooth edges and curves. The more and smaller tiles we use, the smoother or as we say less pixelated, image will be. These sometimes gets referred to as resolution of the images.

Vector graphics are somewhat different method of storing images that aims to avoid pixel related issues. But even vector images, in the end, are displayed as a mosaic of pixels. The word pixel means a picture element. A simple way to describe each pixel is using a combination of three colors, namely Red, Green, Blue. This is what we call an RGB image.

In an RGB image, each pixel is represented by three 8 bit numbers associated to the values for Red, Green, Blue respectively. Eventually using a magnifying glass, if we zoom a picture, we'll see the picture is made up of tiny dots of little light or more specifically the pixels and what more interesting is to see that those tiny dots of little light are actually multiple tiny dots of little light of different colors which are nothing but Red, Green, Blue channels.



3.9 2-Dimensional grid of RGB

Pixel together from far away, create an image and upfront they're just little lights that are ON and OFF. The combination of those create images and basically what we see on screen every single day.

Every photograph, in digital form, is made up of pixels. They are the smallest unit of information that makes up a picture. Usually round or square, they are typically arranged in a 2-dimensional grid.

Now, if all three values are at full intensity, that means they're 255, it then shows as white and if all three colors are muted, or has the value of 0, the color shows as black.

The combination of these three will, in turn, give us a specific shade of the pixel color. Since each number is an 8-bit number, the values range from 0-255.

Combination of these three color will posses tends to the highest value among them. Since each value can have 256 different intensity or brightness value, it makes 16.8 million total shades.

3.9.2 Illuminant

This is the color balancing technique used in Adobe Photoshop's "auto levels" command. The idea is that in a well balanced photo, the brightest color should be white and the darkest black. Thus, we can remove the color cast from an image by scaling the histograms of each of the R, G, and B channels so that they span the complete 0-255 scale. In contrast to the other color balancing algorithms, this method does not separate the estimation and adaptation steps.

In order to deal with outliers, Simplest Color Balance saturates a certain percentage of the image's bright pixels to white and dark pixels to black. The saturation level is an adjustable parameter that affects the quality of the output. Values around 0.01 are typical.

3.9.3 Colour Space Selection

Color spaces are a way to represent the color channels present in the image that gives the image that particular hue. There are several different color spaces and each has its own significance. Some of the popular color spaces are *RGB* (Red, Green, Blue), *CMYK* (Cyan, Magenta, Yellow, Black), *HSV* (Hue, Saturation, Value), etc.

BGR color space: OpenCV's default color space is RGB. However, it actually stores color in the BGR format. It is an additive color model where the different intensities of Blue, Green and Red give different shades of color.

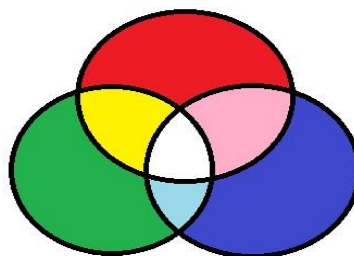


Fig 3.9 Composition of RGB

HSV color space: It stores color information in a cylindrical representation of RGB color points. It attempts to depict the colors as perceived by the human eye. Hue value

varies from 0-179, Saturation value varies from 0-255 and Value value varies from 0-255. It is mostly used for color segmentation purpose.

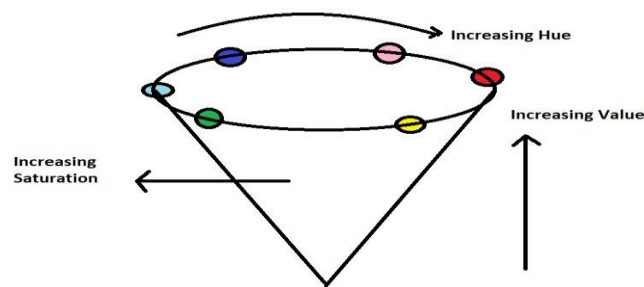


Fig 3.9 HSV Colour Model

3.9.4 Edge detection

Edge detection includes a variety of mathematical methods that aim at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities. The points at which image brightness changes sharply are typically organized into a set of curved line segments termed *edges*. The same problem of finding discontinuities in one-dimensional signals is known as step detection and the problem of finding signal discontinuities over time is known as change detection. Edge detection is a fundamental tool in image processing, machine vision and computer vision, particularly in the areas of feature detection and feature extraction.

The edges extracted from a two-dimensional image of a three-dimensional scene can be classified as either viewpoint dependent or viewpoint independent. A viewpoint independent edge typically reflects inherent properties of the three-dimensional objects, such as surface markings and surface shape. A viewpoint dependent edge may change as the viewpoint changes, and typically reflects the geometry of the scene, such as objects occluding one another.

A typical edge might for instance be the border between a block of red color and a block of yellow. In contrast a line (as can be extracted by a ridge detector) can be a small number of pixels of a different color on an otherwise unchanging background. For a line, there may therefore usually be one edge on each side of the line.



Fig 3.9.a Real image



Fig 3.9.a Edge detected image view



Fig 3.9.b Real Image



Fig 3.9.b Edge Detected Image view

Although certain literature has considered the detection of ideal step edges, the edges obtained from natural images are usually not at all ideal step edges. Instead they are normally affected by one or several of the following effects:

- focal blur caused by a finite depth-of-field and finite point spread function.

- penumbral blur caused by shadows created by light sources of non-zero radius.
□ shading at a smooth object.

A number of researchers have used a Gaussian smoothed step edge (an error function) as the simplest extension of the ideal step edge model for modeling the effects of edge blur in practical applications.

$$f(x) = \frac{I_r - I_l}{2} \left(\operatorname{erf} \left(\frac{x}{\sqrt{2}\sigma} \right) + 1 \right) + I_l.$$

At the left side of the edge, the intensity is $I_l = \lim_{x \rightarrow -\infty} f(x)$, and right of the edge it is $I_r = \lim_{x \rightarrow \infty} f(x)$. The scale parameter σ is called the blur scale of the edge. Ideally this scale parameter should be adjusted based on the quality of image to avoid destroying true edges of the image.

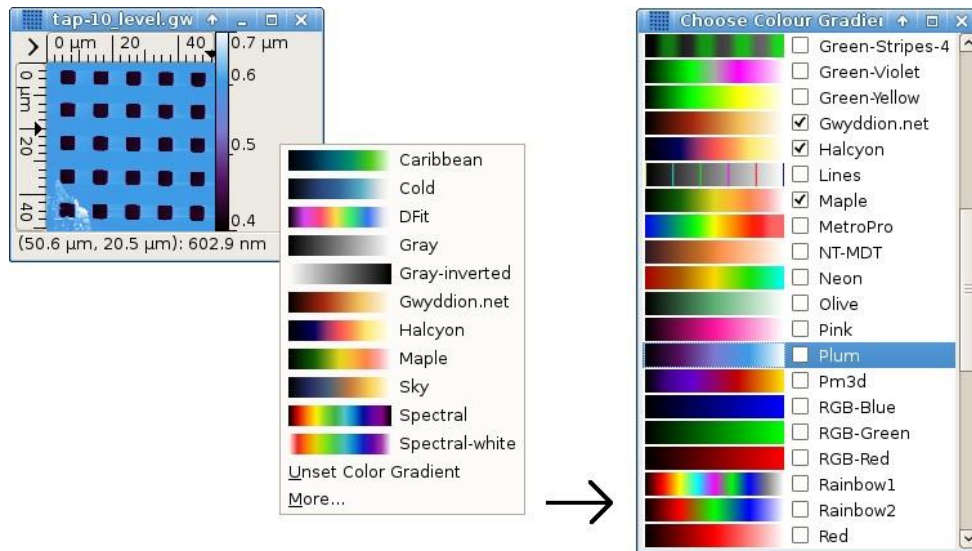


Fig 3.9 Colour Gradient

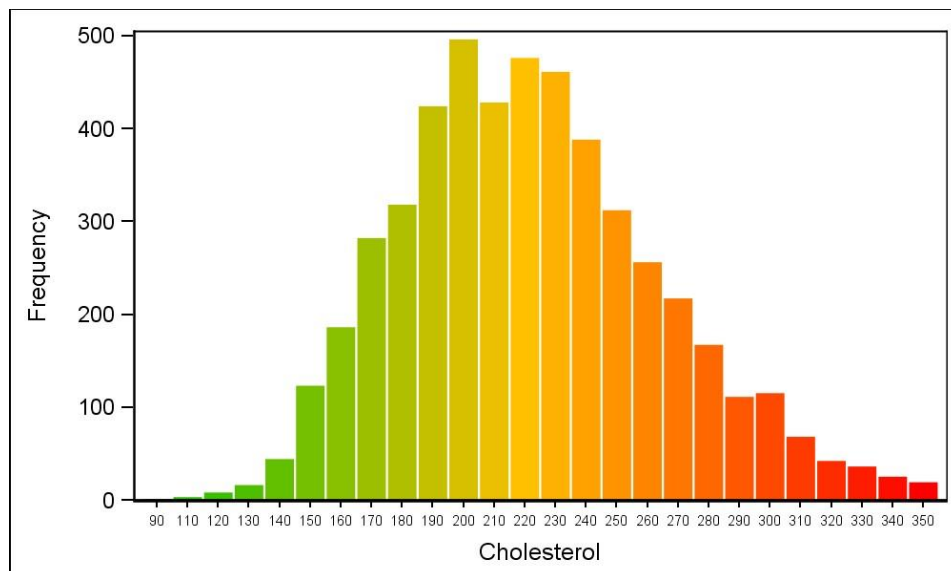


Fig 3.9 Histogram For Colour Gradient

3.9.5 Integrating Microsoft Excel with Python using Pandas

With Excel being so pervasive, data professionals must be familiar with it. Working with data in Python or R offers serious advantages over Excel's UI, so finding a way to work with Excel using code is critical. Thankfully, there's a great tool already out there for using Excel with Python called **pandas**.

Pandas has excellent methods for reading all kinds of data from Excel files. You can also export your results from pandas back to Excel, if that's preferred by your intended audience. Pandas is great for other routine data analysis tasks, such as:

- quick Exploratory Data Analysis (EDA)
- drawing attractive plots
- feeding data into machine learning tools like scikit-learn
- building machine learning models on your data
- taking cleaned and processed data to any number of data tools

Pandas is better at automating data processing tasks than Excel, including processing Excel files.

We will use Python 3 and IDLE to demonstrate the code in this tutorial. In addition to Python and Jupyter Notebook, you will need the following Python modules:

- matplotlib – data visualization
- NumPy – numerical data functionality
- OpenPyXL – read/write Excel 2010 xlsx/xlsm files
- pandas – data import, clean-up, exploration, and analysis
- xlrd – read Excel data
- xlwt – write to Excel
- XlsxWriter – write to Excel (xlsx) files

There are multiple ways to get set up with all the modules. We cover three of the most common scenarios below.

- If you have Python installed via Anaconda package manager, you can install the required modules using the command `conda install`. For example, to install pandas, you would execute the command – `conda install pandas`.
- If you already have a regular, non-Anaconda Python installed on the computer, you can install the required modules using pip. Open your command line program and execute command ***pip install <module name>*** to install a module. You should replace *<module name>* with the actual name of the module you are trying to install. For example, to install pandas, you would execute command – ***pip install pandas***.

- If you don't have Python already installed, you should get it through the [Anaconda package manager](#). Anaconda provides installers for Windows, Mac, and Linux Computers. If you choose the full installer, you will get all the modules you need, along with Python and pandas within a single package. This is the easiest and fastest way to get started.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	air_force	Air Force E #5d8aa8		93	138	168																	
2	air_force	Air Force E #00308f		0	48	143																	
3	air_superior	Air Superior #72a0c1		114	160	193																	
4	alabama	Alabama C #a32638		163	38	56																	
5	alice_blue	Alice Blue #f0f8ff		240	248	255																	
6	alizarin_cr	Alizarin Cr #e32636		227	38	54																	
7	alloy_oran	Alloy Oran #c46210		196	98	16																	
8	almond	Almond #efddec		239	222	205																	
9	amaranth	Amaranth #e52b50		229	43	80																	
10	amber	Amber #ffbf00		255	191	0																	
11	amber_sai	Amber Sai #ff7e00		255	126	0																	
12	american	American #ff033e		255	3	62																	
13	amethyst	Amethyst #9966		153	102	204																	
14	android_g	Android G #a4c639		164	198	57																	
15	anti_flash	Anti-Flash #f2f3f4		242	243	244																	
16	antique_br	Antique Br #cd9575		205	149	117																	
17	antique_f	Antique F #915c83		145	92	131																	
18	antique_r	Antique R #841b2d		132	27	45																	
19	antique_w	Antique W #faebd7		250	235	215																	
20	ao_english	Ao (English) #008000		0	128	0																	
21	apple_grei	Apple Grei #8db600		141	182	0																	
22	apricot	Apricot #fbc02d		251	206	177																	
23	aqua	Aqua #00ffff		0	255	255																	
24	aquamarine	Aquamarine #7fffd4		127	255	212																	
25	army_gree	Army Gree #4b5320		75	83	32																	
26	arsenic	Arsenic #3b444b		59	68	75																	
27	arylide_ye	Arylide Yel #e9966b		233	214	107																	
28	ash_grey	Ash Grey #b2beb5		178	190	181																	
29	asparagus	Asparagus #87a96b		135	169	107																	
30	atomic	Atomic Ta #9966		255	153	102																	

Fig 3.9 Excel Data set

Excel files quite often have multiple sheets and the ability to read a specific sheet or all of them is very important. To make this easy, the pandas `read_excel` method takes an argument called `sheetname` that tells pandas which sheet to read in the data from. For this, you can either use the sheet name or the sheet number. Sheet numbers start with zero. If the `sheetname` argument is not given, it defaults to zero and pandas will import the first sheet.

By default, pandas will automatically assign a numeric index or row label starting with zero. You may want to leave the default index as such if your data doesn't have a column with unique values that can serve as a better index. In case there is a column that you feel would serve as a better index, you can override the default behavior by setting `index_col` property to a column. It takes a numeric value for setting a single column as index or a list of numeric values for creating a multi-index.

In the below code, we are choosing the first column, 'Title', as index (`index=0`) by passing zero to the `index_col` argument.

CHAPTER 4

RESULTS AND DISCUSSION

To begin with, testing of the trained model, we can split our project into modules of implementation that is done.

Dataset collection involves the process of collecting different crack dataset. Various datasets were collected and one example among the collected dataset can be found below.

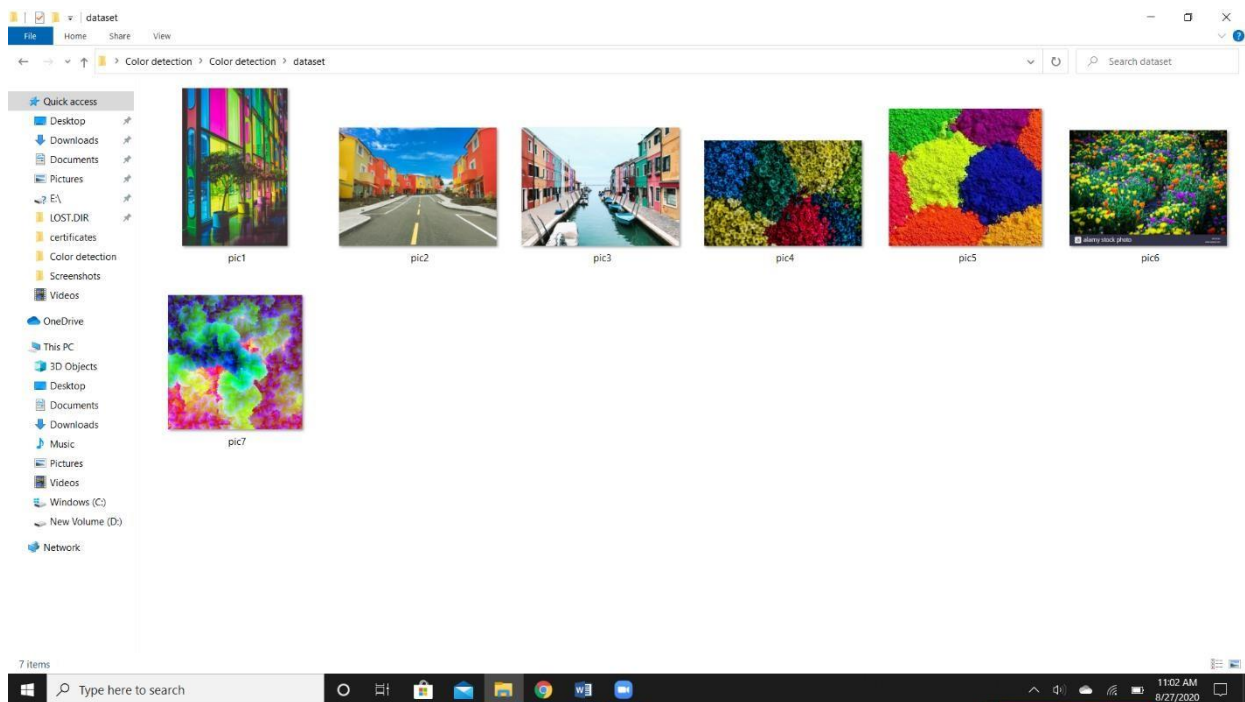


Fig 4.1 Collected Dataset

These datasets are then preprocessed to form an equal aspect ratio so that it can be made ready for training with the model which can be seen in the following figure.

The datasets are separated into different categories to undergo preprocessing which can be seen in the below figure

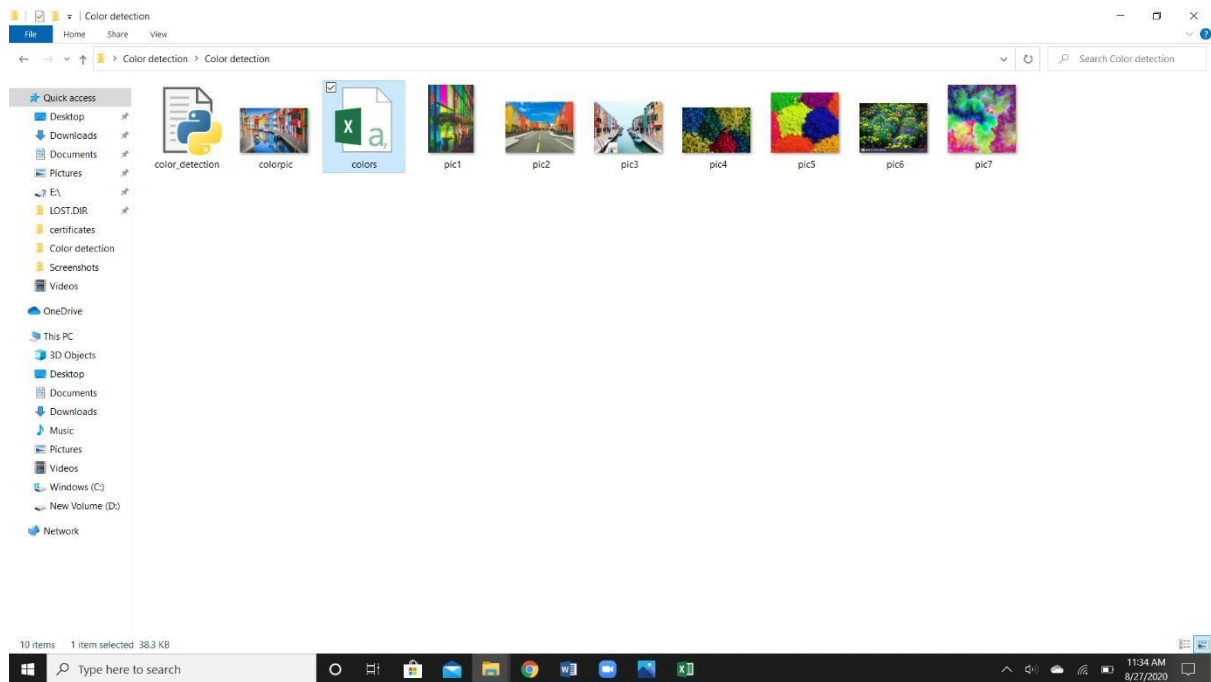


Fig 4.2 Separated dataset

After this the final implementation is done where the training process takes place and the results are obtained using Alexnet architecture.

In order to run the code, first we need to go inside the project folder and select the location to run from there such that the location of the code is the main thing to be considered. This can be seen in the following figure below

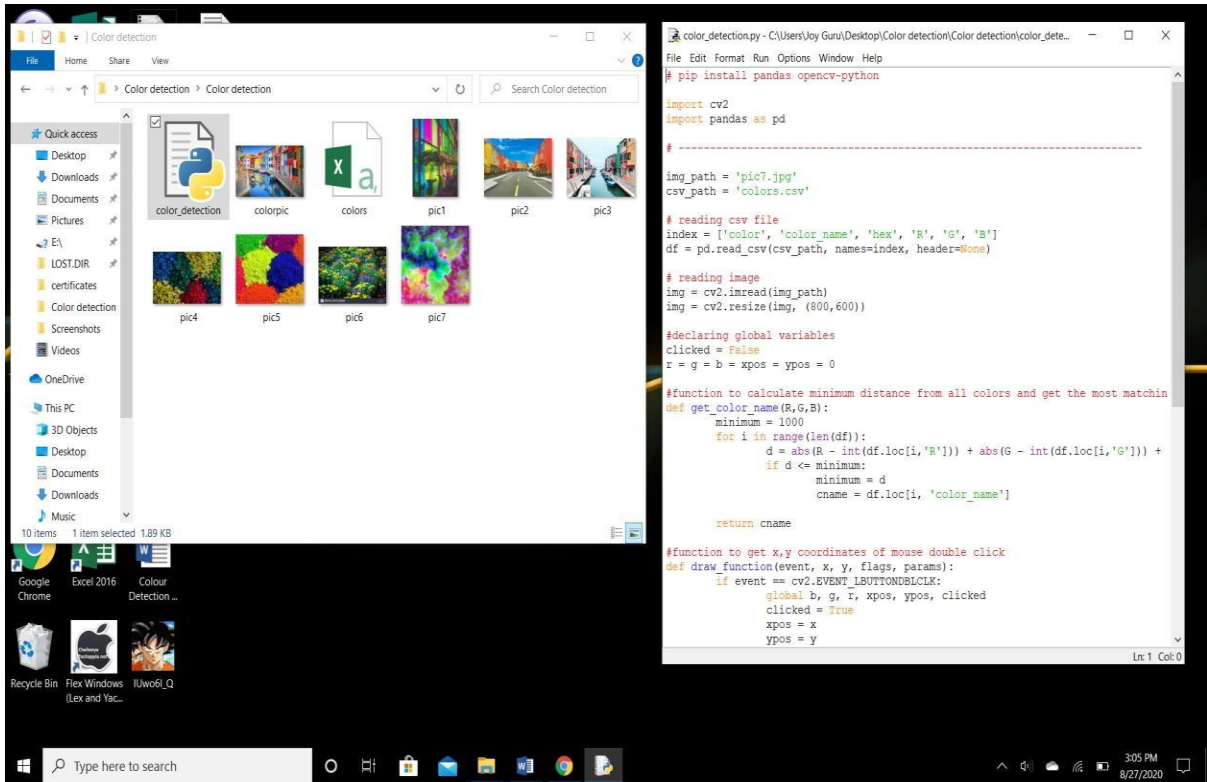


Fig 4.3 Moving Inside the Coding Folder for Execution

Then as the code is run, the execution begins that can be seen in the following figure

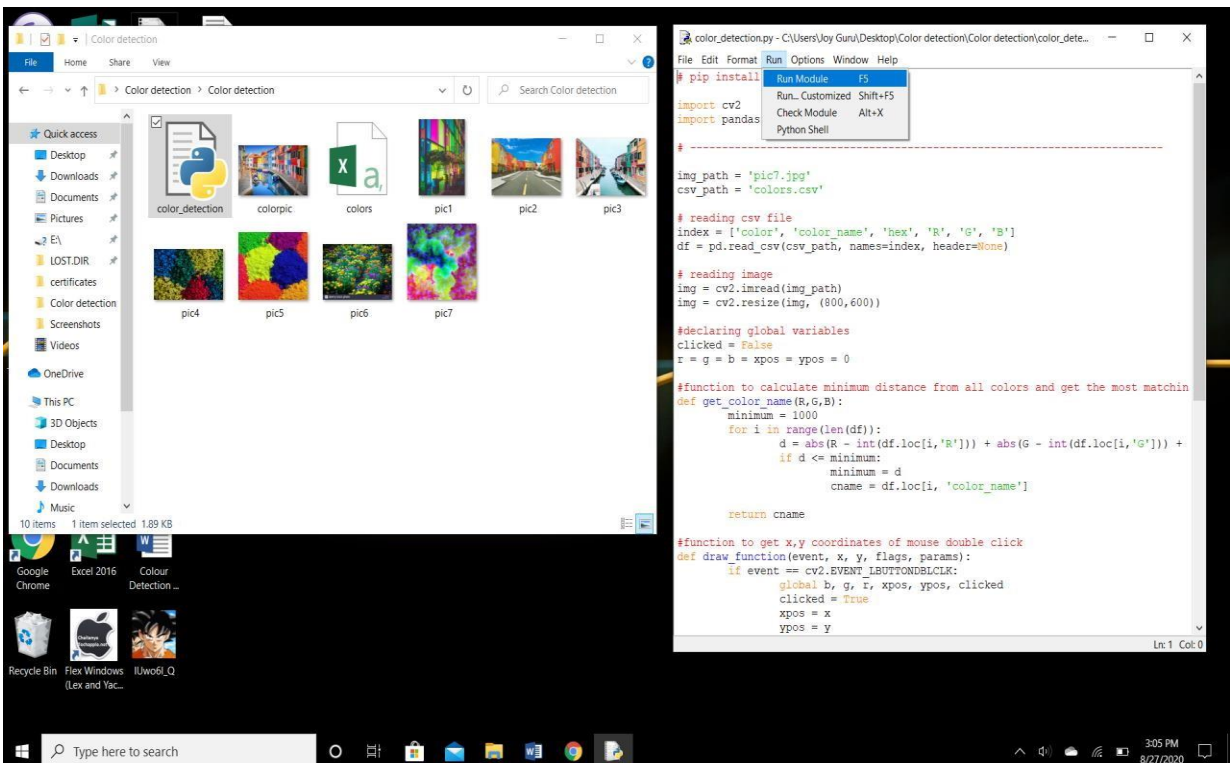


Fig 4.4 Editing and running the module

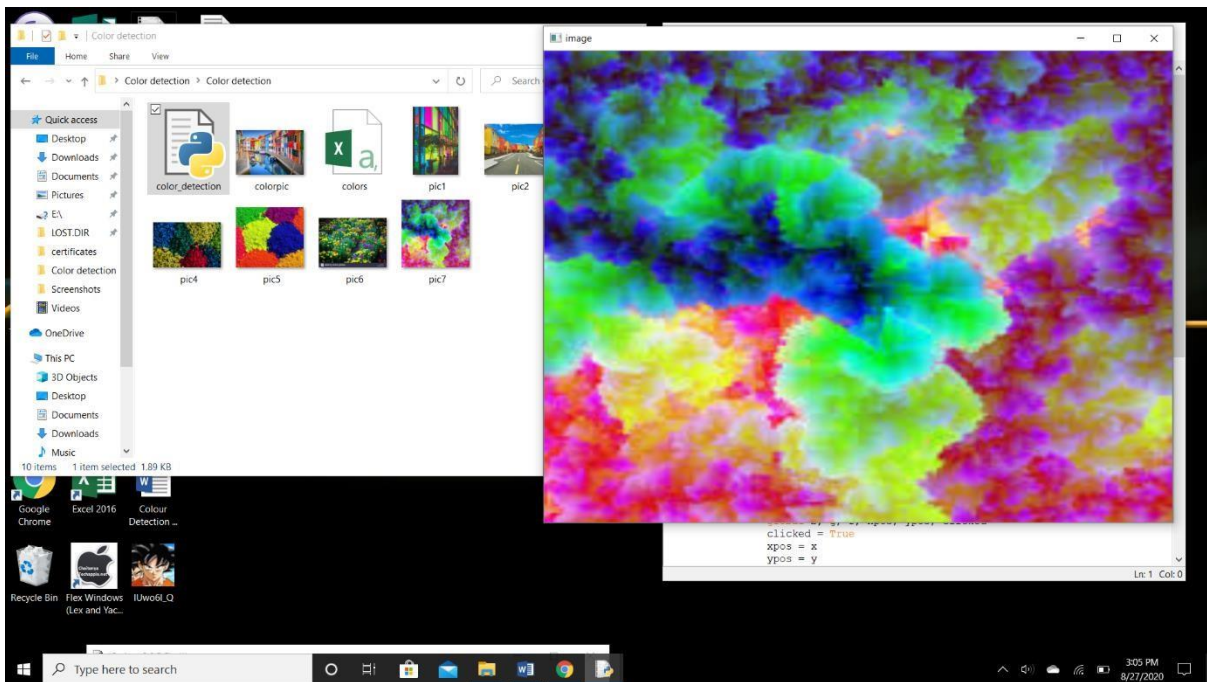
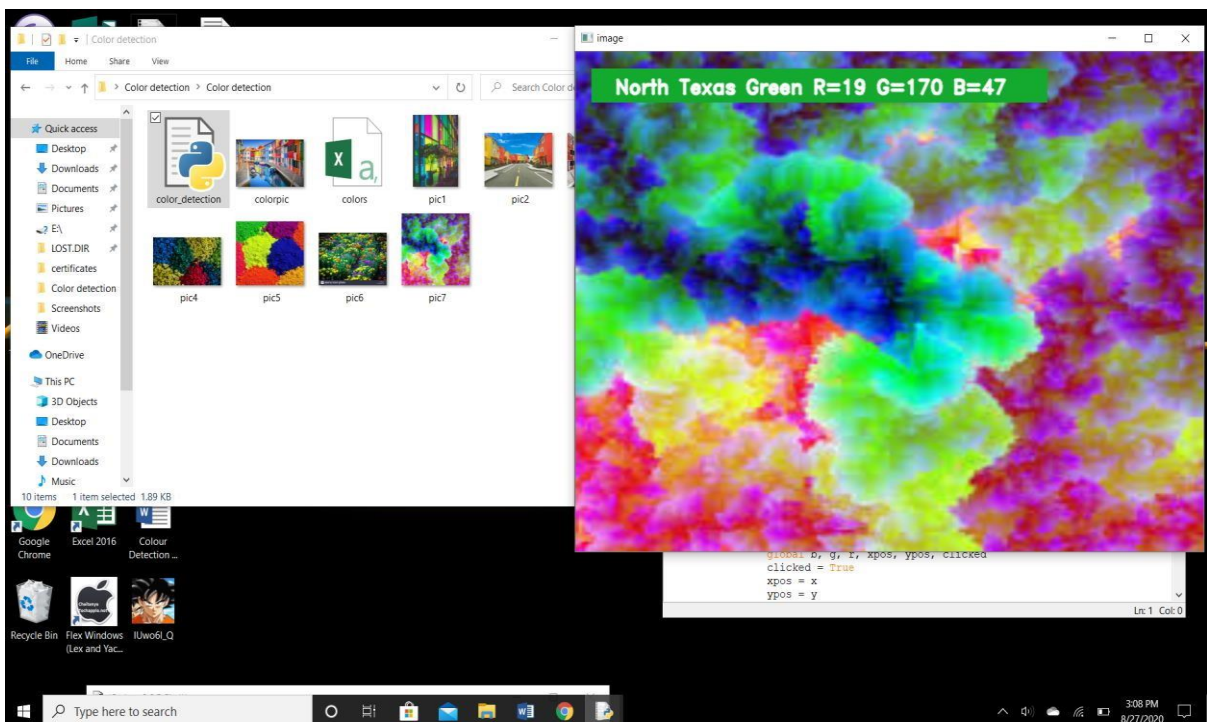
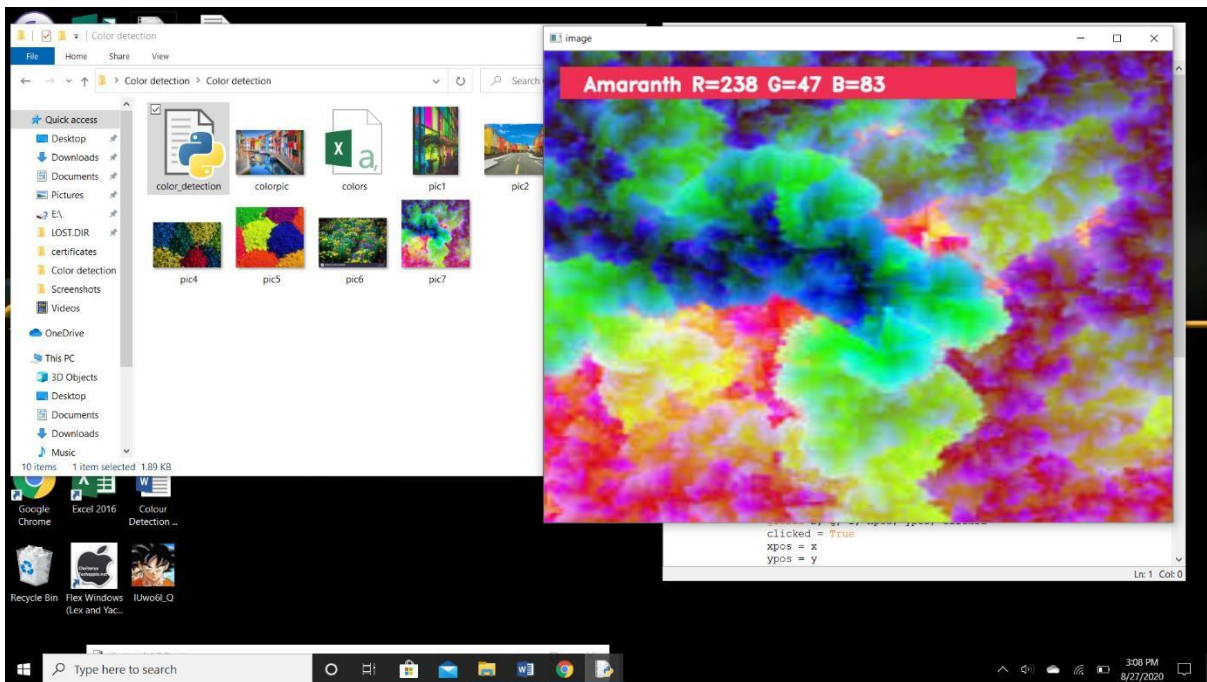


Fig 4.5 Displaying the colour image to be detected

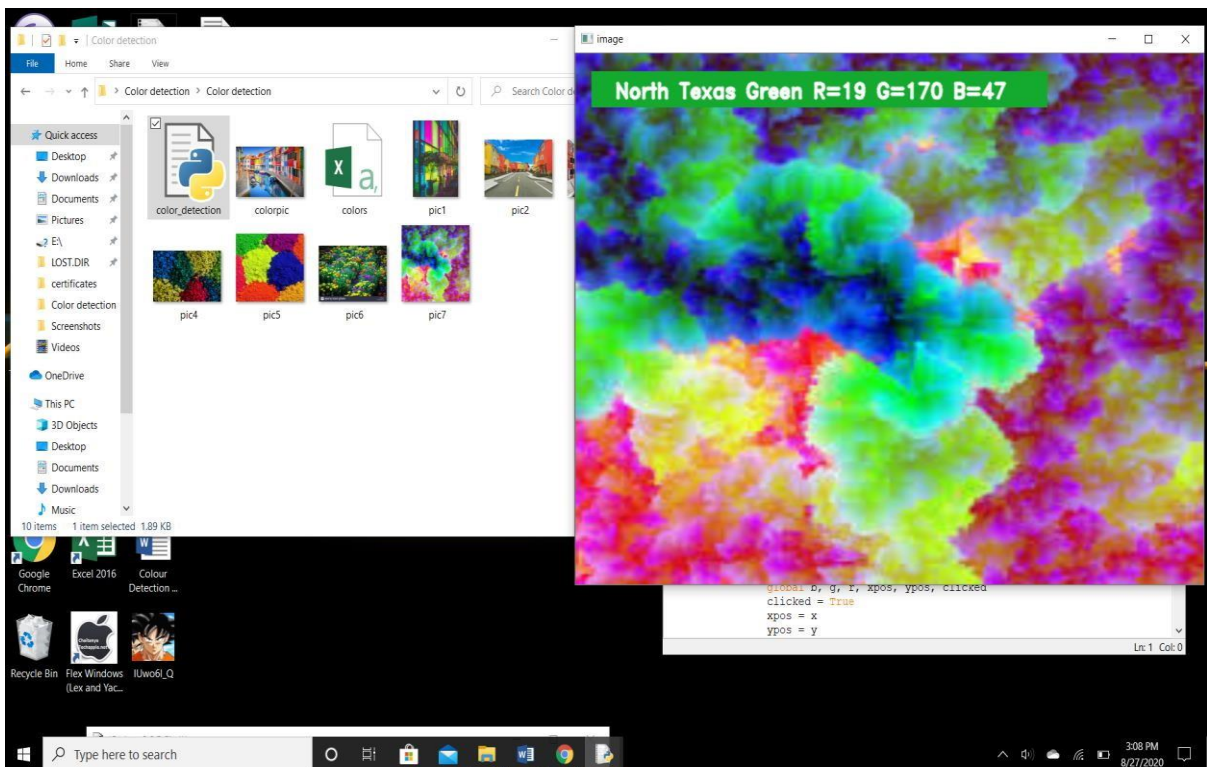
As the code runs, the selected colourfull image would be displayed that can be seen in the following figure.



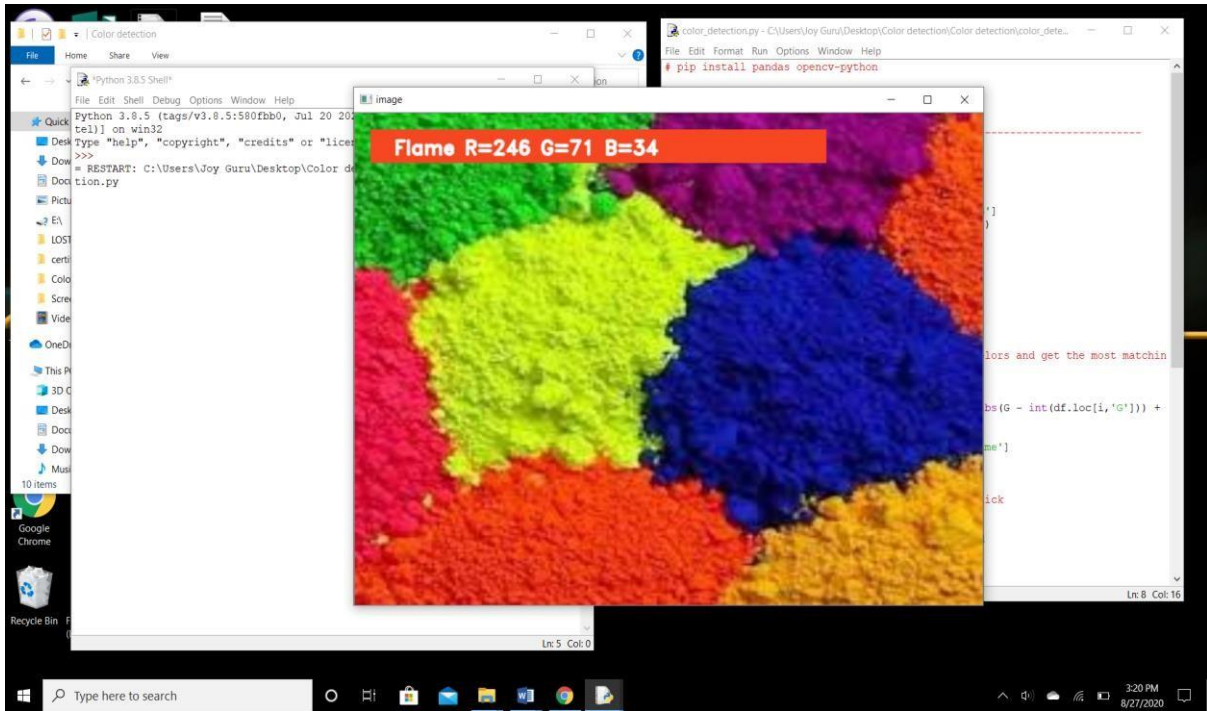
(a)



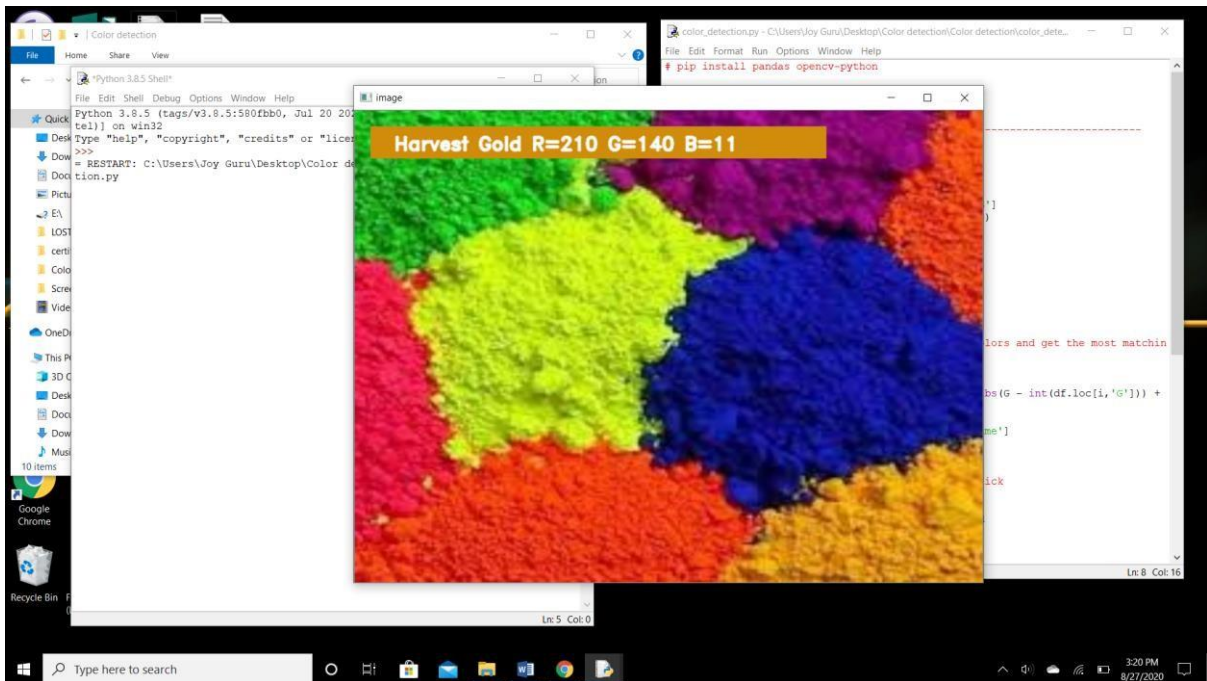
(b)



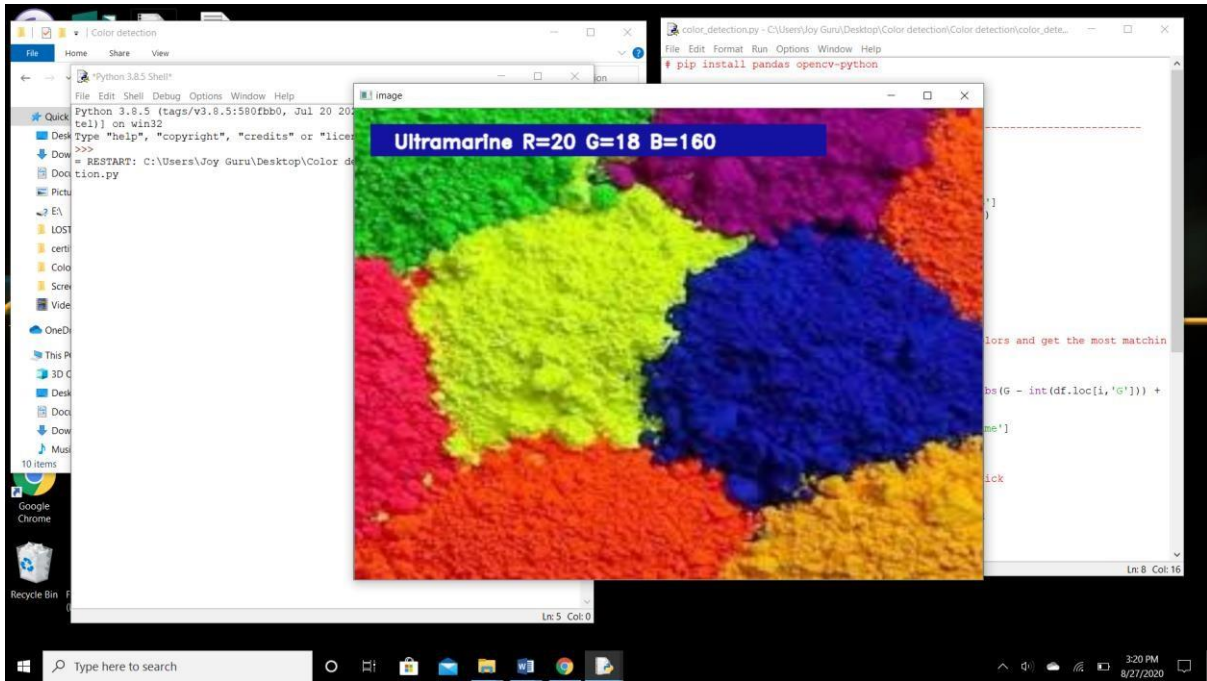
(c)



(d)



(e)



(f)

Fig 4.6 (a,b,c,d,e,f) Colours being detected with Prespective coordinates

The respected coordinates of the the colours are being detected due to the integrated of Microsoft Excel using Pandas.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	air_force_	Air Force E	#5d8aa8	88	140	168							
2	air_force_	Air Force E	#00308f	0	48	143							
3	air_superic	Air Superic	#72a0c1	114	160	193							
4	alabama_c	Alabama C	#a32638	163	38	56							
5	alice_blue	Alice Blue	#f0f8ff	240	248	255							
6	alizarin_cr	Alizarin Cri	#e32636	227	38	54							
7	alloy_oran	Alloy Oran	#c46210	196	98	16							
8	almond	Almond	#efdecf	239	222	205							
9	amaranth	Amaranth	#e52b50	229	43	80							
10	amber	Amber	#ffbf00	255	191	0							
11	amber_sac	Amber (Sa	#ff7e00	255	126	0							
12	american_	American I	#ff033e	255	3	62							
13	amethyst	Amethyst	#96c	153	102	204							
14	android_g	Android Gr	#a4c639	164	198	57							
15	anti_flash	Anti-Flash	#f2f3f4	242	243	244							
16	antique_br	Antique Br	#cd9575	205	149	117							
17	antique_fi	Antique Fi	#915c83	145	92	131							

Fig 4.7 The reading of the colour coordinates using datas from Excel

CHAPTER 5

CONCLUSION AND FUTURE WORKS

5.1 CONCLUSION

Color information plays an important role in the color image segmentation and real-time color sensor, which affects the result of video image segmentation and correct real-time temperature value. In this paper, a novel real-time color image segmentation method is proposed, which is based on color similarity in RGB color space. According to the color and luminance information in RGB color space, the dominant color is determined at first, and then color similarity can be calculated with the proposed calculation method of color component, which creates a color-class map. Next, the information of the corresponding color-class map is utilized to classify the pixels. Due to the characteristic that thermal inks feature color values that change in real time as the temperature changes, the segmentation results of thermal ink can be used as a real-time color sensor. Then, we also propose a method of color correction and light source compensation for the sake of potential inaccuracy of its measures. We discuss the proposed segmentation method application combining with color sensor (thermal ink) in real-time color image segmentation for Cyber physical system (CPS) by the application in fire detection and summarize a new method in identifying fire in a video based on these characteristics. The experiments showed that the proposed method in vision-based fire detection and identification in videos was effective; the results were accurate and can be used in real-time analysis.

5.2 FUTURE PURPOSE

Color is one of the most influential attributes of light, although we may not be aware of this fact and its importance. Nonetheless, color plays a distinctive role of immense importance in our daily life and quite a few industrial and scientific applications. The number of sensors dedicated to sensing color is minimal, and the existence or operation of such sensors are little known to the public.

Color detection sensors emit light onto an object and measure either the direct reflection or the output. Many of these sensors have integral light sources (fiber optics, lasers, LEDs and halogen lamps are among these light sources) to achieve the desired effect. **Colour detection sensors** are used to grade colored products, distinguish coded markings, verify or detect the presence of adhesive or date codes on a package. These sensors are powerful sensing devices which can sense light, color and differentiate accordingly. The grid of the color-sensitive filters and sensors array perform color sensing, which assists in providing the information about color which is present in the image or on a specified object.

Based on the sophistication, the sensor can be programmed to identify only one color or multiple colors or shades for sorting operations. Accurate color mark detection and color recognition are the two specific applications of color detection sensors.

Colour detection sensors find their applications in observing consistency of colors in the production of textiles and these sensors are deployed as a part of industrial automation. Rising capital expenditures in industries such as automotive, oil and gas and power are fuelling the demand for industrial automation and are also boosting the associated automation markets including color detection sensors.

Several industries such as food and beverages, commercial and consumer printing, consumer electronics, automotive, pharmaceutical and healthcare, chemicals, textiles are employing these sensors for the identification of minute variations of color.

Luminescence sensor, RGB sensors, contrast sensor, are the various color detection sensors by product type. Among which, RGB sensor contributes to a significant share of color detection sensors as a large percentage of the visible spectrum can be created using these colors.

The growth of the food packaging market is also an imperative driver for global color detection sensor market to monitor safety and for quality control in meat production. Rising demand for the color sensors in textile industries is also prominent since these sensors can detect the color tone of fabric and likewise for quality control of the fabric. Pressing demands and regulations with regards to safety and efficient packaging, food, and beverage industries are actively deploying color detection sensors especially in the color mark and registration detection applications.

Furthermore, the growth of the smartphone and tablet markets is set to increase the demand for color detection sensors. These sensors form an integral component of mobile devices for detection of color brightness, temperature, and RGB components of ambient light.

Customization, probability, and the ease of the usage of these products have boosted the penetration of these sensors in end-user industries especially textile and other manufacturing industries.

There are a few pitfalls regarding accuracy when operating under extreme conditions of the industrial environment. As these color detection sensors are usually made up of plastic and other less sustainable materials owing to reduce the overall price of the components, these sensors are incapable of providing long-time service; this is further leading to the frequent replacement. Costs incurred in setting up color detector systems coupled with maintenance costs required impedes the SMEs to invest in this technology. Another challenge that could hamper market growth is when color differentiation becomes challenging as these sensors are prone to encounter shades usually from sunlight or industrial lighting. However, increasing number of stringent regulations with regards to product quality and sustainability have been pressurizing the manufacturers to enhance product quality and to make them feasible for all sort of environmental conditions.

Advanced technologies such as accurate color sensing and spectral sensing are emerging as new trends. Atlas Scientific is among the companies involved in the manufacturing of high-quality sensors for environmental monitoring. Atlas solved the market challenges by embedding the light sensor in a rugged housing below a layer of transparent epoxy which protects the sensor from moisture and performs efficiently.

SICK combines a contrast sensor and a color sensor into a single device: the KTS/X

Prime to overcome the problems relating to color sensors owing to their slow response speeds plus these color sensors usually cost a lot more than the standard contrast sensors.

The supreme players operating in the global color detection sensor market include AMG AG, Atlas Scientific LLC, Banner Engineering Cor., Baumer Holding AG, Balluff GmbH, Hamamatsu Photonics K.K., HiTechnic Products, Keyence Corporation, Omron Corporation, Pepperl+Fuchs GmbH, SensoPart, SICK AG and Nidec-Shimpo Corporation.

REFERENCES

- [1] Reetu Awasthi and Khushboo Khurana, "Techniques for Object Recognition in Images and Multi-Object Detection", (IJARCET), ISSN:2278-1323, 4th, April 2013. [2] Artificial Intelligence. (December 2017). Retrieved from https://en.wikipedia.org/wiki/Artificial_intelligence
- [3] Computer Vision. (December 2017). Retrieved from https://en.wikipedia.org/wiki/Computer_vision
- [4] Computer Vision's Open Source. (December 2017). Retrieved from <https://en.wikipedia.org/wiki/OpenCV> [5] (2017, December 17). Object Detection [Online]. Available: http://en.m.wikipedia.org/wiki/Object_detection
- [6] Numpy.org, 2017. [Online]. Available: <http://www.numpy.org>
- [7] <https://www.invensis.net/blog/it/benefits-of-python-over-other-programming-languages/>

APPENDIX

#SOURCE CODE

```
# pip install pandas opencv-python
```

```
import cv2
```

```
import pandas as pd
```

```
# -----
```

```
img_path = 'pic5.jpg' csv_path  
= 'colors.csv'
```

```
# reading csv file index = ['color',  
'color_name', 'hex', 'R', 'G', 'B']  
df = pd.read_csv(csv_path, names=index, header=None)
```

```
# reading image img =  
cv2.imread(img_path) img =  
cv2.resize(img, (800,600))
```

```
#declaring global variables  
clicked = False r = g = b =  
xpos = ypos = 0
```

```
#function to calculate minimum distance from all colors and get the most  
matching color def get_color_name(R,G,B):
```

```
    minimum = 1000
```

```
    for i in range(len(df)):
```

```
        d = abs(R - int(df.loc[i,'R'])) + abs(G - int(df.loc[i,'G'])) + abs(B  
- int(df.loc[i,'B']))
```

```
        if d <= minimum:
```

```
            minimum = d
```

```
            cname = df.loc[i, 'color_name']
```

```
    return cname
```

```

#function to get x,y coordinates of mouse double click
def draw_function(event, x, y, flags, params):
    if
    event == cv2.EVENT_LBUTTONDBLCLK:
        global b, g, r, xpos, ypos, clicked
        clicked = True        xpos = x
        ypos = y
        b,g,r =
img[y,x]        b = int(b)
        g = int(g)        r =
int(r)

# creating window cv2.namedWindow('image')
cv2.setMouseCallback('image', draw_function)

while True:
    cv2.imshow('image', img)
    if clicked:
        #cv2.rectangle(image, startpoint, endpoint, color, thickness)-
1 fills entire rectangle
        cv2.rectangle(img, (20,20), (600,60), (b,g,r), -1)

        #Creating text string to display( Color name and RGB values
)
        text = get_color_name(r,g,b) + ' R=' + str(r) + ' G=' + str(g) + ' B=' +
str(b)

        #cv2.putText(img,text,start,font(0-
7),fontScale,color,thickness,lineType )
        cv2.putText(img, text, (50,50), 2,0.8,
(255,255,255),2,cv2.LINE_AA)

```

```
        #For very light colours we will display text in black colour
if r+g+b >=600:
    cv2.putText(img, text, (50,50), 2,0.8,
(0,0,0),2,cv2.LINE_AA)
    if cv2.waitKey(20) & 0xFF ==
27:
        break

cv2.destroyAllWindows()
```