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Automatic Controlling of Electrical Appliances in Classroom Using Image Processing

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***ABSTRACT*:** *In this period of energy crisis, the main concerned part is the conservation of energy. Starting it from our day to day life, energy in form of electricity can be conserved by avoiding the unwanted utilization of electrical appliances which we tend to forget when we leave a room. Many techniques have been used but most of them have disadvantages like extra hardware needed, low efficiency, expensive etc. Considering this, we came up with an idea of using image processing for automation of the appliances with the help of the cameras installed in the classrooms.*

Keywords: Automation, electrical appliances, image processing, classroom, camera.

I. INTRODUCTION

Classroom is one place where many of us have been there. Many of us might even have come across a situation where one wants leave the classroom no sooner the bell rings. As the ring goes off pupil are in hurry to leave the class so they can reach home or wherever they wanted to. This usual scenario ends with the unnoticed electrical appliances being remained ON and results into wastage of electricity. Some institute even hire peon to look over the classes and turn OFF the appliances which is again a waste of human resource and extra money needed to do the same.

With compulsory requirement of camera in institutes has helped a lot in our technique. The camera, the eye in the implemented program, becomes the brain of the system. In this way the image processing of the captured images is done via camera to make the smart decision of whether a person is present or not according to which the electrical appliances which be turn ON or OFF.

II. METHODOLOGY

Block Diagram

Here is the basic block diagram of the system show in Fig (1)

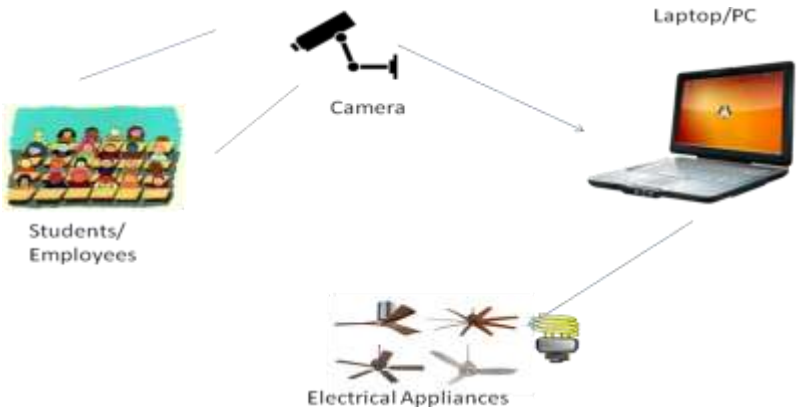

Fig. 1: Block Diagram

A. Acquisition of Image

The camera is used as the main component in this whole process, it will work as an eye as explained earlier. A video is a combination of different frames running at different rates per second. The compilation of all these frames makes a video which is captured by the camera. The camera needed to be installed in a particular way so that the whole classroom is visible through it. An image is in digital format having pixels which decides the quality of the image, the more are pixels the better will be the quality. To get a good result we can use a high resolution camera.

Image of the empty classroom is taken as reference without any person as shown in Fig. 2. So that we can have estimation as to how the frame can be divided into cells for further process. Another image is captured where student have occupied their seats in the classroom show in Fig. 3.

Fig. 2: Reference Image

Fig. 3: Real Time Image

B. Image Partition

The camera is fixed at one place to observe the whole class. We took one reference image based on which partitions of image into cells were done. An image is a collection of pixels, each pixel gives different location of itself. The captured reference image was processed and the pixel of whole image got analysed. After which it is divided into parts according to the electrical appliance like fans and tube light located in the classroom [2]. The area covered by electrical equipments is termed as cell. Each cells were obtained when we got the intersection points of the lines when drawn to make the partition in the image. In our case the whole image is divide into 6 cells, each cell named as Cell 1 to Cell 6 respectively. The ranges for these cells are given in the Table I. These were the 6 cells that were processed to identify as to which cell possess the respective electrical appliances. Fig. 4 shows the division of the image according to the cells as mentioned earlier. This figure will show the detail description of the below mentioned range of cells

Table I : Range of the Cells

	Cell 1	Cell 2	Cell 3	Cell 4	Cell 5	Cell 6
X-axis	1 to 633	633 to 1280	1 to 633	633 to 1280	1 to 633	633 to 1280
Y-axis	1 to 314	1 to 314	314 to 481	314 to 481	481 to 960	481 to 960

Fig. 4: Image Divided into Cells

Table II: Electrical Appliance in Each Region

Cell 1	Cell 2	Cell 3	Cell 4	Cell 5	Cell 6
Fan1 Light1	Fan1 Light2	Fan2 Light1	Fan3 Light2	Fan4	Fan5

C. Face Detection

In face detection process we are detecting upper part of people who are sitting in the classroom, which includes face. Nowadays Face detection is widely used for many applications in different fields. There are many face detection algorithms available but amongst all, Viola-Jones [1] face detection algorithm is effective to be used in real-time object detection. The main advantage is that the detection is very fast. In this method we are capturing frames from real time video in particular time intervals and then detect person for the same. Sometimes we get a false detection but can be rectified by varying the threshold value of the system. It is advisable to set the threshold value during the installation of the camera or before the process is made to start so that we get less error as possible.

Fig. 5: Faces Detected

1.) Centre of the image

The centre coordinates of the detected image is identified which will in help to find the position of the image in the screen. The following formula is used to find the coordinates or the centroid of the image.

Formula: (X, Y) = ((x + (w/2)), (y+ (h/2)))

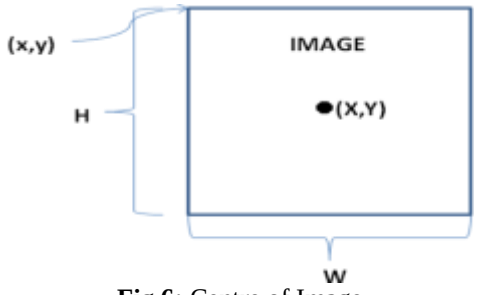

Fig.6: Centre of Image

The centre coordinates of the detected persons' image are given below:

x_1=709.5 x_2=522.5 x_3=427 x_4=1126.5 x_5=381.50

y_1=194 y_2=288 y_3=447.5 y_4=526 y_5=535.5

Referring the Table I we can easily co-relate the position of the detected images on the table mentioned below, which displays the co-ordinate of the centre of the images. Hence gives us the complete idea as to which cell it represents.

Table III : Coordinates of the Detected Images

	Cell 1	Cell 2	Cell 3	Cell 4	Cell 5	Cell 6
(X,Y) coordinates	(522.5,288)	(709.5,194)	(427,447.5)	X	(381.5,535.5)	(1126.5,526)

2.) ***Flowchart***

The flowchart of the whole system is to identify the position of the detected person. If it's identified then the electrical appliances present in that place gets switch ON or OFF automatically reducing the human effort.

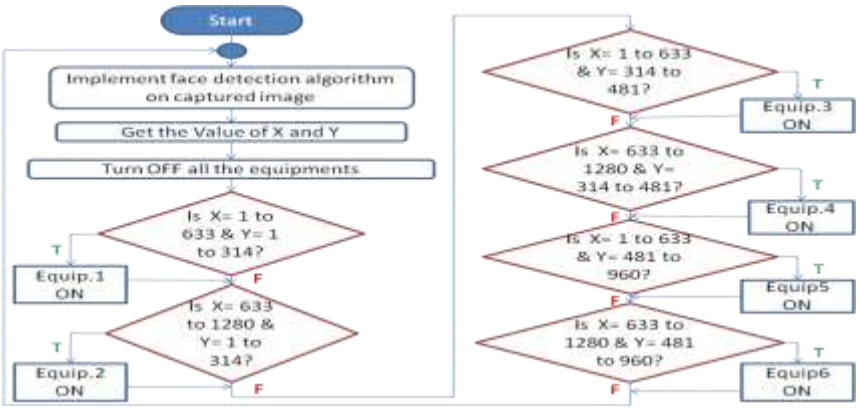

Fig.7: Flowchart of the Position of Detected Image

D. Results

To obtain a result on the above discussed method, the whole program is made to run in GUI (Graphical User Interface) so that the implementation can be seen virtually. MATLAB GUI is used to show the whole process. A layout is made according to the electrical appliance fixed in the classroom as show in Fig. 8

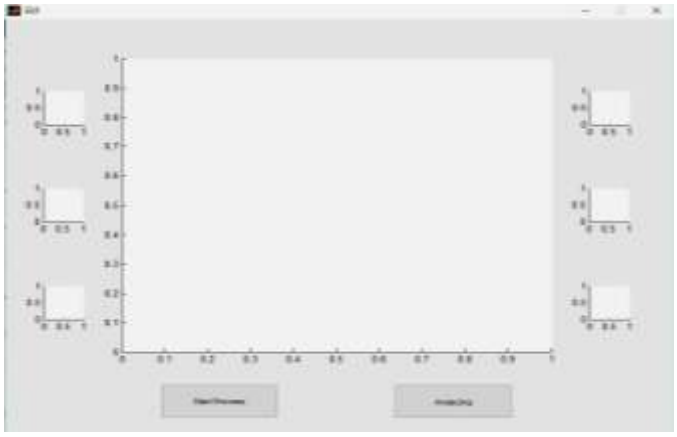

Fig. 8: Graphical Layout

First the camera is turned ON after which the face detection algorithm is made to be implemented on the live video stream as shown in Fig. 9

Fig. 9: Real Time Image with Electrical Equipment

Results are continuously obtained soon after the faces are detected. The output is shown in Fig. 10 will give us the idea as to which appliances are to be turned ON or OFF according to the presence or absence of the person who is sitting on that particular region where the respective electrical components are present.

Fig. 10: Equipments Controlled According to Detected Faces

III. CONCLUSIONS

In this way a classroom can be visualized where all the electrical appliances can be controlled automatically without further human assistance. This makes the camera smart enough to monitor the electrical equipment and thus brings the whole idea of automation into classrooms. Hence a lot of efforts and resources can be conserved which can be utilized for different purpose.

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