Customized E-Learning Using Image Processing

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We all are aware of the current situation of Covid-19 in the world, and in this situation, the Education system is one of the most badly affected systems of all. The traditional teaching of chalk and board have turned to presentations from laptops. But sometimes the new method of presentations are not convenient for teaching some subjects. So, this proposed system will be a bridge from the traditional method of chalk and board to the live lecture online. In this proposed system, the educationist can use the traditional method to teach which will be live-streamed and also, be recorded and stored on the educator's laptop for future usage, these videos will be live and with the use of MATLAB R2014a codes, the video will be auto cropped so that it will be clear and focused on the required position at the receiving end i.e. students. Simultaneously, the video is converted into frames and from these frames, the content written on the board will be extracted and converted in the form of notes or study material for the students using Python 3. All these processes are done using Image processing.

Keywords: E-Learning, video cropping, PDF.

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1. Introduction

India Today stated in their headline about the Covid-19 pandemic reshaping the education Iindustry on February 23, 2021, 14:41 IST[1]. 2020 showed a great change in the adaptation, adoption, and evolution in the world of education[1]. According to the UNESCO report, between March and April 2020, 165 nations shut down schools and colleges, affecting nearly 90 percent of the student population in the world[2]. From the video conferencing apps like Zoom and Google Meet to more delicate and customized platforms like Microsoft Teams, educators barely had time to get along with the technology that was completely new to them, Tarika Shekdar and Sharanya Mosakalanti, posted this on feminisminindia[2]. Recording a lecture using the traditional board requires a strength of two, which is not possible at home. It is sometimes stressful to convert every page into PowerPoint, especially for diagrammatic and mathematical content with complex concepts. To extract some information or to get an enhanced image from images, image processing is a procedure to perform some operations on images. It is a kind of signal processing. Here, the input is an image and the output may or may not be an image or characteristics/features associated with that image. Image processing forms the core area of research in engineering and computer science disciplines too.

Image processing includes the below given three steps:

- Through acquisition tools images are imported.
- Analyzing and manipulating the image.
- Based on image analysis, the output can be an altered image or a report of an image Customized E-Learning using Image Processing

The main purpose of the project is

- To include writing/traditional boards in E-Learning.
- To find the final cropping areas with high aesthetic quality.
- To automatically generate recordings and notes of lectures as study material.

The problem statement of the proposed system can be stated as to develop an automated E- Learning desktop application introducing a traditional board for creating real-time video conferencing and study material.

Major Challenges faced in this domain are as follows:

- Image Enhancement - Enhancing severely degraded images is a big challenge. Due to the contrast of the image being low, it is blurred, and less focused, and the image may be of poor quality. For image enhancement, the aim is to process images for improving their quality. [10]
- Accuracy -Achieving 100 percent accuracy while processing images is a dream. The hand-written text could be illegible and decimates the chance of getting the proper quality.
- Video Conferencing - Real-time video transmission over wireless channels is a big task.

2. Methods

Video conferencing may degrade the received images and sound[1], and an Automated study material making facility is missing[4], The notes making process is only used for white boards[6], and Real-time video lectures, recording and making notes simultaneously[3]. These are the research gaps that we have identified through different research papers.

Problem Formulation

1. Automated study material making facility is missing - Automated study material facility is made available based on the concept of board scanning and image enhancement.

2. The notes-making process is only used for whiteboards - White balancing using the Stitching process will overcome the restriction of using the only whiteboard in notes making process.
3. Real-time video lectures, recording and making notes simultaneously - By using all the proposed algorithms, the system will be able to perform all the mentioned tasks simultaneously.

As per the block diagram(Fig 1), the educator's setup will include a teaching board along with the laptop which will be placed at an angle where the focused region will consist of the whole board along with the background. After the setup is complete the educator will start the video recording/live-streaming and the live video and audio will be sent to the Matlab as an input. Matlab will convert the video into cropped frames and then resize those frames, after which they will be converted back into the video, and then the final video will be sent to the student's laptop. During the teaching process, the frame difference will be calculated continuously, if at a particular point the frame distance becomes zero the notes making process will start. This study material along with the recorded video will be saved on the educator's laptop who will share it with the students when required.

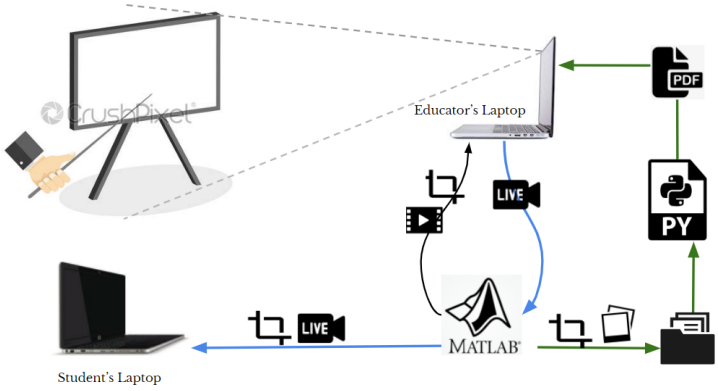

Fig 1: Block Diagram

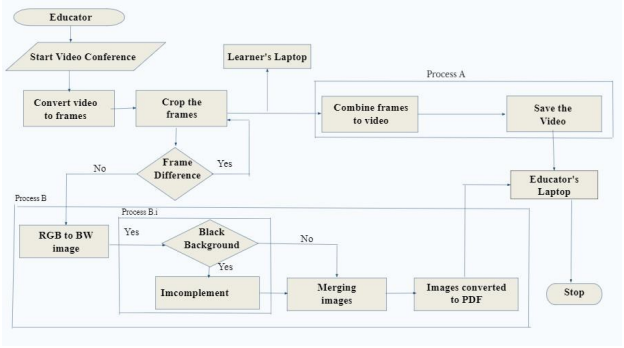

Fig 2: Flowchart

Algorithm

Step 1: Educator starts the video conference and generate a link

Step 2: Video from webcam is received by Matlab

Step 3: Auto Cropping

(a) Convert video to frames
(b) Crop the frames
(c) Resize the frames

Step 4: The cropped and resized frames are sent to the

(a) Learners Laptop
(b) Process A go to step 5
(c) Check frame difference - if present go to step 4(a) else go to step 6 (Process B)

Step 5: Process A

(a) Combine frames to videos
(b) Saving video into Educators Laptop

Step 6: Process B:

Converting the RGB image to Black and White image.
If background = Black go to step 5
Else go to step 6

Step 7: Imcomplement

Step 8: Merging images

Step 9: Convert into pdf

(Educator ends the video conference)

Step 10: Send material to the educator's Laptop.

Step 11: End

Code and Methods

- Difference Between two Frames
  x=imread('69.JPG');
  y=imread('421.JPG'); g=size(x);

```
y=imresize(y,[g(1),g(2)]);
figure;
imshow(x);
title('First
image'); figure;
imshow(y);
 title('Second image');
figure;
imshow(x-y);
title('Difference of two images');
```

In the above code we have used imread(), imresize(), imshow() and size() functions.

- Converting into Binary image and Complement

```
 clear all;
close
all; clc
im =imread('whiteboard.png');
imshow(im);
title('Color image');
b=im2bw(im);
numWhitePixels                =
sum(b(:)); numBlackPixels =
sum( b(:));
if(numBlackPixels > numWhitePixels)
title('black image');
bw2= imcomplement(b);
imshow(bw2);
imwrite(bw2,'C:1.png');
else
imshow(b);
imwrite(b,'C:2.png')
; end
```

In the above code we have used sum(), imwrite() and im2bw() functions.

- PDF making in Python import img2pdf import os folder=(r'C:') list=os.listdir(folder)

  newList=[x for x in list if x.endswith(".png")]

```
print("Total",len(newList))
pdf=img2pdf.convert(newList)
file=open("new.pdf","wb")
file.write(pdf)
file.close()
```

In the above code we have used img2pdf and os packages.We have also used os.listdir(), img2pdf.convert(), open(), write() and close() functions.Saving Cropped Video cam=webcam('Integrated Webcam'); preview(cam);

```
t=20;
fps=30;
nof=t*fps;
vidWriter=VideoWriter('video.mp4');
open(vidWriter); for index=1:nof
img=snapshot(cam);
cimg=imcrop(img,[100,100,850,550
]);writeVideo(vidWriter,cimg);
pause(t/nof)
end
close(vidWriter)
; clear cam;
```

In the above code we have used snaphot(),imcrop(),writeVideo(), pause() and VideoWriter() functions.

3. Results

Math Works has become the leading developer of mathematical computing software. MATLAB is the language of a technical computing programming environment for algorithm development, data analysis, visualization, and numeric computation. Simulink is a graphical environment for simulating and Model-Based Design for multidomain dynamic and embedded systems. There is a mixed-integer linear programming for solving mixed-integer optimization problems with the help of MATLAB Webcam and supports Raspberry Pi™ from MATLAB table. It is also a data container that manages, sorts, and filters tabular data categorically, an array to store data along with values from a set of discrete categories Python 3 has brought many more improvements over Python 2. Those changes are easy to describe and can be understood quickly. Print, an actual function, integer division, is no longer required to type "object" while defining a class. Python 3.0 also uses the concepts of text and data in place of Unicode strings and 8-bit strings. Python 3 contains easier syntax as compared to Python 2. It also consists of lots of libraries of Python 2 that are not forward compatible. Many libraries are created in Python 3 to be strictly used with Python 3.

Table 1: Functions

Function	Description
imread()	imread(filename) reads the image from the file by the given filename, referring to the format of the file from its contents. If file is multi-image, then imread reads the first image in the file.
imresize()	B = imresize(A,scale) returns an image B which is scaled in times of the size of image A.
imshow()	imshow(I) shows the grayscale image I in the figure.
size()	size (A) returns a row vector whose elements are the length of the corresponding dimension of A.
sum()	sum (A) returns the sum of the elements of A along the first array dimension whose size is not equal to 1.
imwrite()	imwrite (A, filename) writes image data A to the file specified by the file name in a file format derived from the extension,it creates a new file in the current folder.
im2bw()	im2bw (I, level) binary grayscale image I by replacing all pixels in the input image with a brightness greater than the level with a value of 1 (white) and all other pixels with a value of 0 (black).
img2pdf()	Convert to image BW. img2pdf is an open source Python package for converting images to PDF format.
os.listdir()	Python's os.listdir () method is used to get a list of all files and directories in a given directory.
snapshot()	img = snapshot (g); capture the current frame as a frame from camera g and assign it to the img variable.
imcrop	imcrop creates an interactive image cropping tool associated with the grayscale, true color, or binary image displayed in the current image. imcrop returns a cropped image
writeVideo()	writeVideo (v, img) writes data from the array to the video file associated with v.
VideoWriter()	Use the VideoWriter object to create a video file from the array.

4. Discussion

4.1. Implementation Details

The proposed system makes use of MATLAB R2014a. This version of MATLAB provides Webcam support and the functions mentioned, imcrop, imcomplement, sum(b(:)), sum(~b(:)) have been widely used. Spyder 3 is used for implementing some parts of the system, in Python programming language which is using img2pdf package for notes making process. Image is converted into pdf bytes using img2pdf.convert() functions provided by the img2pdf module, then the pdf file is opened, written, and saved.

4.2. Experimental Results

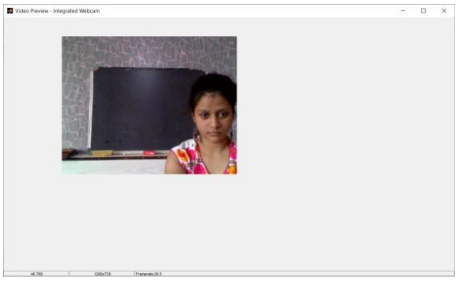

Fig 3: Preview of Webcam

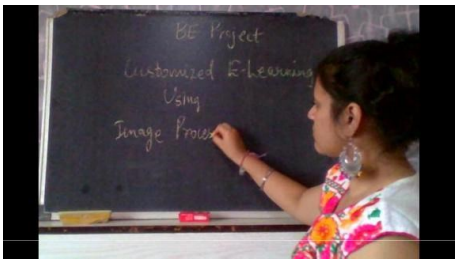

Fig 4: Preview of Saved Video

In the figures, we have implemented saving a cropped video. Fig 3 shows the preview of the webcam when the code is executed. Fig 4 is the preview of the cropped video saved. Firstly, when the webcam gets started, it captures the person teaching, the writing board along with the background. This uses the imcrop function to crop the frames generated per second and the writeVideo function to combine all the frames to form a video. The video of 20 seconds with 30fps gets cropped and saved.

In the figures, we have implemented Difference Between the Frames of the image. Fig 5 is the input image1. Fig 6 is the input image2. Fig 7 represents the output image. Firstly we give the path for the two images. Then images are read using the imread function. Resizing of images takes place. Finally, the difference between the two images is displayed using the imshow(x-y) function

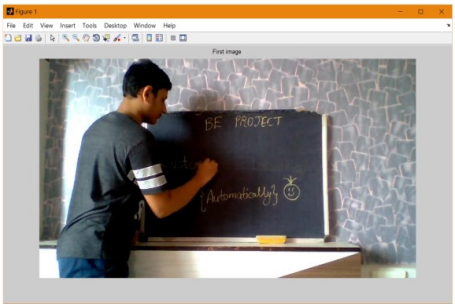

Fig 5: Input Image 1

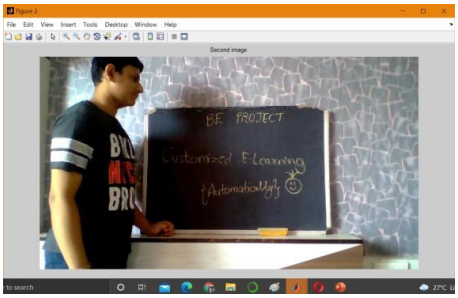

Fig 6: Input Image 2

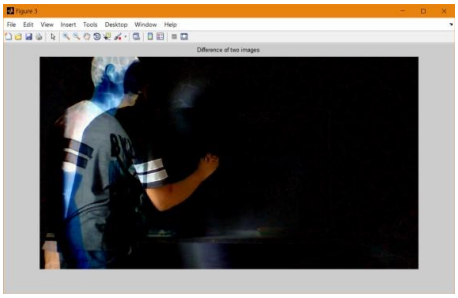

Fig 7: Output Image

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In the figures we have imcomplemented an image. Fig 8 is an input image of a blackboard. Fig 9 represents the imcomplemented output image. Firstly, the colored image is converted to a binary image using the im2bw function. And then it checks for the number of pixels in black and white. As the input image contains maximum black pixels, all the black background is converted to white and all-white text is converted to black using the imcomplement function and saves the output image

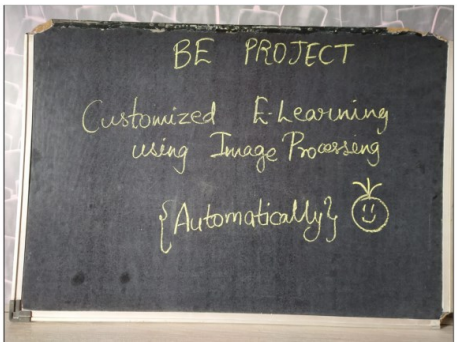

Fig 8: Input Image (Blackboard)

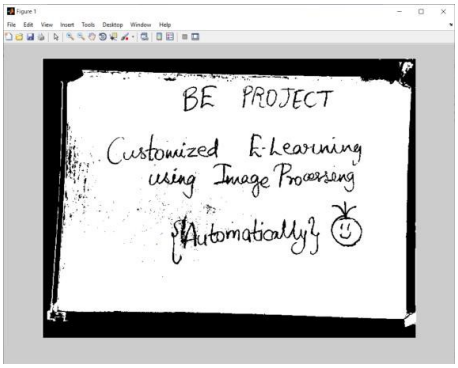

Fig 9: Output Image (Blackboard)

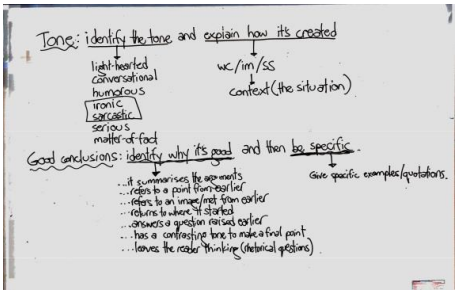

Fig 10: Input Image (Whiteboard)

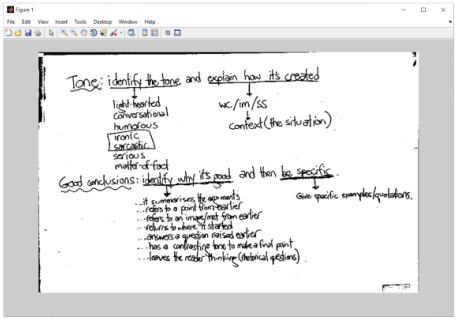

Fig 11: Output Image (Whiteboard)

In the figures, we have imcomplemented an image. Fig 10 is an input image of a whiteboard. Fig 11 represents the imcomplemented output image. Firstly, the colored image is converted to a binary image using the im2bw function. And then it checks for the number of pixels in black and white. As the input image contains maximum white pixels, the output image of conversion to a binary image is saved.

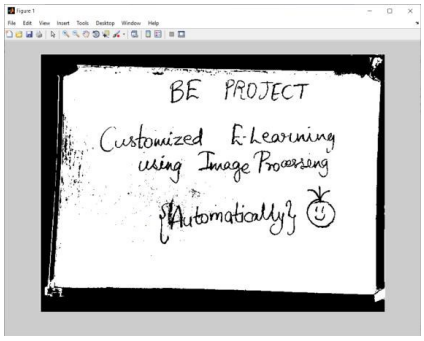

Fig 12: Page 1 of new.pdf

The figures Fig 12 and Fig 13 show page1 and page2 of new.pdf respectively, here img2pdf package has been used for conversion of images to pdf.

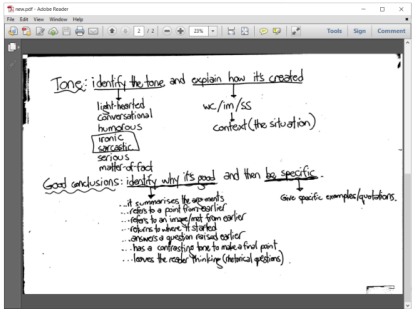

Fig 13: Page 2 of new.pdf

References

[1] Rop, K.V. & Bett, Nelson. (2012), "VIDEO CONFERENCING AND ITS APPLICATION IN DISTANCE LEARNING", Annual Interdisciplinary Conference, The Catholic University of Eastern Africa, Nairobi Kenya,June 2012,pp.1-9,Vol: 1,

[2] Din, Mohiu & Bashir, Aneela & Basit, Abdul & Lakho, Sadia (2020), "Abandoned Object Detection using Frame Differencing and Background Subtraction," International Journal of Advanced Computer Science and Applications,pp.676-681, 11. 10.14569/IJACSA.2020.0110781.

[3] J. Chen, G. Bai, S. Liang and Z. Li, "Automatic Image Cropping: A Computational Complexity Study," 2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), Las Vegas, NV, USA, 2016, pp. 507-515, doi: 10.1109/CVPR.2016.61.

[4] The MathWorks, Inc ,"Complement image - MATLAB imcomplement,",1994-2022[Online]. Available : https://in.mathworks.com/help/images/ref/imcomplement.html. [Accessed: Oct. 14, 2021].

[5] Programming Techniques,"Extract Frames from Video MATLAB",MARCH 13, 2012. Available: https://followtutorials.com/2012/03/extract-frames-from-video-matlab.html. [Accessed: Oct. 1,2021].

[6] Kalaivani.R1 , Manicha chezhian.R2,"Object Detection in Video Frames Using Various Approaches,"International Journal of Advanced Research in Computer and Communication Engineering Vol. 2, Research Scholar, Associate Professor, Computer Science, NGM College, Coimbatore, India.

[7] Danyliw, Ned, "Video Reconstruction from Randomized Video Frames",Corpus ID: 19745438, 2016.[Accessed : Dec 2, 2021]

[8] Zhengyou Zhang, Li-wei He, "NOTETAKING WITH A CAMERA: WHITEBOARD SCAN-NING AND IMAGE ENHANCEMENT," Microsoft Research, One Microsoft Way, Redmond, WA 98052, USA [Online]. Available: zhang,lhe@microsoft.com

[9] The MathWorks, Inc, "Crop image - MATLAB imcrop", Available:https://in.mathworks.com/help/images/ref/imcrop.html.[Accessed : Oct.25, 2021]

[10] The Math Works, Inc, "Compare differences between images MATLAB imshowpair" ,Website title:In.mathworks.com, Available: https://in.mathworks.com/help/images/ref/imshowpair.htmlbta3ucy-3.[Accessed:Sept 1, 2021]