ENERGY OPTIMIZATION USING MACHINE LEARNING AND IOT

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Abstract : **The major problem in the most populated and developing countries like India, is power or Energy crises. Hence there is a too much need of energy saving. We use several ways to save power like using the electric and electronic gadgets whenever and wherever it is needed and switching them off while not in use. "Energy preserved is energy earned". Kilowatt Hour - This is what someone pays after buying energy from the local utility company. Unit of measuring energy is kilowatthour (kWh). In one hour, one kilowatt of power is used. A light bulb is typically 60 watts if you leave it on for an hour you have used 60watt hours, or .06 kWh. This means 24*.06*30*12 i.e 515.4kWh of energy is consumed by a light bulb which is continuously on. There are many places like classrooms, large auditoriums and meeting halls there will be a fan or a light bulb keeps running in unmanned area too, even before the people arrive. That improves the wastage of power in large amount and contributes to a considerable amount of electricity loss. Here we propose a method of controlling power supply of auditoriums and classrooms using Machine Learning and IoT techniques**

IndexTerms **- Image Processing, Machine Learning, Energy Conservation**

I. INTRODUCTION

ELECTRICITY and electrical devices are most important part of our life. They are used everywhere. We cannot imagine our life without electricity, but with the usage of electricity comes its wastages. People are very careless when it comes to electricity. They Forget to put off the electrical devices while not in use, absent minded leaving the room keeping devices on, not switching off them while not necessary. These are the few things that happen with everyone in our day to day life. These result in wastage of electrical energy. Generally we do not pay much attention towards such silly mistakes. We ignore it as a small wastage, but if we consider the same mistake happening in every work place, school. College, public place etc. then we can understand that a massive amount of electrical energy is lost in this way. Object detection is most profound aspect of computer vision due the number practical use cases. Thus automated power management system is used to detect whether the room is empty or not. By using this technique we monitor changes in the classroom through sequence of image and accordance with that the power supply is controlled. Image processing is a form of signal processing in that the input is an image and output may be either image or a set of characteristic related to the image. In this implementation first empty image is taken using digital camera then it is converted into gray and by using image enhancement technique we enhanced the image and apply edge detection. In the similar manner real time image is captured, enhanced and edge detected. Now the both images compared to each other and on the basis results the control signal is generated by using hardware. Reducing energy costs by controlling the lighting and temperature based upon the real time occupancy and predicted schedule is an efficient way. A smart and intelligent system to maintain your routine chores is not only an efficient but a robust way to automate your heating and lighting system. [10]

II. RELATED WORK

Shraddha Dhirade paper on Monitoring and Controlling of an Auditorium:

[1] They proposed a system on the basis of Raspberry pi. The monitoring and controlling of electric equipment are developed using Raspberry-pi3. Automatic power controlling, and monitoring system is designing for making an auditorium's lighting system as well fans easily controllable and monitoring. Raspberry pi's camera will detect the persons with the help of face detection, which are seating in the auditorium along with their location. The fans and light will be automatically turn ON in auditorium after detecting number of persons seating with their respective location. Raspberry pi-3 is implemented on NOOBS operating system using python language. Now days, multiblock local binary pattern (MB-LBP) is useful method which is used for face detection of person. MB-LBP is required to implement on the Raspberry pi3 to detect faces of humans for extracting of attributes of faces. [1]

[2] N. Shribhagat Varma paper on Automatic Electrical Appliances control based on Image Processing: They design a power management system which will sense if the room is vacant and accordingly turn the lights off. To avoid this sheer loss of money and resources, automated power management system looks to detect whether the room is empty and accordingly switch off the lights and fans. The camera captures live feed of the room and gives it to the computer to process it. The face detection module then detects human presence. The strength and contribution of this work lies in the combination of a large number of sensors readings which allows deriving higher level semantics as compared to reacting on single sensor readings only. [1]

[3] Viola Jones paper on Robust Real Time Object Detection: This paper describes a visual object detection framework that is capable of processing images extremely rapidly while achieving high detection rates. There are three key contributions. The first key contribution is the introduction of a representation of a new image called the "Integral Image" which allows the features to be computed fast. The second is a learning algorithm, based on AdaBoost, which selects a small number of critical visual features and produce extremely efficient classifiers. The third contribution is a method for combining classifiers in a "cascade" which allows background regions of the image to be quickly discarded while spending more computation on promising object-like regions. A

number of experiments in the area of face detection are conducted. The system produces face detection performance comparable to the best previous systems. It is implemented on a conventional desktop, face detection proceeds at 15 frames per second. Accordingly "Manoj Kumar Asst. Students can be at corner or they can be at in front in a group etc. Test case I display two students are sitting and their subtracted image is another image0. also test case II display two students are sitting and their subtracted image is shown in another image. The study shows that this method is helpful in saving electricity. This method is very cheap, efficient and can reduce wastage of power. This will consistently detect that is there any person in a classroom and auditorium and hence saves electricity. [1]

III. FACE DETECTION USING VIOLA JONES ALGORITHM

The Face Detection task is easily done in the perspective of human visual task but when it comes in the view of computer it is little bit difficult. An image is given in which the faces are detected leaving the illumination, pose variation and lighting factors. The faces of the people have been detected as shown in Fig.1.
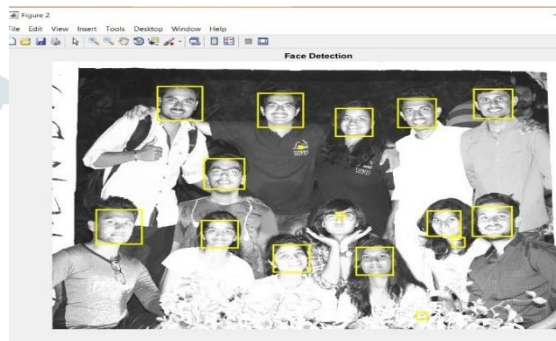
Fig. 1. Face Detection

In image preprocessing unit, data prepare for next module. The normalization and illumination has been done on the image on this module which is based on the face expression and pattern here. The specified information which is effective from the detection of eye and noise is performed using face feature extraction module. This is very useful in differentiating the faces and the non-faces part with respect to several photometric and the geometric variations. Finally these images can be used to detect the facial parts such as eyes, nose, mouth and upper body based on the extracted features. The Viola-Jones face detection method is the first frame-work based on object detection that provides good detection rates in real-time is given by Paul Viola & Michael Jones in the year of 2001. This algorithm has been implemented in 'Matlab' using the method vision. [5]

The Viola - Jones contains of 3 techniques for the facial parts detection:
1. The Haar like features for the feature extraction is of a rectangular type which is determined by an integral image.
2. Ada boost is a machine-learning method for detecting the face. The term 'boosted' determines the classifiers that are complex in itself at each stage, which are built of basic classifiers using any one of the four boosting techniques.
3. Cascade classifier used to combine many of the features. The term 'cascade' determines the several filters on a resultant classifier.

IV. HUMAN DETECTION

Human detection is implemented in Python We have used advanced python libraries like ImageAI. ImageAI is a python library which is built to empower developers to build applications and systems with self-contained Deep Learning and Computer Vision capabilities using simple and less lines of code. Built with simplicity as main concern, ImageAI supports a wide range of Machine Learning algorithms for custom image prediction, object detection, video detection, image prediction, video object tracking and image predictions trainings. ImageAI does image prediction and training using 4 different Machine Learning algorithms trained on the ImageNet-1000 dataset. It also supports object detection, object tracking and video detection using RetinaNet, YOLOv3 and TinyYOLOv3 trained on COCO dataset. ImageAI will provide support for a wider and more specialized aspects of Computer Vision including and not limited to image recognition in special environments and special fields. Before ResNet, there had been various ways to deal with vanishing issues of gradient, for example, adds an auxiliary loss in a middle layer as extra supervision, but none of them seemed to really find the solution for the problem.

The main motive of ResNet is to introduce a "identity shortcut connection" that can skip multiple layers. The authors often discuss that stacking layers should not lower the performance of network, because we could easily store identity mappings over the present network, and the final architecture would work the same. This suggests that the deeper model should not generate a training error higher than its previous model layers (a smaller number of hidden layers). It is assumed that letting the stacked layers fit a residual mapping is simpler than letting them directly fit the desired underlaying mapping, the residual block above

explicitly allows it to do that. ResNet is not the first to make use of shortcut connections, Highway Network actually introduced gated shortcut connections. These parameterized gates control amount of information that is allowed to flow across the shortcut. Same type of idea can be found in the Long-term Short Memory (LSTM) cell, in which there is a parameterized forget gate that controls amount of information that will flow to the next time step. Therefore, ResNet is actually a special case of Highway Network.
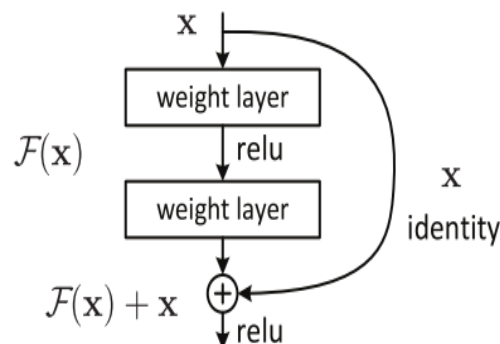

Fig.2. Basic ImageAI structure [9]

V.PIR

PIR sensor is popularly called as Pyroelectric sensor aka Passive Infrared Sensor. It is basically an electronic sensor used in various motion detecting applications. A PIR sensor detects InfraRed radiations emitted by any object inside its field of view. Basically, all objects emit heat energy in the form of radiation. All objects with a temperature above absolute zero emit heat energy in the form of radiation at infrared wavelengths. These emitted infrared radiations can be detected with and used in several applications. A PIR sensor do not emit any amount of radiation and that is the they are called passive, in the name itself, for detection purposes but they just measure the radiation emitted by other objects within the range of measurement. They work on the principle of detecting infrared radiation emitted by any object or reflected from objects. The property of detecting infrared rays can be used to detect motion of humans. They are having some properties such as small, inexpensive, low- power, easy to use. For that reason, they have become most preferers in home appliances and gadgets used businesses.[4]

Fig. 3. Internal Components

Possible outputs from PIR sensor module:

The PIR sensor module has only one digital mode of output. So it has only 2 possible values of output – either a HIGH or a LOW. ÂBy default standards, when there is no object inside the range of PIR sensor it gives a LOW value or 0V at output. When an object is identified inside the field of view of PIR sensor it gives outputs a HIGH value or +5V at output

VI.PROPOSED METHODOLOGY

The main motive is to build a system which detects and recognize the textures of human parts of body in an image or a video. The estimation parameters of the parts in human body are tracked with the various parameters of facial features. Face Detection

through the computer is a challenging task as it requires to recognize and identify it with different size, shape, textures and varying intensities of colors on it. This can be further applied to real world applications of face recognitions in online exams, identifying persons gender/age, and much more. The logic of the face detection with computers is to detect and vary between the facial and non-facial structures and returns the facial parts present in the human body. Initially presence of human was checked using Face Detection using Image processing. This was actually implemented using Viola Jones algorithm. Image was also split into four sections. If face was not detected in some particular region, power supply to that region was cutoff. This method gave many false positives and fatal errors. Viola Jones also did not perform well on continuous real time video processing. Hence, we developed a modified algorithm for human presence detection. Human presence in a region is detected with help of PIR sensor and it is confirmed using human detection done with the help of Machine Learning: Neural Networks to be specific. Outputs of both the techniques then become inputs to a AND Gate. If output of AND logic gate comes out as 1, power supply in the room is manipulated accordingly. Hardware interfacing of relays and sensors is done with help of Arduino. Machine Learning algorithm is built on python. It is interfaced with Arduino using pyserial library in python – which is used for serial communication. Arduino works with relay modules: which are basically switching elements to do the actual power shut off in case where human presence is not found.

VII.RESULT

Fig.4.input image

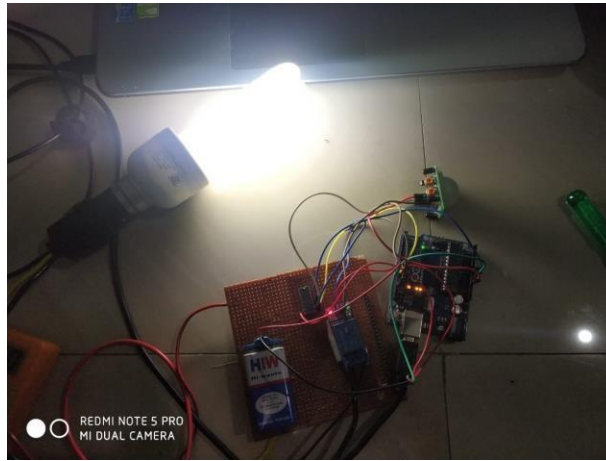Fig.5.output image

Fig.6.code output

Fig.7.module output

VIII.CONCLUSION

Thus energy optimization is achieved using deep learning data and sensor data. Number of false positives occurring in case of face detection done for human presence is drastically decreased. This system works accurately most of the times – accuracy of deep learning algorithm being around 99%. This data when coupled with Arduino and hence relay modules is used for actual power manipulation and hence energy optimization.

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