

## Design And Development Of Hybrid Algorithm For Interactive Recoloring Of Wall

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**Abstract:** Nowadays, humans spend most of their time indoors, either at work or at home. There are many reasons due to which colour of the walls need to be changed from time to time. Deciding the new colour for the wall is an essential and challenging task. The software developed and discussed in this article consists of two parts that eases the user's work in visualizing new colour on the wall and getting the cost for the paint required. The first part helps in recoloring a wall with a new colour digitally, and the second helps to calculate the area of the wall painting for cost estimation. Finally, the recoloured wall image with estimated paint cost value is displayed to the user.

**Keywords:** Computer Vision, Object Detection, K-means Algorithm, Dimension estimation, Re-colouring of image and Image processing etc

### 1. Introduction

Image processing is one of the most popular topics for discussion in recent times. It involves features like size detection & modification, colour correction, segmentation, and so on. Image re-colourization is one such concept that has wide computational applications which are complex and practically problematic. Colouring the house walls is a significant thing as repainting is done only after many years whenever it is highly needed. Premium paints make sure that people do not need to repaint until they're ready for a change of colour. There are too many paint colours to choose from, and the user doesn't know where to begin; and, many users do not get the results they want while painting. The user can visualize the different colours on the wall digitally without purchasing the colour. Visualizing the wall colour digitally and getting the required paint's cost is uncommon and beneficial for the customers.

The general process of decorating a room starts with selecting a colour from various colours via small paint cards. But it can be challenging to visualize how the wall would look after painting with the colour chosen.

A trial-and-error method also cannot be used owing to the expensive cost of painting, thus makes it even more challenging to determine which colour fits best. Thus, the goal is to design an algorithm that shows a preview of the painted wall with the selected colour.

### 2. Background review

#### 2.1 Image Processing

Image processing is a process that helps to perform basic operations on the digital image for the extraction of useful information from it and to enhance the quality of image. After the application of image processing, the resultant output provides the characteristics/features of the image.

There are many purposes of image processing in day-to-day life. But the vital goal is visualization and image sharpening and restoration. With the help of visualizing, the objects which are difficult to detect can be observed, and sharpening helps to improve noisy images.

#### 2.2 Open Computer Vision 2

OpenCV is a library of Python binding which provides tools, hardware, and a real-time Optimized CV library. This library has at least twenty-five thousand optimized algorithms, including a machine learning algorithm and a comprehensive set of CV. These help to identify objects, track camera movements, detect objects and faces, from image database find a similar image and track moving objects and many others.

It has Java, MATLAB, Python and C++ interfaces and supports macOS, Linux, Android, and Windows.

#### 2.3 K-Means Algorithm

It is an unsupervised learning algorithm. Whenever a data set of items is given with certain features and their respective values, this algorithm is used to categorize or group these items into k clusters based on their similarities. The similarities between the items can be calculated using Euclidean distance or Hamming distance from the centroid of the clusters. Initially, k random data points are selected from cluster centroids, and

euclidean distances of each datapoint from all the centroids are recalculated. Every item is grouped with the cluster with minimum Euclidean distance. This process of distance calculation and regrouping of cluster items are repeated until all the clusters stabilize, i.e., no item is likely to move to other clusters. K means is the most widely used and a very efficient clustering algorithm.

### 3. Proposed method

The Complete process is divided into two parts, as shown in Fig:1. The user logs into the system, and a choice of two options appears on the screen. The user needs to select either recoloring of wall paint or wall paint cost estimation. The block diagram in Fig:1 shows the details of the complete process briefly.

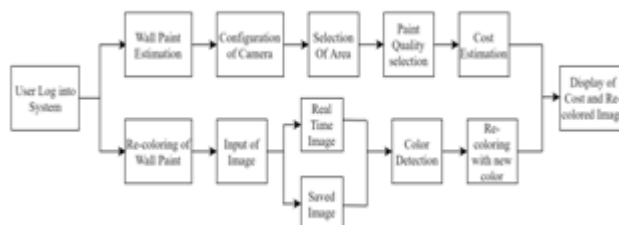


Fig -1: Complete Block Diagram of Process

#### 3.1 Re-coloring of Wall Paint digitally

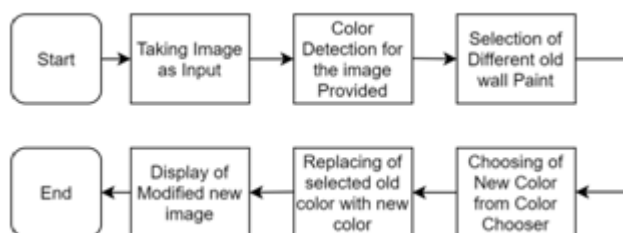


Fig -2: Block Diagram of Re-coloring of wall paint in input image

Recoloring the wall is an essential part for a house's lifetime. The house is mainly recolored before festivals or when color fades away after few years. The main principle behind recoloring is done with the help of pixels. The process followed is shown in the block diagram. Image is taken as input in formats .jpg , .png . Basic operations like resizing is done after the image is taken as input. Image is imported using the cv2 library, and it is in GBR format. Therefore, the image needs to be converted to RGB format to get the original image.

After performing these basic operations in the input image, 2nd step is color detection from the image provided. The algorithm used for color detection is K-Means Algorithm as explained in Section 2.3. The number of colors to detect is given as input to the algorithm. The obtained colors are displayed in the pie chart as shown in Fig:3.

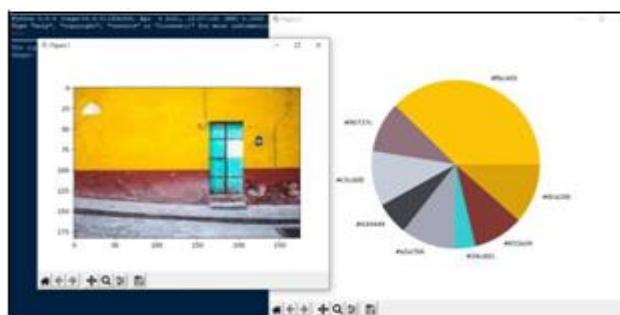


Fig -3: Display of colors detected from input image with the help of Pie Chart.

In the 3rd step with the help of pie chart user can select the hex code related to each color obtained from the image. The selected color's hex code is converted to RGB form and stored in a list (python). The 4th step starts with the opening of the color picker window. The user then selects the desired new color by selecting the displayed color options as shown in Fig:4.

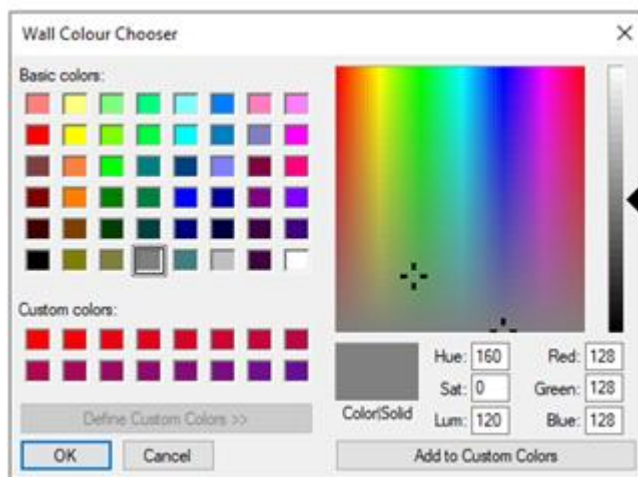


Fig -4: Color Chooser Window

In the 5th step, the primary process begins. All the colors selected by a user is sorted and stored in a list for further process, using two loops- one for selecting and another for replacing each pixel with new color. After replacing all the old color pixels with new paint color, the required final image is shown on the new window as shown in Fig:8.

### 3.2 Paint CostEstimation

#### 3.2.1 Image ProcessingPhase

Touse theproposed area estimation algorithm, first pre-process the image and set the focal length on the algorithm for the camera is done. Then the camera records a shot in real-time, which is then converted to grayscale to improve speed and precision. The canny edge detector algorithm is used to detect objects. The transformed image is analyzed with the aid of a suitable algorithm. Then, to close gaps between edges in the edge picture, the dilation and erosion algorithm is used. The flow map for the suggested scheme is shown in Fig:5.

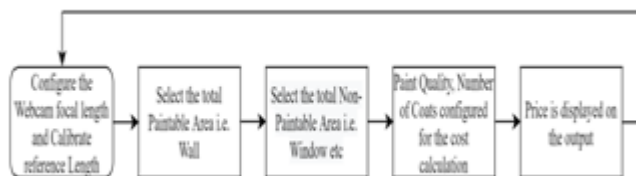


Fig -5: Block Diagram of Paint cost Estimation Process.

#### 3.2.2 Edge and GradientDetection

To detect the edge gradient and path for each pixel in the compute gradient step, the Sobel operator is used to describe the gradient at each pixel of the smoothed picture.

After obtaining the gradient magnitude and direction, a complete scan of the frame is performed to remove unwanted pixels that may not create the edge. For the Non-maximum suppression, only local maxima should be treated as edges at this stage. The smoothed edges in the frame of the gradient magnitudes are replaced by sharp edges when non-maximum suppression is used.

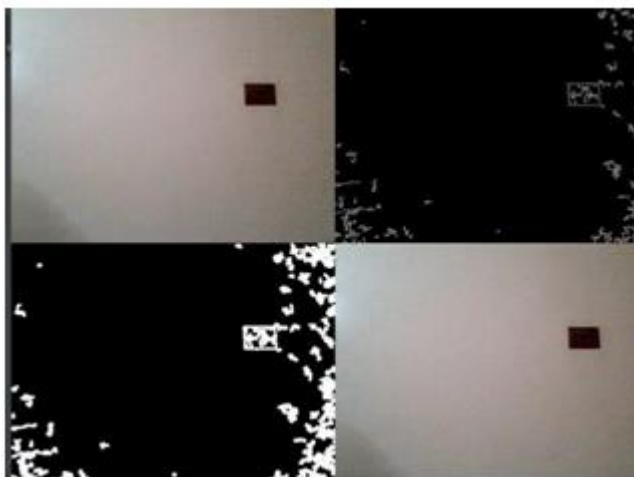


Fig -6: Frame after applying non-maximum suppression.

Non-maximum suppression is used to retain all local maximums in the gradient image while excluding the rest. Fig:6 shows the frame after applying non-maximum Suppression.

Hysteresis thresholding is the final step of the Canny Edge detector algorithm. This stage determines which edges are

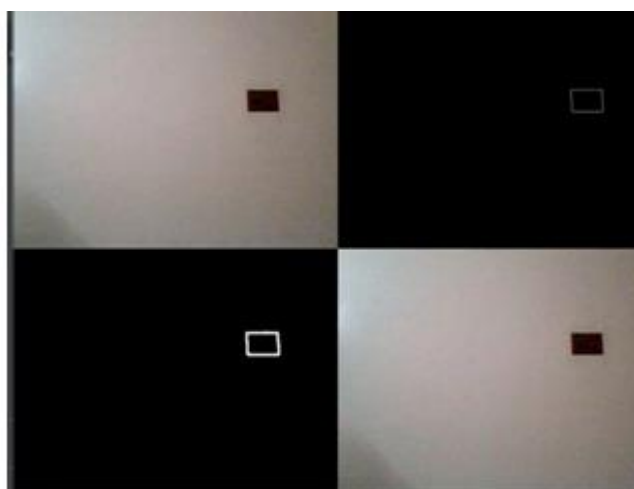


Fig -7: Input frame after applying dilation & erosion operation

definitely edges and which are not. The two threshold values are determined by trial and error, and their

description depends on each frame's quality. This is accomplished by selecting large and small threshold values. It is labelled as durable if the edge pixels are more substantial than the significant threshold. The last edges are calculated as firm edges. Additionally, the edge pixels are disabled. If an edge pixel is weaker than the trim threshold, it is labelled as a pixel preparation and its numeral values are not changed.

### 3.2.3 Dilation and erosion

A morphological mechanism, such as a mixture of dilation and erosion, is used in this research. The opening is the first step in the process, which is accompanied by erosion and dilation. The second operation is closing, which is accompanied by dilation and erosion. Certainty can only be obtained by discovering the edges using in-depth frames. Figure 7 depicts the picture after the erosion and dilation operations have been completed.

A green rectangle then surrounds the objects. As a result, the points of the bounding box rectangle are represented by small purple circles. Since the bounding box is ordered, the midpoints can now be calculated. Finally, the reference object is used to measure the pixels per metric value. The ylen(height) variable is set to the height distance in pixels, and the xlen (width) variable is set to the width distance in pixels. The Euclidean distance between sets of center points is then determined.

#### 4. Results

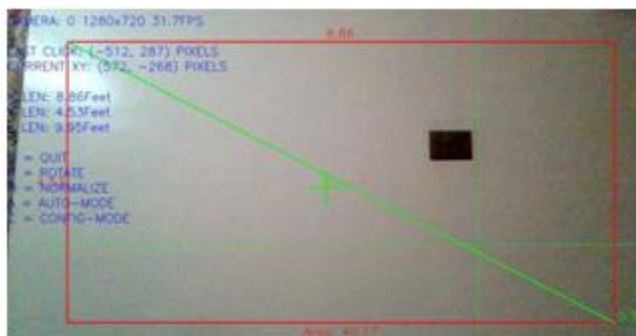
This paper initially introduces some of the basic concepts that help in understanding the article quickly. The two parts of complete process are implemented and the results are obtained and shown below.



**Fig -8:** Output image of Re-coloring of wall Paint Digitally.

The algorithm used for processing has replaced all the pixels of the old colour, i.e., yellow colour, and its shades selected by the user with new color i.e., grey color. Some of the yellow color pixels are present in the final image and are not replaced with new color as their hex code might not have displayed to the user for selection. Currently, the algorithm gives 90% efficiency.

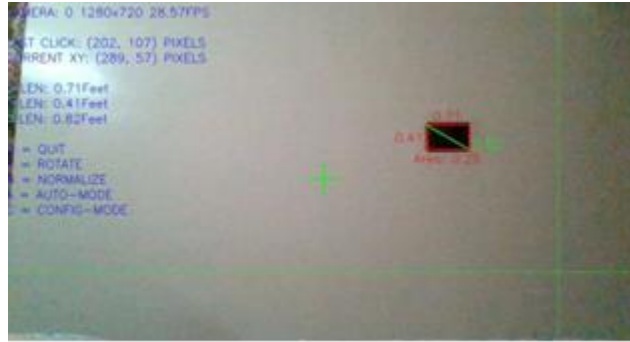
The algorithm's efficiency decreases with objects of the same colour as the wall is kept in front of it. Image of wall obtained with a smaller number of shades and no objects in front of it gives 100% efficiency.



**Fig -9:** Measuring the total Paintable Area

A method for measuring objects in real-time video and still images is developed after configuring the camera with a real-time S.I. unit. A few experimental configurations were made to verify the suggested method's correctness. The Python programming language was used to incorporate the proposed scheme. The algorithm which is developed is now used for the paint cost estimation.

For the experiment, the camera has been effectively capturing the pictures. The proposed system applies four operations such as record frames, finding edges, finding objects, and measuring each object's size. When the application is run, the output screen displays on the screen. The user selects the total paintable and non-paintable areas as appears in Fig:9 and 10.

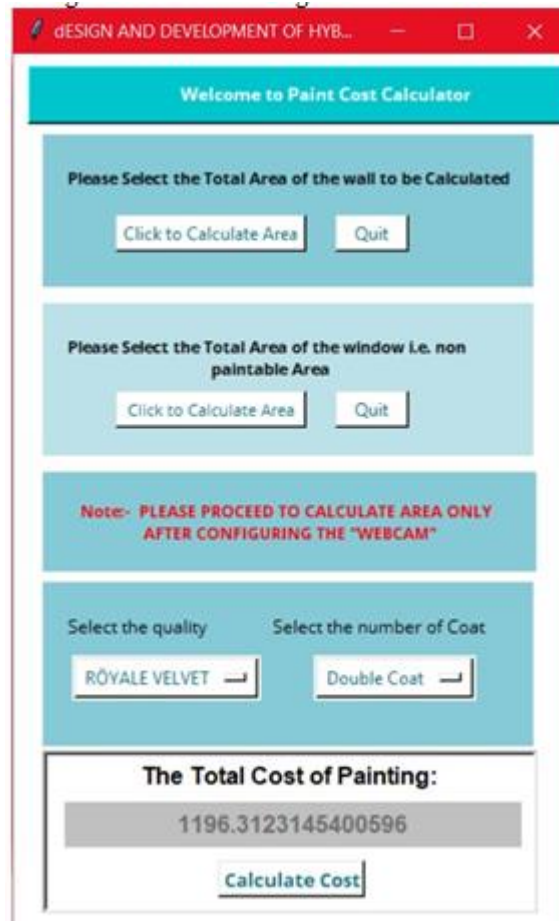


**Fig -10:** Measuring the Area of non-paintable objects

To estimate the total cost of painting, details such as quality of paint and number of paint coats are filled in the dialogue box as per the user's requirement, and the total cost is displayed on the screen. The user selects both the paintable and non-paintable areas, and the total paint cost is displayed in INR.

The area calculated from Fig:9 is 40.17 square feet, and the area calculated from Fig:10 is 0.29 square feet. Therefore, the resultant final area value calculated is 39.88 square feet.

Total cost calculated on final area value is displayed in the dialog box of the GUI in fig 11.



**Fig -11:** Displaying the total Cost in GUI

AREA	AM-A (Sq. feet)	PM-A (Sq. feet)	Accuracy (%)
1.Paintable Area	0.72	0.71	98.6
2.Non-Paintable area	41.3	39.17	99

**Table-1,** shows the accuracy of proposed object measurement system for the area captured by the algorithm. Abbreviations in the table are as follows; AM-H: Actual Measured-Area, PM-A: Proposed Measured-Area.

## 5. Conclusion

Visualising a new paint color in a house is not easy for people. In this paper, a hybrid algorithm was proposed that solved this issue by providing a preview of a recolored image by detecting and recoloring various shades of same color using k means clustering algorithm. The algorithm also estimated the cost for the paint required for desired number of layers of paint by determining the paintable area using sobel edge detection algorithm.

The hybrid algorithm is designed more efficiently and advanced as compared to more simple algorithms i.e. color detection, recoloring, area calculation in real-time and cost estimation as all these individual operations are accomplished using hybrid algorithm.

The proposed algorithm can be further enhanced for highly noisy images that gives lesser accuracy as compared to the current 98% accuracy.

## References

1. Huda M. Jawad; Tahseen A. Husain "Measuring Object Dimensions and its Distances Based on Image Processing Technique by Analysis the Image Using Sony Camera", 2017 Eurasian Journal of Science & Engineering
2. BinLi "Research on geometric dimension measurement system of shaft parts based on machine vision", (2018)
3. EURASIP Journal on Image and Video Processing volume
4. Muhammad Ahmad Shahid; Muhammad Aksam Iftikhar; Zaheer Ahmad Gondal; Muhammad Adnan "Object Size Measurement through Images: An Application to Measuring Human Foot Size", 2018 International Conference on Frontiers of Information Technology (FIT)
5. Zhong-Qiu Zhao; Peng Zheng; Shou-Tao Xu; Xindong Wu" Object Detection with Deep Learning: A Review". IEEE Transactions on Neural Networks and Learning Systems ( Volume: 30, Issue: 11, Nov.2019)
6. Dong Wan Roh Sungkyunkwan University, Suwon, Korea; Jae Wook Jeon "Real-Time Object Size Measurement", 2019 International SoC Design Conference (ISOC)
7. Object Detection with Color and Depth Images with Multi-Reduced Region Proposal Network and Multi-Pooling", ICASSP 2020 - 2020 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP).
8. David Liu, Jeff Piersol, Serena Yeung;" Real-Time Segmentation, Tracking, and Coloring of Walls Using iOS",
9. F. W. Ramlan, V. Palakonda and R. Mallipeddi; "Differential Evolutionary (D.E.) Based Interactive Recoloring Based on YUV Based Edge Detection for Interior Design", International Conference on Information and Communication Technology Convergence (ICTC), 2019
10. T. Liu, Y. Wei, Y. Zhao, S. Liu and S. Wei;" Magic-Wall: Visualizing Room Decoration by Enhanced Wall Segmentation", IEEE Transactions on Image Processing (VOL. 28, NO. 9, September 2019).