

## Smart Energy Saving an Application of Image Processing

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### ABSTRACT

*Forgetting to put off the electrical device while not in use, keeping the device on while not necessary, therefore resulting in wastage of electrical energy has become common in our day to day life. Not much attention is paid towards such silly mistakes, but these little wastages can form a formidable amount of overall energy wastage if we consider the same mistake happening in every work place, house, educational institute, public place etc.*

*So the aim of this undertaking is to develop a system that monitors a place/ room or an area in a large room, for the presence of human activity. If no human presence is detected, a pre-determined set of electrical devices, if 'on' are 'put off' thus saving electrical energy.*

*The system consists of a camera that takes pictures of the space being monitored, periodically. The 'Raspberry Pi' forms the computational unit, comparing successive images. A particular algorithm is used for the purpose. Human presence in the room results in difference between successive images. Should there be no difference in the successive images, then the Raspberry Pi checks the states of the devices, if they are on then it sends control signals to the relay circuits to put off the running devices.*

### INTRODUCTION

Electricity and electrical devices are integral part of our life. They are used everywhere today. We cannot imagine a life without electricity, but with the usage of electricity comes its wastages. People are often careless when it comes to electricity. Forgetting to put off the electrical devices while not in use, absent minded leaving the room keeping devices on, not switching off the devices while not necessary etc are the few things that happen with everyone in our day to day life. These result in wastage of electrical energy. We usually 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.

### Smart solution

A smart solution to the above problem is to save these wastages at every work place, educational institute, public place etc. by the help of a system that monitors that wastage. Here we have designed a prototype of a system that can do the task of monitoring a room for electricity wastage.

The system monitors a place/room or an area in a large room, for the presence of human activity. If human presence is found, it continues to monitor the room like before. If no human presence is detected, then, it checks a pre-determined set of electrical devices. If those devices are 'ON' then the system takes necessary actions to 'put off' those devices. Therefore wastage of electrical energy is prevented.

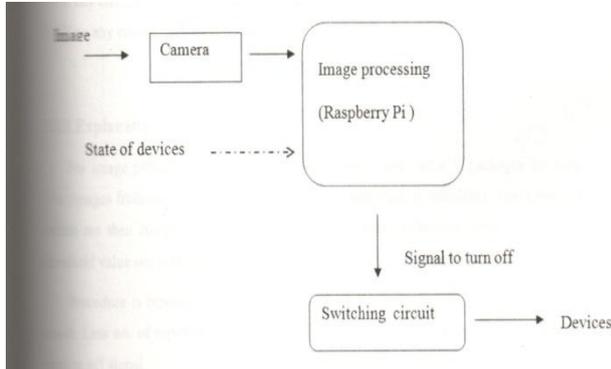
The system consists of a camera that captures pictures of the space being monitoring, periodically. We have used 'Night Vision Intex – IT 105 WC camera for this purpose.

The Raspberry Pi- class B model' forms the computational unit. It is a credit card sized computer used for computation purposes. It compares successive images. A particular algorithm is used for the purpose. The Raspberry Pi programming is done by using 'python' programming language. The basic logic is that human presence in the room results in difference between successive images due to some sort of movement of the human cannot sit completely still for a long period of time. So if the successive images show difference then this is anticipated as human presence and the raspberry pi checks the states of the devices, if they are on then it sends control signals to the relay circuits to put off the running devices. The control signals given by the Raspberry Pi are of 5V. An appropriate relay circuit is used.

### Working & Implementation

The Intex night vision camera is used to capture images of the room being monitored. These images are sent to the raspberry pi for computation

purpose. The Raspberry Pi waits for ten continuous image frames to be constant before assuming that there is no person in the room to put off the devices.



At the same time the Raspberry Pi monitors the state of the devices. When no person is found in the room, it sends the 5V control signal to the relay switching circuit to put off those running devices. The relay circuit is interfaced to the Raspberry Pi using a buffer in order to save the Raspberry Pi from any possible damages. An Opto – coupler can be used to replace the currently used relay circuit for higher safety.

**Algorithm**

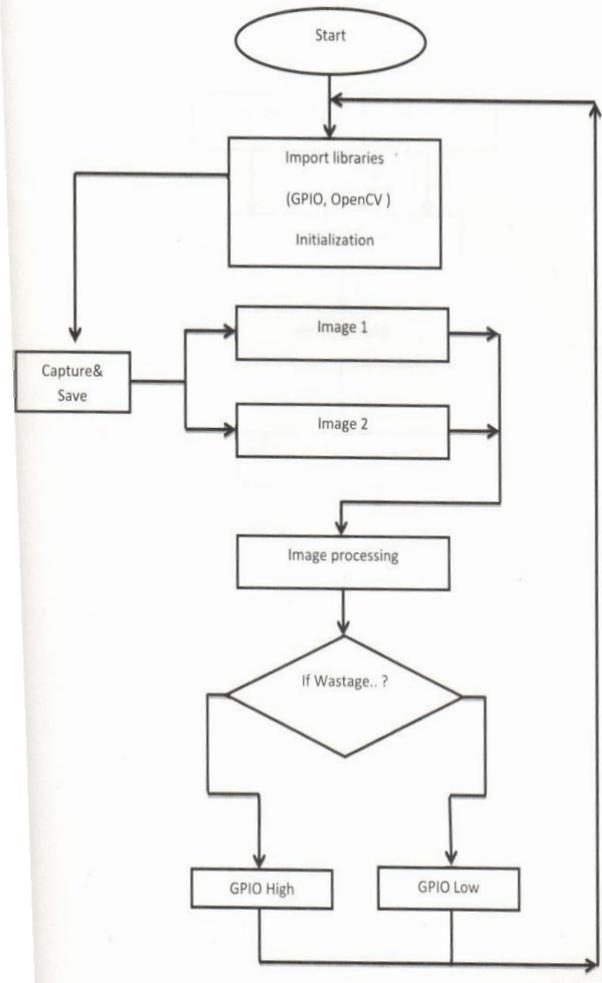
- Import the required modules and packages
- Get two images from camera within a short time interval
- Image processing: Compare the images
- Repeat the Step 2 and 3 for thrice
- If there is change in the images make GPIO high
- If there is no change repeat the step 2 and 3 for five more times
- If any change is detected make GPIO high
- If no any change, make GPIO Low.

**Explanation**

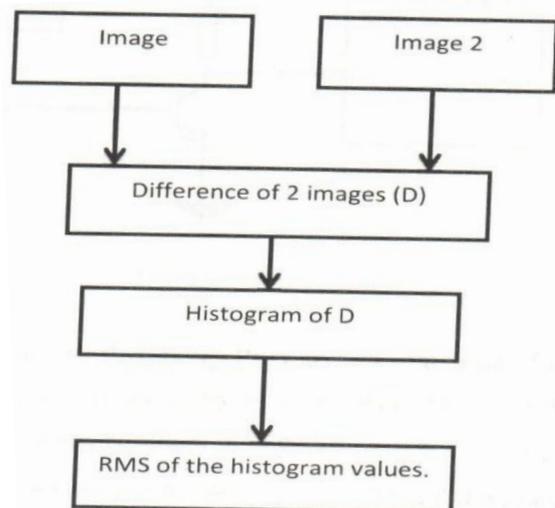
For image processing, PIL (python image library) and Open CV packages are used. Two images from camera are taken and their histogram value is calculated. If the difference value is within the threshold value set, it is assumed that there is no change in the image.

Procedure is repeated for more set of values to have confirmation on the processing result. Less no. of repetition for resuming signal and more no of repetitions are done for turning off signal.

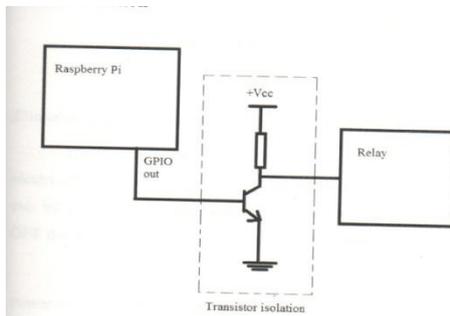
The flowchart of the system is shown below.



Flow chart of the image processing block



### Transistors Isolation



The control signal from the Raspberry Pi is given to the base of the transistors. This drives the transistors. The output to the relay is taken from the collector. Therefore the current required to drive the relay is supplied by Vcc, according to the control signal.

Therefore total isolation between Raspberry Pi GPIO and the relay is obtained.

### Conclusion

Wastage of electrical energy in the day to day life is a common problem and is considered unavoidable. Therefore saving of electrical power has become one of the primary needs.

The system is a prototype that uses image processing as a tool to provide an efficient method to prevent unnecessary usage of electricity. The technique of image processing is an efficient and innovative approach to the problem. The power consumption by the system is optimal and efficient compared to the functioning and application of the system.

The system is expected to achieve good interest from the market since on mass production, while the system is realized on chip, will prove cost efficient.

### Future Enhancement

Outputs of multiple cameras can be processed through a single Raspberry Pi processor using the concept of 'context switching' in the system program.

The proposed system can also be used for security purpose along with power saving. Slight modifications to the system, along with a few hardware interfaces enables us to achieve this.

The cameras monitors the room continuously for human presence. The extended security applications involved leaving the system ON even at night. An alarm interface can be used to indicate the presence of a thief along with turning the light ON; since the camera is 'night vision' enabled. Therefore the burglar alarm is realized using the system.

Also it is possible to send alert messages with a GSM module interface and emails to the user with an internet enabled system.

### References

- [www.Raspberrypi.org](http://www.Raspberrypi.org)
- David Braben on Raspberry Pi Edge 25 November 2011 Edge. 25 November
- [Elinux.org/R\\_Pi\\_begginers](http://Elinux.org/R_Pi_begginers)
- [Project.dragonner > raspberrypi > wiringpi](http://Project.dragonner > raspberrypi > wiringpi)
- [Effbot.org/imagingbook/index.htm](http://Effbot.org/imagingbook/index.htm)
- [www.pythonware.com/products/pil](http://www.pythonware.com/products/pil)
- [Learnpythonthehardway.org/book](http://Learnpythonthehardway.org/book)
- [Opencv.org](http://Opencv.org)