An Efficient Survey on Energy Conservation System with Video Surveillance

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Abstract- Energy conservation System plays a very important role in the world. In our country also follows a rapid way to save the energy to fulfil this crisis, the users and devices play an important role. This Literature review of an energy conservation system tells about the replacement of sensor devices. Instead of sensors, we aim to apply video processing techniques with machine learning algorithms to save energy consumption. The objective of this paper is to conserve energy using different techniques. We study different approaches and compare their desirable and undesirable features. In this paper, a research analysis is done on recent research techniques related to energy conservation with or without sensors. The consequence of energy conservation by observing loads of classrooms on the educational institutions and Universities by considering the energy consumed with the present level and endorsing energy adequate appliances.

Keywords- Video processing, Machine learning, Energy conservation, Sensors, Luminance.

I. INTRODUCTION

Nowadays saving power (energy) is a necessary thing. Because without power human cannot live peacefully [1]. All the important home appliances are working with power only. Automated control of electrical appliances in a home is a way to offer a simple, comfort, and secure environment for residents. Generally, smart home applicants aim to intelligent services to support appliances like lights, fans. Home power consumption is the biggest area of energy consumption in the world [2]. Occasionally, the frequent on-off of the electrical appliance in a room maybe not gratuitous, and we need not control the power of the appliances. In such a situation that the users may forget to switch off the power of the electrical appliance, these may cause energy loss [3]. To avoid these circumstances, some of the applications are used sensors to control the on and off electrical appliances automatically. Instead of sensors, the utilization of a surveillance camera is, to congregate information regulating the humans and detecting the movable objects. The camera relates to the circuits through DTMF [4]. This recognizes all movable objects and triggers the

appliances [5], Surveillance is the progress that monitoring such objects or a scene, and it is classified into three types manual, semi-autonomous, and fully autonomous. One of the most popular methods used in video surveillance is manual, while semi-autonomous surveillance here essential momentous human intervention beside with video processing [6]. In another way the video surveillance system with no human intervention is fully autonomous. Consider the input as a video sequence and high-level decision-making tasks are performing by gesture recognition and abnormal event-detection [7].

We aimed to propose a system with the live video, the human object is detecting with the area which we consider the image differences and with a different value that we identify a human in the scene. Once the object was identified with surveillance video then the DTMF (Digital Tune Modular Frequency) in the hardware component is directed to control the actions of appliances like lights, fans [8].

Information technology plays an important role in human life in recent days. Information and Communication Systems are greatly deployed in human life every day. Various surveillance cameras are used for security purposes and installed in all areas. These cameras take large more videos and images are extracted from the video which is used for surveillance purposes. A surveillance system requires a human operator for constant monitoring of fully human monitoring capabilities. The developing countries suffering from energy cries, such a frequent supply of electrical power to the surveillance system is most difficult [9].

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│          Surveillance Camera             │
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┌─────────────────────────────────────────┐
│  Detecting human objects / Finding       │
│            Illuminance level             │
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│  Controlling the Electrical appliances   │
│                (on/off)                  │
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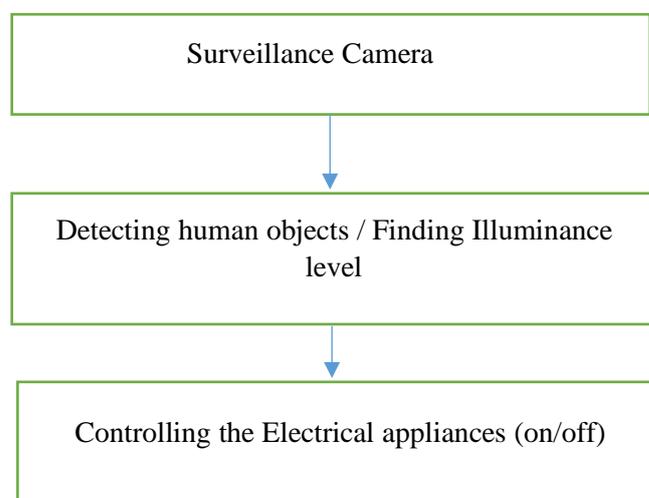
Figure 1 Simple Overview of Energy Conservation

Figure 1 represents that initially a room was focused on surveillance cameras, the video is capturing life through the surveillance camera. From the video, we tried to find the human objects with background subtraction and foreground detections algorithms. Based on the human presence in a room, the electrical appliances are controlled. In case a human can cross over the light or fan etc., then we aim to control the device either on or off. So, we can easily control all the electrical devices installed in the room with surveillance cameras. Later we are aimed to control the electrical appliances with human identification or with illuminance level for outside rooms like a corridor, street, etc., In most researchers has done this implementation with some sensor device, but here we tried to implement with surveillance video, means that no usage of any sensors.

In a surveillance application, we have many algorithms for finding humans in the scene. Mostly the researchers looking background subtraction and foreground detection algorithm for identifying a human object in a video. For this, we have many algorithms. Illuminance levels are captured based on lightening weather conditions, like the scene as captured by the surveillance as somewhat darkness then we compare the video with the weather data to identify whether conditions like evening or night then we decide to control the lights should be in on/off.

The idea behind is to detect a human object in a video is taken from pedestrian path human detection [10] and face recognition [11]. The human in pedestrian detection is finding the whole human body but while consider face recognition is to detect the human face. The main difference with these two is human detection is to find whether the object is there or not whereas the face recognition is to find a person is there or not. The main motive of object detection in pedestrian is to find the object motion like sitting or walking. Here the upper half of a human body is considered as a human body and it consists of face, hands, and half of the upper human body.

Lighting is an area, to achieve the energy efficiency at the design level, by incorporating the modern energy-efficient lamp luminaries and gears. Controlling the appliances with the lighting system is applied with four basic parameters intensity, luminous flux, luminance, and illuminance [12]. The common and normal activity light level ranges are 100-300 lux. For a classroom here consider 300 lux is the standard lux level for lighting design. The color rendering index of the light source is to render the surface or object is to compare with the standard light source.

In [13] an adaptive dimming scheme is based on a daylight pipe incorporated with indoor lighting and platform controlling has been analyzed and it shows significant energy savings. In another way [14] A estimation methodology for electrical energy consumption in an office with daylight and occupancy-controlled artificial lighting. In another method, an analysis of energy efficiency improvements for a school building has been discussed in [15].

II. LITERATURE SURVEY

A background subtraction algorithm, he has done the modeling of background at each pixel position with single 3D Gaussian distribution. Once the background model is done, then pixel in the input frame deviates from the model is considered as a foreground pixel [16]. But a single Gaussian function is not a suitable model for an actual dynamic background. This will suitable for only small or gradual changes in a visual scene or else lighting whereas it is not recommended for large and immediate fluctuations in a visual scene. The system also expects only one user [17].

An adaptive GMM algorithm was proposed and it used to analyze the Gaussian mixture probability density. The decision will implicate with pixel-based subtraction if the pixel is appropriate to the foreground object or some background. The recursive method is applied for updating the parameter efficiently also select the components simultaneously for each pixel. The pixel-level approach was implemented for finding an object in a scene. Herewith focused to recover the problem sudden changes and lighting of a scene [18].

A method proposed for robust background subtraction which used in the adaptive dictionary learning and splitting approach. This method helps to learn the dictionary through sparse representation and efficient splitting method to detect a human object. It has been applied to the background finding the object with minimal reconstruction error using target objects. Generally, most of the sparse representation methods consider only the holistic representation didn't concentrate the full use of sparse coefficients. But this learning overcomes that facilitate the leads to the results of image and video restoration and classification [19].

An algorithm for foreground detection based on the improved codebook. In this, the linear transformation is used, the RGB color is converted into YCbCr color for reducing the illumination change and chromaticity convergent. Search the code words of each pixel values with YCbCr and ensure that foreground detection. Later remove the code words which are not accessed a long time in a scene and matched with the random abandon value method [20].

Introduce a new background algorithm by organizing a gradient-based edge detector called the second derivative in gradient direction filter. It uses four fundamental background subtraction techniques called frame difference, approximate median, running average, and running Gaussian average [21]. This algorithm provides good blob images, ANN recognition of human and non-human objects in a scene. The two-frame differencing method was proposed, to detect the moving region by using pixel differences on each successive frame in a video sequence. It was described with a motion region. After the classification of the motion region, it can be used as a template to track the object [22].

An efficient algorithm that single Gaussian is not a decent model for outdoor scenes, in which background pixel is modeled with a mixture of Gaussian. Also, it discussed that each pixel of an image is considered as a mixture of Gaussians and online approximation is used to update the models. Later the Gaussian distribution of the adaptive mixture model is evaluated for the background process. Also, this paper deals with stable, real-time tracking with clutter motions, lighting changes, and long-term visual changes in a scene [23]. We are mostly interested to examine the surveillance with the context of power grids that are monitored and controlled by surveillance applications. Monitoring applications are mainly used for object detection that deviates from normal behavior and rendering surveillance.

The environmental parameters that focused as motion, brightness, and temperature. ZigBee, WiFi, and Ethernet are used to establish communication with user and system components. Environmental sensors are used to measure the temperature, brightness, and motion environment. The power sensor measures the power consumption of electrical appliances. ZigBee technology provides the establishment of mesh networks. Raspberry pi is controlled and collects the entire sensor reading values to transmit the control server [24]. Building the energy performance with an artificial neural network to predict the heat and Cooling in the room and analyze optimize the energy performance [25]. The lighting control has been investigated with daylight illuminance. The experimental tests are carried out with university building labs and classrooms. In this EN 1532 standard is used for basic automation in energy efficiency. The impact of dimming lighting strategy is focused on daylight illuminance changes in the room [26].

The Ethernet and RF wireless technology are used to save energy in the classrooms. The systems mainly design with a power supply unit, microcontroller device, and wireless module. Microcontroller realizes the information between Ethernet and control nodes [27]. Many types of research are shown that energy conservations like fuzzy logic, software agent architecture, and neural networks. There are several algorithms are proposed to reduce the energy without affecting the impact of the user comforts [28]. The Passive Infrared Radio (PIR) sensor controls the electrical devices in the classroom when the students or staff presence was absent. If any of the students or staff enter into the classroom the energy is emitted from the body is focused by the Fresnel lens, then the PIR sensor is activated and the microcontroller act as a power-saving device [29].

The controller STC89X52, and the circuit board are focused on the classroom to save the energy. All the lamps in the room are controlled individually concerning the control signal. The camera in the classroom is to capture the video

and extract the images then apply a face recognition algorithm to process and identify the face [30]. Then the location of the image was identified, and the position lamp only controlled either on or off. Lighting control system are designed with fuzzy logic algorithms, the illuminance levels are calculated to control the classroom illuminance level origin at 250 lux. For this measurement control variables, parameters, and target-based conditions are used. The light sensor is measuring the illuminance level in the room. The fuzzy logic controller controls the lamp in the building with low-cost investment [31].

Reducing energy consumption is done by automatic system design. This design involved two models the human detection and activity quantization. Persons are identified through multiple registered image channels [32]. The activity is identifying the object movements at a time. The lighting was proposed that, the lighting level is accurately matched with actual needs allow saving the energy and human comfort. This system organized with HBES standards adopting a KNX System [33]. The light control of the classroom is built with schedule, daylighting, luminance control, and zoning. Count the number of faces in the video that capture surveillance cameras in the room, based on the human count the energy conservation process is initiated to start. This process includes relay switch, power supply unit [34]. Zig bee technology is a wireless technology consists of three modules zig bee module, sensor module, and microcontroller. The microcontroller controls the overall system and the sensor senses the light level like dark or bright surround the streetlight. The microcontroller intimates the action and status of streetlight control with ZigBee [35]. In this paper the electricity consumption by indoor illuminance level, room parameters, and indoor illuminance level were recorded and analyzed. The indoor illuminance level and electricity consumption are done by illuminance meter and power harmonic analyzer. The room parameter includes light transmittance, window area, internal reflectance, and a total area of internal surfaces [36].

III. An Overview of an Energy Conservation System

The Energy conservations system has done with three levels, Identifying the humans, analyzing illuminance level, Controlling the electrical appliances. Figure 2 shows that a simple operation on controlling the electrical appliances with the video sequence. In this, a video sequence is considered as input, the video consists of 25 frames per second. The video sequence is converted into frames, the resolution of the frame consists of 1280 X 720-pixel resolution. Next with the background subtraction algorithm, we find the humans present in the room, based on the human presence we aimed to control the electrical appliances in a room.

3.1 Identifying the humans-
Single Walker human is subject to identification of the human randomly enter the classroom once at a time. In a real-number sequence, one can use principal component analysis (PCA) to extract the features in a video. Feature extraction is applied in two different ways: sample and feature.
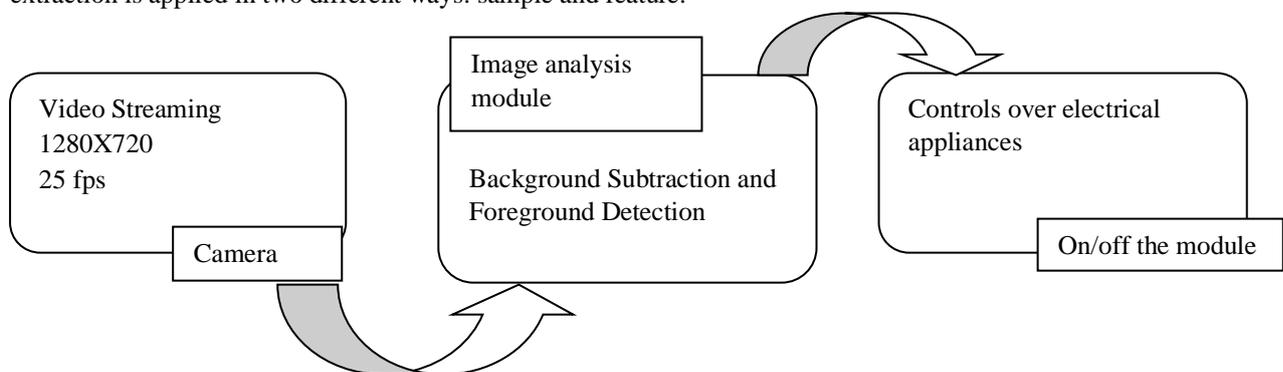

Figure 2 Simple model of proposed system

Multiple Walker Identification is many subjects that usually overlap and interfere with each other, making it difficult to extract feature sequences of each object. But in this paper, the exploit geometric advantages are a way of forming several non-overlapped sub detections- regions. Here, we use the terms of marginal and joint identification rates to describe multiple human recognition performance. The prototype system can trace humans simultaneously with two major scenarios. The multiple walker recognition problems apply to the theory of sub-detection-regions. It tolerates a standalone monitoring system to different illumination conditions, also a complement for conventional video human tracking and identification.

3.2 Analysing illuminance level -
In such a situation that, sometimes human is not present is not there also we need to control the electrical appliances. In a room or corridor, the human was found at a dark time then it is compulsory that to control the device is in on

condition. We propose that finding the illuminance level of the area is most or average to the darkness the appliances are to be the active condition.

3.3 Controlling the electrical appliances -

Finally, the electrical appliances (light, fan, etc.,) are controlled with DTMF circuitry. The video surveillance camera relates to DTMF circuitry and it triggers the appliances with the detection of human objects. In this module, generally, some researchers' users control the appliances with sensor devices, but our motive is that implement without sensors. So, we focused that taking a video through the surveillance camera and based on the light illuminance value and human presence to get on / off control over the appliances. Some of the surveillance technologies used for controlling the appliances are shown in Table 1.

Table -1 List of the surveillance technologies

Sl. No.	Type	Technologies	Examples of technique
1.	Visual surveillance	Video Imaging scanner	Smart CCTV Infrared scanners, sonar imaging, thermal imaging, x-ray imaging, the radiation imaging
2	Location tracking	Proximity sensing, Scene analysis	Proximity sensors, Image recognition algorithms
3	Ubiquitous surveillance	Triangulation Embedded sensors	Triangulation algorithms Wearable digital media

Table 2 shows that some of the sensors used for controlling the appliances.

Table -2 List of sensors

Sl. No.	Sensor type
1	Audio and acoustic sensors
2	Binary sensors
3	Radio Frequency Identification (RFID)
4	Heat Sensors
5	Infrared Sensors
6	PIR Sensors
7	Radar Sensors
8	X-rays Detectors

IV APPLICATIONS

It involves human detections in surveillance that may be used for person-specific identification in some scene, congestion analysis, and interactive surveillance with many cameras. In the surveillance environment, the main recognition of controlling the electrical appliances in classrooms in the universities and houses. Since the video-based surveillance systems are to detect doubtful events and be used to ensure safety for controlling the appliances.

V. FINDINGS

As conclude with the literature survey many algorithms and methods are proposed to detect a human object in a scene and counting the numbers of persons in a scene. Background subtraction algorithm is applied to subtract the background and Gaussian Mixture Model is used to detect the foreground object and pixel-level approach was implemented to find the foreground object. Facing the problem that finding the sudden changes in a scene was recovered with 3D Gaussian Distribution.

The adaptive learning strategy is used for applying background subtraction to detect the human object. Codeword method RGB into YCbCr reducing the time to detect the human object. An Artificial Neural Network (ANN) algorithm classifies the human and non-human objects in a scene. The algorithm for pixel difference between frames is developed, and the single Gaussian method used for the above all algorithms are deals with finding the human object that captured with the surveillance camera in a room.

The energy-saving system was implemented with several sensors and circuitry all are deal with reducing the energy conservations. ZigBee technology and sensor are used to sense the environmental parameters like temperature, motion, and brightness. ANN is used for energy saving. EN1532 is identifying the basic automation, Radio Frequency technology and fuzzy logic are used.

Passive Infra-Red (PIR) sensor controls the electrical devices in the room and calculating the dimming level like dark and brightness is identified with fuzzy logic, face recognition algorithm calculates the human presence in a room. Involved activity recognition to control the appliances, HBES standards adopt the day-light values.

VI CONCLUSION AND FUTURE WORK

The comparison and analysis involve minimizing the conservation of energy levels for home appliances. It illustrates that some optimization methods that can follow for energy conservation. This survey reflects that the use of power differs from many methods. It deals with the usage of an effective approach to power-saving. Also, it aims to overcome the drawbacks while facing sensors. This study expressed how the proposed method can be improved to realize energy-saving services in home appliances by involving different video processing methods. The proposed examples involve with many advantages: proper functioning of appliances, save energy and cost and benefit from the reduction of failure rates and downtime. We extend this work by exploring video processing with machine learning and sensors to recover the disadvantages faced with the reviewed algorithms. So, our new proposed work may increase the benefit to reduce energy conservation.

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