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Device power consumption avoidance using image processing

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***Abstract*—Almost 70 percent of India's electricity today comes from coal-fired plants. About 17 percent comes from hydropower, much of which is from large dams in the northeast. Around 3.5 percent is derived from the nuclear power plants and the rest is from the wind farms. A technology review called India's Energy Crisis conducted by MIT as on October 7, 2015 says that about 300 million of India's 1.25 billion people live without electricity. Another quarter billion or so get only spotty power which is as little as three or four hours a day, from the total generated power which was about 65.78 billion units. One of the major reason for this kind of power crisis is due to the fact that, large malls auditoriums, classrooms in urban areas have electrical equipment running unnecessarily in unmanned areas. There are many ways to avoid this problem, like installing IR sensors for detecting people and turning on the devices. But these methods are quite costlier and complex for larger areas. Hence a new method of controlling the power supply of auditoriums or classrooms is proposed using, Image Processing.**

Keywords—Image Processing, Image Partitioning, Edge Detection, Hough Transform , Threshold Determination

I. INTRODUCTION

The most common scenario that is faced today is that in places like auditoriums or classrooms electrical equipment like fans, lights or air conditioners running, even if there is no people around. Since those equipment are operated manually, turning on and off of a fan in accordance with the arrival of people, is an uncomfortable task. As a precaution, they are switched on prior to the arrival of people, that avoids uncomfortness. This causes wastage of power in a considerable amount. Hence an efficient system that automatically does the ON and OFF of the electrical appliances, in these kind of places is a demand. Existing automatic controlling techniques use Infrared sensors to detect people. This kind of technique uses the count of the people, but this system doesn't give any information about the areas that are not occupied. Also requirement of large array of IR sensors results in high installation cost and added complexity of circuitry. Moreover IR is harmful for human beings.

Hence, a new method is proposed to meet this demand, using a famous technique called, Image Processing. Here, the image of an empty auditorium is considered as the reference image and any variation in that reference image is detected through a series of images and according to that the power supply is controlled, thereby turning ON the respective equipment and thus avoiding the free running of appliances in unmanned areas, hence preventing the wastage of power. This is "Filling two needs with one deed", since the camera serves dual purpose, that is for detecting people as well as surveillance purpose. This is a very simple, efficient and cheaper technique of saving energy. Using this technique any changes in the auditorium are monitored through a sequence of image and according to that the supply control takes place. Image processing is a signal processing technique in which the input is an image, and the output may be either an image or, a set of characteristics or attributes that are related to the image of interest. Image processing technique makes power supply control implementation quite easier. The auditorium or classroom's empty image is taken as a reference image, using a digital camera in an elevated view. Now the gray conversion of the image is done and enhancement techniques are applied to enhance the image, after which edge detection takes place. In the same way the real time image that is captured and enhanced after which edge detection takes place. Now the enhanced reference and the real time images are compared and then respective control signals are generated with the obtained results, using a hardware prototype.

II. PROPOSED SYSTEM

The block diagram as given in fig.1 represents the general framework.

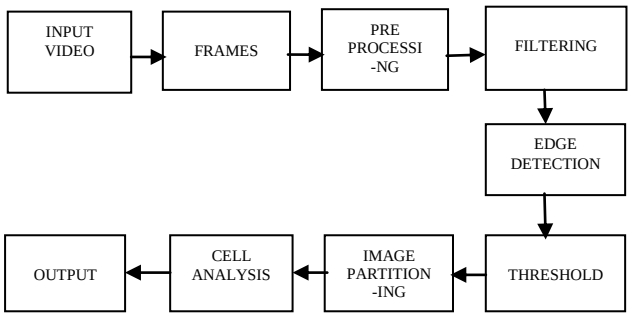

FIG 1 GENERAL FRAMEWORK

III.APPROACHES USED

The block diagram includes the input video, frames, preprocessing, filtering, edge detection, threshold, image partitioning, cell analysis and the finally the processed output image. Now, each blocks given above can be explained in detail.

A.Acquisition of input video

The system requires a reference image and a real time image for comparison. So that there is a need to get a reference image and a real time image from a video that is recorded. For the purpose of detecting people either a camera or image sensor is used. In this case it is better to choose a surveillance camera because it doesn't need any additional set ups like IR sensors or Image Sensors that would result in complexity. Now the video that is recorded is sent to a computer or microcontroller interfaced with it.

B.Conversion of video to frames

Now the video that is obtained from the camera is converted into frames using mat lab coding in order to get the reference and the real time images. Then the reference and real time images are sent for preprocessing. A sequence of frames or images constitute a video and a maximum of 20-30 frames are generated per second.

C.Preprocessing

Preprocessing is a process that involves converting a RGB image (color image) into a grayscale image. A gray scale image is more convenient as it contains only intensity information and also it has only single threshold value for each pixel. These images are comprised of a maximum shades of gray that varies from black at the weakest intensity to white at the strongest intensity. Intensity levels of the grayscale image ranges from 0 to 255 resulting in a total of 256 components.

D.Filtering

Filtering is a process that helps in modifying or enhancing the image of interest. Say for instance, an image can be filtered to highlight some features or discard some features. Smoothening, sharpening and edge enhancement are some of the image processing techniques that can be implemented with filtering.

E.Edge Detection

For Hough Transform to be applied, any grayscale image should be converted to a binary image. For this purpose edge detection is used. As Sobel operator is less sensitive to noise present in images, canny edge detection is chosen. This type of edge detection takes place in three steps. First step involves smoothening of the images to remove the noise. Second step is the computation of the gradient magnitude, which is similar to Sobel edge detection. Final step is non maximum suppression that involves removal of pixels that are not part of an edge.

F.Threshold

Thresholding is the effective method to separate the objects from the background. The purpose of thresholding is to extract those pixels from an image which represent an object. It replaces each pixel in an image with a black pixel if the image intensity $I_{i,j}$ is less than some fixed constant T ,or a white pixel if the image intensity is greater than that constant.

G.Image Partitioning

Image partitioning helps in identifying the object of an image of interest. Images are partitioned based on region of interest. Images are divided into segments or cells based on the number of devices used. The goals of image segmentation includes the following. First goal is to save time, so that complicate compression is given more time. Second one is to have a good shape matching with less computation time. Final one is to have the shape left intact without any fragmentation.

H.Cell Analysis

In cell analysis, the reference and real time images are divided into number of cells based on the devices used. Threshold values are calculated for each and every cell of an image. For example if the image has three fans, the image is divided into three cells, each of which has its very own threshold values. Now each cell of the reference image is compared with each cell of the reference image.

I.Output

If the computed threshold value of the real time image exceeds the calculated threshold value of the reference image, then the corresponding devices alone are turned ON with respect to object detection, thereby avoiding unnecessary running of electrical equipment in unmanned areas. This prevents wastage of power considerably.

III. SIMULATION PROCESS

At first a single frame is taken instead of a complete video for simplicity. The very first frame of the video is taken as the reference image and one more frame at random time is chosen as the real time image. Now the real time image is sent for preprocessing that includes filtering, edge detection, image partitioning as well. If the image is already is in grayscale, the image is directly subjected to edge detection. If not the color image is converted into grayscale using respective algorithms. Canny edge detector is used in this process. The reference

image is now divided into three cells as the number of cells used is three. Now threshold is calculated for all three cell using Hough transform. The same procedure is applied to the real time image. Now the processed images are taken for comparison and the comparison results will be explained in the following section.

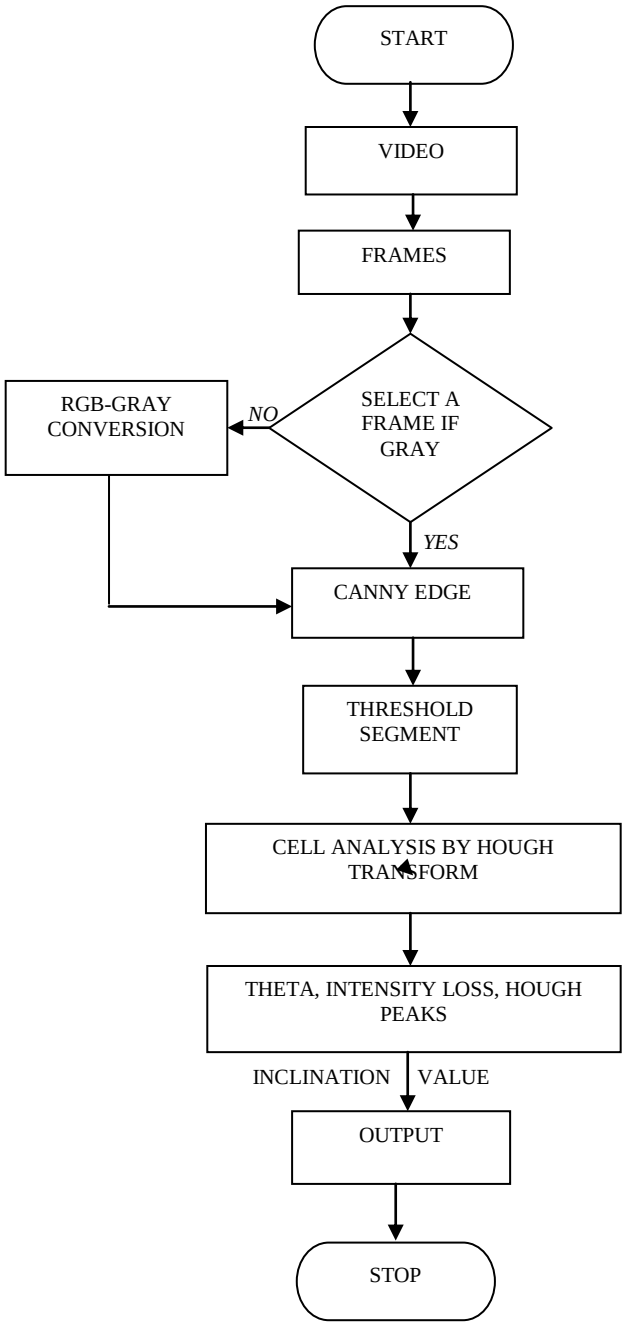

FIG 2 FLOWCHART

IV. CELL ANALYSIS AND RESULTS

FIG 3.1 RGB (COLOR) IMAGE

FIG 3.3 ISOLATED CELL

FIG 3.2 GRAY SCALE IMAGE

FIG 3.4 EDGE DETECTED IMAGE

FIG 3.5 CELL STATUS

FIG 4.1 RGB (COLOR) IMAGE

FIG 4.3 ISOLATED CELL

FIG 4.2 GRAY CONVERTED IMAGE

FIG 4.4 EDGE DETECTED IMAGE

FIG 4.5 CELL STATUS

On comparison of the images, if the threshold of a particular cell in the real time image exceeds the threshold of the corresponding cell in the reference image, then the devices in the cell alone are turned ON. In this case, cell 2 of the real time image have a higher threshold to that of the cell 2 in the reference image and hence, fan 2 alone is turned ON.

RESOLUTION FOR VARIOUS CELLS

CELL NUMBER	WIDTH(pixels)	HEIGHT(pixels)
Cell 1	512	202
Cell 2	512	168
Cell 3	512	142

THRESHOLD VALUES FOR VARIOUS CELLS

CELL NUMBER	ESTIMATED MIN THRESHOLD VALUE
Cell 1	54406
Cell 2	78159
Cell 3	21266

SUMMATION VALUES FOR EACH CELL

S.NO	CELL NUMBER	THRESHOLD VALUE	DEVICE STATUS
1.	Cell 1	54406	Fan 1 off
2.	Cell 2	69000	Fan 2 on
3.	Cell 3	21266	Fan 3 off

Conclusion

This study shows that image processing is one of the useful techniques to control the power supply in the large areas like malls and auditoriums. Also this prevents the free running of electrical appliances thereby reducing the power wastage. Also it proves to be a consistent and efficient technique to detect the presence of people since it uses real time images. Y

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