Abstract

In today's world, electricity plays a vital role and hence there's a necessity to find a way to save electricity in various places where it's being used in abundance. People do not take this seriously and do not put in efforts in order to save electricity. Usage of electricity has been continually increasing and in most of the places it's being wasted and hence we look forward to propose a way in which electricity can be saved at places where it's being wasted. We here are considering an example of a classroom where electricity is essential. Due to the busy schedule in today's life, it's often observed that people forget to switch off the lights and fans in a room which leads to an increment in the electricity bill. Over a number of years, many advancements have been made in order to automate the working of electrical appliances in a building. We propose a system in order to automate the electric appliances of a classroom in order to save electricity as much as possible. We look forward to make use of a combination of motion detection algorithms and face detection algorithms in order to automate the supply of electricity, i.e switch it off in case no one is present in the room and switch it on in case of the presence of even one person in the room.

***Key words*:** Face Detection, Motion Detection, Raspberry Pi, CCTV Camera.

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Chapter 1

Introduction

1.1 Problem Definition

In todays world, electricity plays a vital role and hence theres a necessity to find a way to save electricity in various places where its being used in abundance. The main problem arises when people forget to switch off the lights and due to that electricity is wasted in abundance in not only private places but also public places. So we propose a system which saves electricity in a classroom and can be therefore used at various other places as well. In this project with the help of a CCTV/laptop camera we detect motion and face in the room and determine presence of people in the room and based on that detection we switch on/off the lights in the classroom.

1.2 Motivation

1.2.1 Statistics:

Following are a few screen shots from an article which was posted in Education Times which tells us how much can be saved on an average in case we switch off the fan and standby devices:

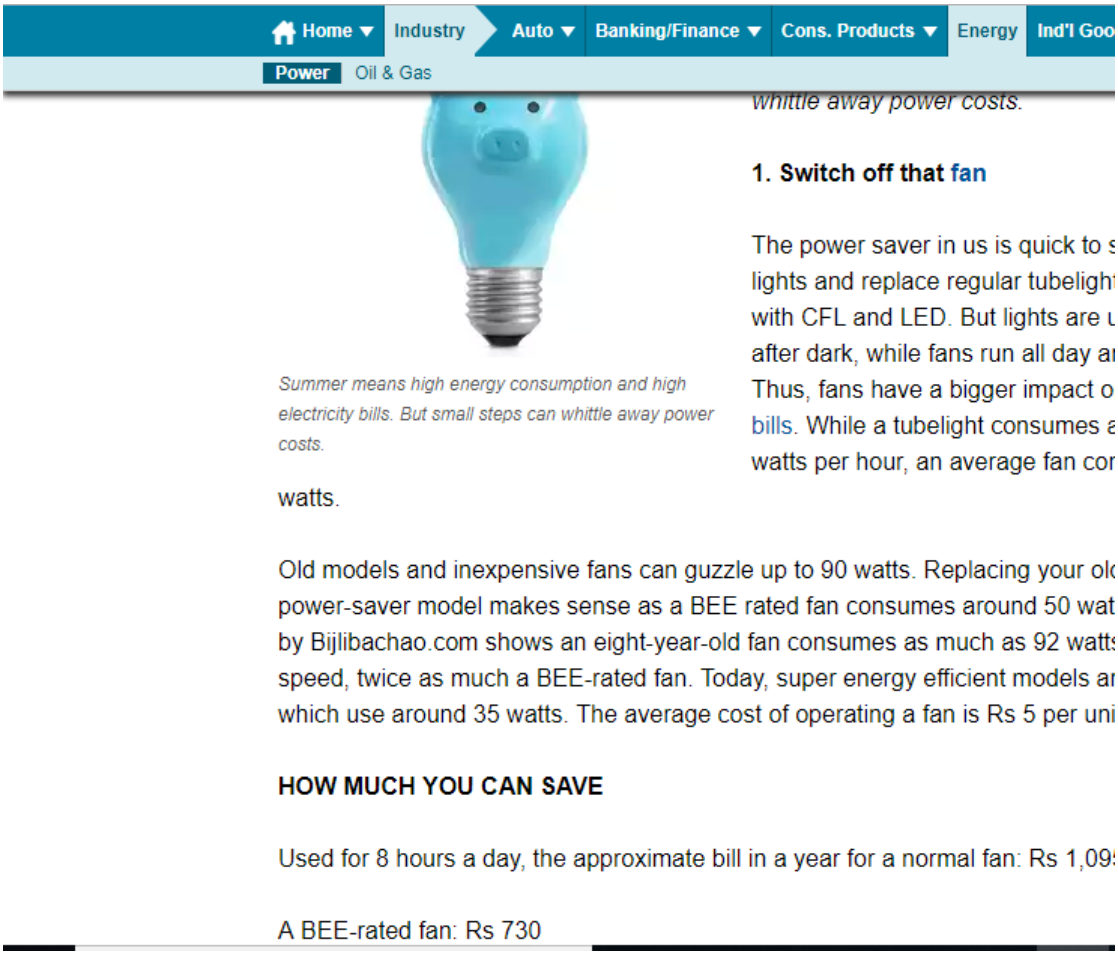
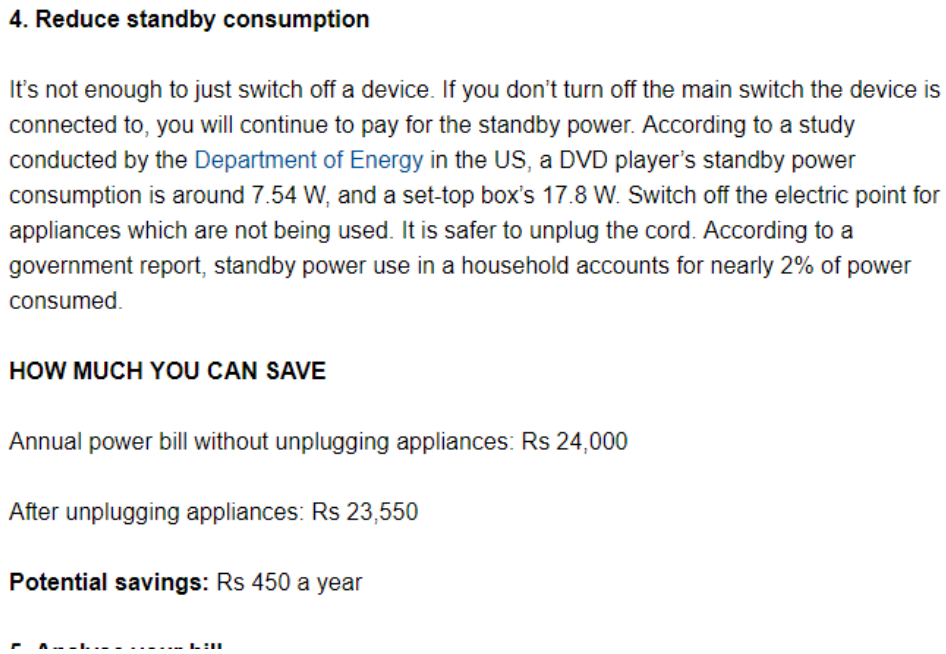


Figure 1.1: Education times article image with respect to the switching off the fan



4. Reduce standby consumption

It's not enough to just switch off a device. If you don't turn off the main switch the device is connected to, you will continue to pay for the standby power. According to a study conducted by the Department of Energy in the US, a DVD player's standby power consumption is around 7.54 W, and a set-top box's 17.8 W. Switch off the electric point for appliances which are not being used. It is safer to unplug the cord. According to a government report, standby power use in a household accounts for nearly 2% of power consumed.

HOW MUCH YOU CAN SAVE

Annual power bill without unplugging appliances: Rs 24,000

After unplugging appliances: Rs 23,550

Potential savings: Rs 450 a year

Figure 1.2: Education times article image with respect to the switching off the devices

1.2.2 Similar Technologies:

There are many Automation Technologies in the market,but in order to implement them we will be requiring a huge amount of money for various technologies and so is not affordable everywhere. It can be surely used in places like home security where in people are ready to spend a huge amount of money but not in public places.In this project we will not be requiring any additional hardware.We will require just a basic CCTV camera which are generally installed in most of the classrooms and Labs.

1.3 Scope

Functional Requirements:

1. The system should detect accurately whether or not a human is present in the room or not.

2. The system should take correct action, say if a human or more are present then the power supply should be given or else it shouldnt be given.

Non Functional Requirements:

1. The performance of the system should be efficient, i.e it shouldnt take a longer time than the normal system used, or else the main motive which is saving electricity wont be achieved very well.

2. The system should be as reliable as the normal power supply system is.

1.4 Salient Contribution

This system will help us save electricity at a lot of places in a very small cost, hence giving us an inexpensive way to save electricity. This would be a huge contribution as we can save an enormous amount of electricity, there by taking care of one of the urgent needs today.

Chapter 2

Literature Survey

2.1 Abstract

In todays world, electricity plays a vital role and hence theres a necessity to find a way to save electricity in various places where its being used in abundance. People do not take this seriously and do not put in efforts in order to save electricity. Usage of electricity has been continually increasing and in most of the places its being wasted and hence we look forward to propose a way in which electricity can be saved at places where its being wasted. We here are considering an example of a classroom where electricity is essential. Due to the busy schedule in todays life, its often observed that people forget to switch off the lights and fans in a room which leads to an increment in the electricity bill. Over a number of years, many advancements have been made in order to automate the working of electrical appliances in a building. We propose a system in order to automate the electric appliances of a classroom in order to save electricity as much as possible. We look forward to make use of a combination of motion detection algorithms and face detection algorithms in order to automate the supply of electricity, i.e switch it off in case no one is present in the room and switch it on in case of the presence of even one person in the room.

2.2 Introduction

Here have been a number of ways to automate the supply of electricity over the past years but none of them have been proven to work in a very efficient manner for public places like a classroom. One of the ways proposed is the automation of electricity using a door lock system. This system requires the authentication of a user in order to enter the room and as soon as the user is authenticate the electricity supply will be given, but this sort of an authentication is not possible in public places like a classroom and if thought of incorporating it in public places, the expenses required are exceptionally high. The

other suggested method is detection of the presence of people using infrared rays and accordingly automating the supply of electricity. But there are a lot of disadvantages of using this method, one of the major one is it being deleterious to humans and it also lacks in accuracy. Hence, we propose a system which is inexpensive and can be easily adapted by public places such as a classroom.

2.3 Proposed System

We propose a system in order to save electricity majorly in public places, our focus being on a classroom. Our project is simply an attempt to save electricity, and the system were proposing would have an edge over the others as it is inexpensive and can be used in any area, doesnt require any special equipment or authorization. Few methods have been applied previously in order to automate the electricity supply using Image Processing. Methods previously implemented in order to save electricity have utilised motion detection algorithms in order to decide whether or not the electricity supply must be given but this is not efficient enough, as a slight change in the orientation of the benches or so will also mark a change and hence electricity supply will be provided. Hence, our approach would constitute not only the motion detection algorithm but also the face detection algorithm in order to know whether or not a human is present inside, hence only in the presence of a human will the supply be provided, assuring our main motive, which is saving electricity. We will also be providing a threshold in motion detection algorithms, so that minute changes which are minimal, shall be ignored. The usage of motion detection and face detection algorithms individually will not be efficient enough. Hence well be trying to use the combination of both and increase the efficiency of this system. The proposed system is inexpensive and can easily be used in public places.

2.4 Procedures

This system basically consists of following important modules:

Camera Module:

Simple camera such as CCTV or laptop camera can be used to detect motion and face too.

Image Capturing:

This module is basically the procedure of capturing a real time video or an image of the room for motion or face detection. The image captured will be compared with the

reference image in motion detection algorithm.

Processing:

After the image is captured, the image is compared with reference image which is interfaced with Raspberry pi using background subtraction. The difference image is in RGB format which is then converted into grayscale image and then to Black and white image so that we can see blobs easily .Based on the percentage of Image matched, the relay circuit will be triggered.

Raspberry pi 3:

To Connect the computer with the hardware of relay circuit we need raspberry pi.

Relay Circuit:

It is used to control the power i.e. to on and off the lights(Here Led light in our project)

2.5 Implementation

Firstly, well be taking/clicking a reference image(thisll be the image of an empty classroom) of the target area which we would be comparing to the live images or frames. Live frames are then captured and the compared images are produced by background subtraction method. Then that image is converted into grayscale image and based on the amount of similarity between this live images and the reference image, we make a decision whether we the lights are to be switch on or not using relay circuit.This process will be using motion detection. This method is very sensitive to the reference image so we would take a threshold value or percent so that minor changes should not affect the process and the accuracy of the system increases. To overcome some drawbacks of motion detection we will use a face detection method and motion detection method as an alternative and will be comparing both the methods to focus on the advantages or the betterment in our implementation Also we intent to built one more algorithm which is the combination of both motion and face detection which had drawbacks when used individually.

Chapter 3

Software Project Management Plan

3.1 Introduction

3.1.1 Project Overview

In todays world, electricity plays a vital role and hence theres a necessity to find a way to save electricity in various places where its being used in abundance. People do not take this seriously and do not put in efforts in order to save electricity.Usage of electricity has been continually increasing and in most of the places its being wasted and hence we look forward to propose a way in which electricity can be saved at places where its being wasted. We here are considering an example of a classroom where electricity is essential. Due to the busy schedule in todays life, its often observed that people forget to switch off the lights and fans in a room which leads to an increment in the electricity bill. Over a number of years, many advancements have been made in order to automate the working of electrical appliances in a building. We propose a system in order to automate the electric appliances of a classroom in order to save electricity as much as possible. We look forward to make use of a combination of motion detection algorithms and face detection algorithms in order to automate the supply of electricity, i.e switch it off, in case no one is present in the room and switch it on in case of the presence of even one person in the room.

3.1.2 Project Deliverables

The deliverables will include tex, html, python, and text files for the purposes mentioned ahead.

1. A Software Requirements Specification Document describing the functional and global requirements of the system as well as representative models (use case model, the object model, etc).
Delivery date: 31th October 2018.

2. A Software Project Management Plan defining the processes necessary for the development and delivery of the system.
Delivery date: 31th September 2018.

3. A System Design Document describing the design goals, hardware/software platforms, data management, software control implementation and boundary conditions.
Delivery date: 2nd November 2018.

4. A Software Test Description (STD) that describes the test preparations, test cases, and test procedures to be used to perform testing of the software system.
Delivery Date: 31th October.

5. A Test Document describing the unit and system tests performed on the system before delivery along with expected and actual results.
Delivery date: 1st March 2019.

6. Source code for all subsystems of the system in Python and PHP.
Delivery date: 13th April 2019.

7. The system documentation describing the principles of operation for the user.
Delivery date: 15th March 2019.

3.2 Project Organization

3.2.1 Process Model

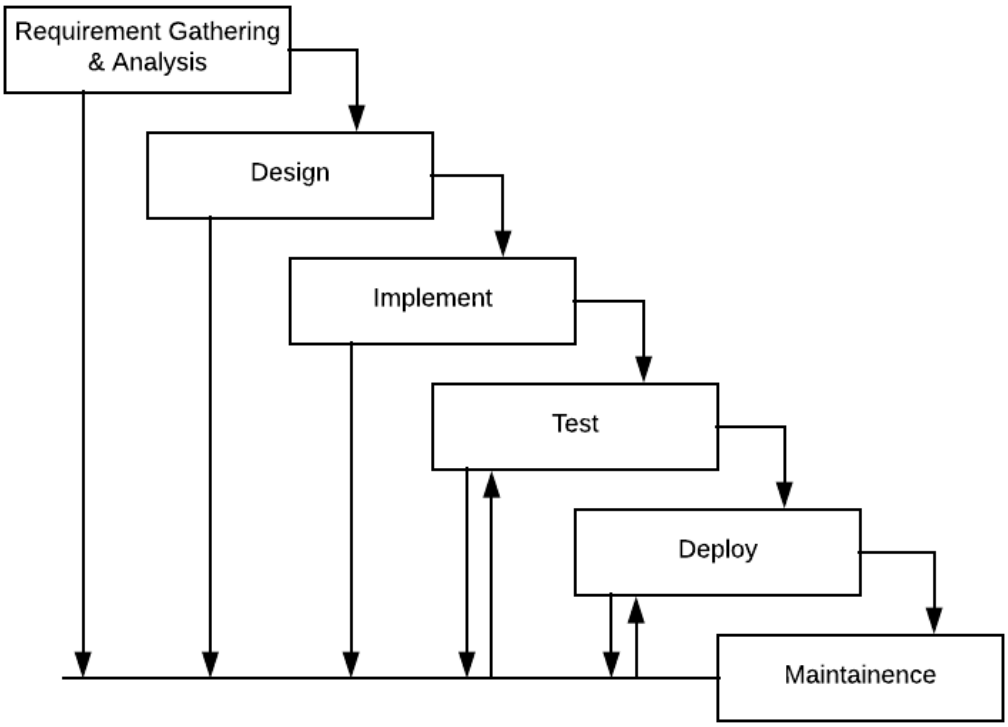


Figure 3.1: Waterfall Model

The Waterfall model is where the product is designed, implemented and tested serially.

This model is ideal for this project as:

- The requirements are fairly clear and the risks are quite low.
- The project development process can be divided into clearly independent tasks.
- Ample resources are available for support.

Table 3.1: Tools and techniques

Requirement	Latex	Survey
Design	LucidChart	UML2.0
Development	Python Shell,C++ turbo	Python and C++
Hardware	Camera,Rpi3 and Rc	NA

3.2.2 Roles and Responsibilities

1. Mr. Pranil Bhavsar Designer- understanding the requirements and designing a solution that will meet the requirements, creating models and diagrams.

2. Ms. Kavya Purushothaman - Developer 1 - write the code that performs the tasks and follow the agreed design and testing the modules.

3. Mr. Bhavya Shah - Developer 2 - write the code that performs the tasks and follow the agreed design and testing the modules.

3.2.3 Tools and Techniques

3.3 Project Management plan

3.3.1 Tasks

Task-1

Description:

SPMP-T1111 Get approval for project from panel members.

Deliverables and Milestones:

PowerPoint presentation explaining need and main features of the project.

Resources Needed:

Microsoft PowerPoint.

Dependencies and Constraints:

Approval seminar takes place according to the schedule and the presentation makes the important aspects of the project clear.

Risks and Contingencies:

The objectives of the project are not clear.

Task-2

Description:

SPMP-T2222 Prepare Software requirements specification (SRS) document.

Deliverables and Milestones:

Tex and pdf files.

Resources Needed:

LaTex editor software.

Dependencies and Constraints:

The objectives and requirements have been properly understood by the team members.

Risks and Contingencies:

There is ambiguity in the requirements.

Task-3

Description:

SPMP-T3333 Prepare Software Project Management Plan (SPMP) document

Deliverables and Milestones:

Tex and pdf files.

Resources Needed:

Latex editor software.

Dependencies and Constraints:

The tasks, deliverables and timeline of the project is clear to the team members.

Risks and Contingencies:

There is ambiguity in the division of tasks.

Task-4

Description:

SPMP-T4444 Prepare Software Design Description (SDD) document.

Deliverables and Milestones:

Tex and pdf files.

Resources Needed:

Latex editor software.

Dependencies and Constraints:

The designer is able to make a clear judgment about the tools and software to be used, and the modules that the project will consist of.

Risks and Contingencies:

The designer unsure about the type of tools to be used, that would match the requirements of the project.

Task-5

Description:

SPMP-T5555 Prepare Software Test Description (SDD) document.

Deliverables and Milestones:

Tex and pdf files.

Resources Needed:

Latex editor software.

Dependencies and Constraints:

The tester is able write test case that would efficiently cover all the functionalities of the project.

Risks and Contingencies:

The tester is unsure about how a certain module can be effectively tested.

Task-6

Description:

SPMP-T6666 Write code for module one .

Deliverables and Milestones:

Python files or C++ (code that will check the similarity of the two images in percentage.)

Resources Needed:

Turbo c++ Python editor- OpenCv v2.7

Dependencies and Constraints:

The developer has a clear plan based on the requirements mentioned in the SRS document.

Risks and Contingencies:

The functionality of the module is unclear to the developer.

Task-7

Description:

SPMP-T7777 Write code for Module two.

Deliverables and Milestones:

Python files(Code that will detect Motion and Face in a Video)

Resources Needed:

Turbo C++ Python editor-OpenCv v2.7

Dependencies and Constraints:

The developer has a clear plan based on the requirements mentioned in the srs document.

Risks and Contingencies:

The functionality of the module is unclear to the developer.

Task-8

Description:

SPMP-T8888 Checking the hardware interface

Deliverables and Milestones:

Establish seamless connection between Camera , Raspberry Pi and the relay circuit.

Resources Needed:

camera ,Raspberry Pi and Relay Circuit

Dependencies and Constraints:

The developer has in depth knowledge of working of the Hardware used.

Risks and Contingencies:

The module is yet not ready according to the schedule.

Task-9

Description:

SPMP-T9999 Building a Prototype for testing.

Deliverables and Milestones:

A basic working model

Resources Needed:

A computer with a WebCam,Raspberry Pi,Relay Circuit and a small set of toys for representing a classroom.

Dependencies and Constraints:

The System is ready for testing and the Software Test Description (STD) document has been prepared beforehand.

Table 3.2: Job Assignment

Team Member	**Task**
Mr. Pranil Bhavsar	Design solutions, prepare project models
Ms. Kavya Purushothaman	Programming and testing of first module
Mr. Bhavya Shah	programming and testing of second module

Risks and Contingencies:

The module is yet not ready according to the schedule.

3.3.2 Assignments

3.3.3 Timetable

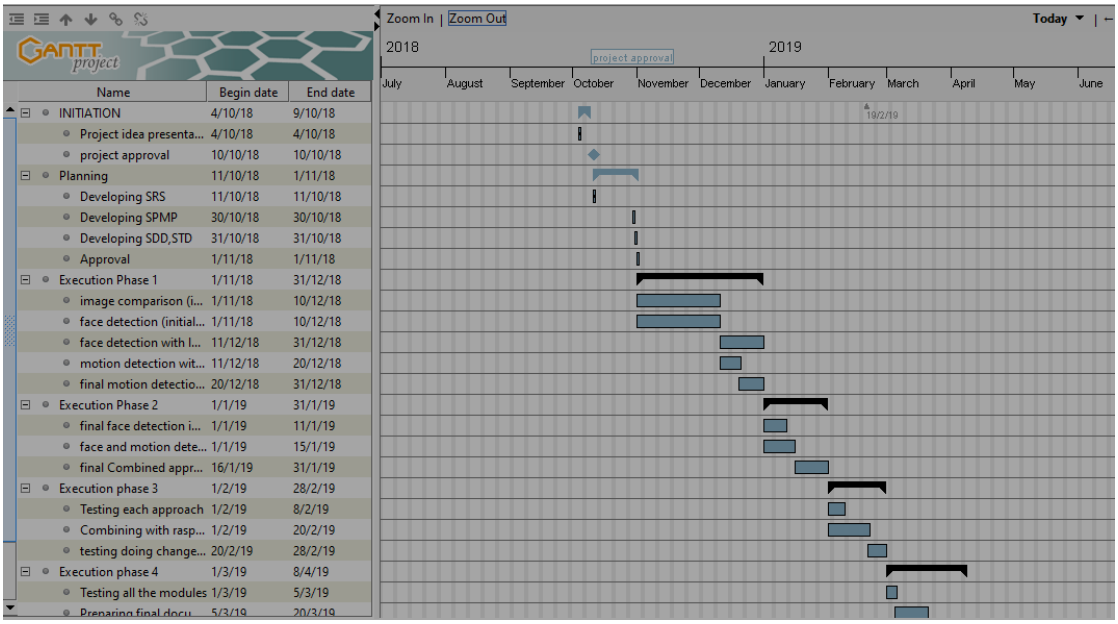


Figure 3.2: Gantt chart

Chapter 4

Software Requirement Specification

4.1 Introduction

4.1.1 Product Overview

In todays world, electricity plays a vital role and hence theres a necessity to find a way to save electricity in various places where its being used in abundance. People do not take this seriously and do not put in efforts in order to save electricity. Usage of electricity has been continually increasing and in most of the places its being wasted and hence we look forward to propose a way in which electricity can be saved at places where its being wasted. We here are considering an example of a classroom where electricity is essential. Due to the busy schedule in todays life, its often observed that people forget to switch off the lights and fans in a room which leads to an increment in the electricity bill. Over a number of years, many advancements have been made in order to automate the working of electrical appliances in a building. We propose a system in order to automate the electric appliances of a classroom in order to save electricity as much as possible. We look forward to make use of a combination of motion detection algorithms and face detection algorithms in order to automate the supply of electricity, i.e switch it off in case no one is present in the room and switch it on in case of the presence of even one person in the room.

4.2 Specific Requirements

4.2.1 External Interface Requirements

User Interfaces

The users of this system shall be anyone walking in or out of the classroom, the user need not perform any activity in order for this product to work efficiently. Hence, this

will surely be a user friendly product. In case any human enters the classroom, the power supply will be given and the lights shall switch on. Similarly, in case any human is not present in the classroom, the power supply will not be given and the lights will be switched off. This system should work efficiently, as in the lights should not switch off in case even one human is present otherwise the product will not work as planned.

Hardware Interfaces

1.Computer/Laptop

1. Computer/Laptop shall have keyboard input.
2. Computer/Laptop shall have roller ball mouse input. .
3. Computer/Laptop shall have minimally a 19-inch monitor.
4. Computer/Laptop shall have at minimum 128 MB of RAM.

2.CCTV Camera

1. System shall capture the video of the classroom on a continual basis and capture the frames every six minutes and accordingly the decision shall be made as to whether the power supply is to be given or not.

3.Raspberry Pi

1. Relay Circuit for the Raspberry Pi Power Supply Automation in the classroom: A small relay circuit is to be made, to switch an appliance ON/OFF.
2. The Raspberry Pi is used to continually run a program.

Software Interfaces

1. Computer/Laptop shall have the Turbo C++ installed.
2. Computer/Laptop shall be Internet capable with at least one Internet browser available.

Communication Protocols

1. Computer/Laptop shall be Internet capable.
2. Computer/Laptop shall have USB connection slots available.

4.2.2 Software Product Features:

The CCTV camera will be capturing an image of the empty classroom which shall be used as the reference image in order to compare any other image captured in the duration, and based on the matching percentage of these two images, the specific action shall take place, i.e whether the power supply is to given or the power supply is not to be given.

1. The system shall have one of the inputs as a picture with no humans present. In such a case the reference image and the image captured will be same and hence the power supply will not be given.

2. Another input might be a picture with one or more humans present. In this case the percent match between the reference image and the original image will be low and hence the power supply will be given.

3. There might also be a situation such that only because the orientation of the benches or the chairs present in the classroom is changed there might be a low than expected matching percentage, but in order to deal with this case, the system shall have a threshold such that with minute changed in the classroom like these, the power supply shall not be given, hence such a situation will be dealt of with care

4.3 Software System Attributes

4.3.1 Reliability

1. Time Between Failures: The system shall not fail on average more than once per month.

2. Time to Repair: The system shall not take on average longer than two days to repair after a system failure.

4.3.2 Availability

1. System Availability: The system shall be available 95 percent of the time unless previously announced for scheduled maintenance or backup. This system will be used in a public place, hence the availability is necessary, otherwise our motive shall be failed, which is to save electricity.

2. System Maintenance Notification: In the event that the system will undergo fore-known system maintenance, it shall be notified.

4.3.3 Security

All the development work performed shall be password protected and the passwords used shouldn't be common passwords and shall be stored in a hash format using an efficient hashing algorithm.

4.3.4 Maintainability

The programming code developed for the system shall conform to programming style standards and shall be commented thoroughly as determined by a code review team. The camera used shall also be taken care of, and checked whether is functioning properly.

4.3.5 Portability

This system can be used at any public place or a private place as well, however we would want to draw the focus for using this system in the public place as at private places such as office cabins and residential houses, authorization system for power supply automation might work just fine. They're expensive but affordable for some families as well as offices. The system proposed by us is inexpensive and can be used in any public place and is efficient enough.

4.3.6 Performance

The system shall not add more than two seconds to the time required to perform an action if the system is not connected. For example, if it takes 3 seconds to turn the light on normally, it will take no longer than 5 seconds for the light to turn on through the system. And also if it takes 3 seconds to turn off the light when there are no humans then it shall not take more than 5 seconds to turn off these lights with the help of this system.

Chapter 5

Software Design Description

5.1 Introduction

5.1.1 Design overview

We propose a system in order to save electricity majorly in public places, our focus being on a classroom. Our project is simply an attempt to save electricity, and the system were proposing would have an edge over the others as it is inexpensive and can be used in any area, and also doesnt require any special equipment or authorization. Few methods have been applied previously in order to automate the electricity supply using Image Processing. Methods previously implemented in order to save electricity have utilized motion detection algorithms in order to decide whether or not the electricity supply must be given but this is not efficient enough, as a slight change in the orientation of the benches or so will also mark a change and hence electricity supply will be provided. Hence, our approach would constitute not only the motion detection algorithm but also the face detection algorithm in order to know whether or not a human is present inside, hence only in the presence of a human will the supply be provided, assuring our main motive, which is saving electricity. We will also be providing a threshold in motion detection algorithms, so that minute changes which are minimal, shall be ignored. The usage of motion detection and face detection algorithms individually will not be efficient enough. Hence well be trying to use the combination of both and increase the efficiency of this system. The proposed system is inexpensive and can easily be used in public places.

Table 5.1: Requirement Traceability Matrix

Requirements	Camera	Raspberry-Pi	Relay Circuit	Led-lights
System should allow camera to take live feed of the video	**X**			
System should able to detect faces efficiently	**X**	**X**		
System should able to detect motion efficietly	**X**	**X**		
All the modules should be properly interfaced	**X**	**X**	**X**	**X**
System should able to cut off and on the power supply efficiently		**X**	**X**	**X**
System should able to detect face and motion simultaneosly	**X**	**X**	**X**	**X**
Detect to able to switch off the power supply if there is no motion or face detection	**X**	**X**	**X**	**X**

5.1.2 Requirements Traceability Matrix

5.2 System Architectural Design

5.2.1 3-Tier Architectural Style

N-tier and 3-tier are architectural deployment styles that describe the separation of functionality into segments in much the same way as the layered style, but with each segment being a tier that can be located on a physically separate computer. They evolved through the component-oriented approach, generally using platform specific methods for communication instead of a message-based approach.
N-tier application architecture is characterized by the functional decomposition of applications, service components, and their distributed deployment, providing improved scalability, availability, manageability, and resource utilization. Each tier is completely independent from all other tiers, except for those immediately above and below it. The nth tier only has to know how to handle a request from the n+1th tier, how to forward that request on to the n-1th tier (if there is one), and how to handle the results of the request. Communication between tiers is typically asynchronous in order to support better scalability.
There are three separate logical parts, each located on a separate physical server. Each part is responsible for specific functionality.
The business layer is deployed behind a firewall, which forces the deployment of the presentation layer on a separate tier in the perimeter network.The presentation layer is deployed on client machines and the business layer and data access layer are deployed on one or more server tiers.
The main benefits of the N-tier/3-tier architectural style are:
1 .Maintainability. Because each tier is independent of the other tiers, updates or changes can be carried out without affecting the application as a whole.
2. Scalability. Because tiers are based on the deployment of layers, scaling out an application is reasonably straightforward.
3. Flexibility. Because each tier can be managed or scaled independently, flexibility is increased.
4. Availability. The modular architecture of enabling systems can be exploited using easily scalable components, which increases availability.

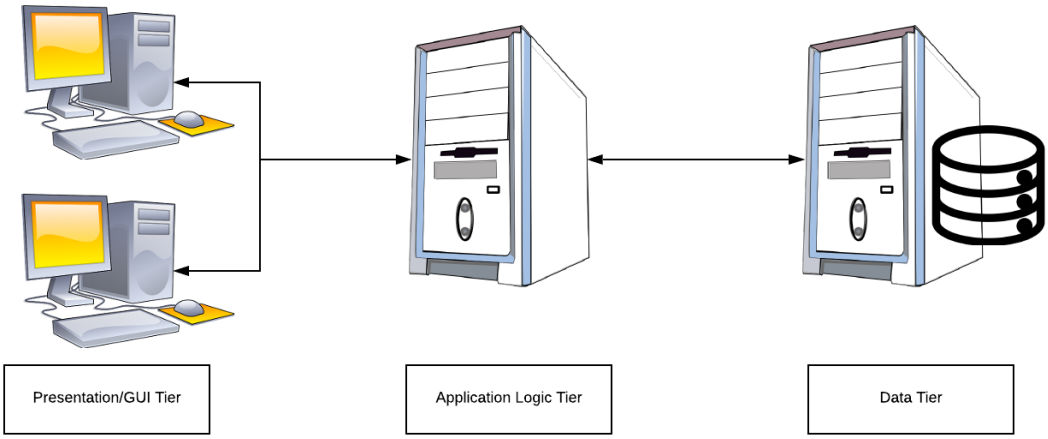


Figure 5.1: Three tier architecture

Problems:
Increased complexity/effort- In general is more difficult to build a 3-tier application compared to a 2-tier application because the points of communication are doubled.

5.2.2 Discussion of Alternative Designs- Client/server architectural style

The client/server architectural style describes distributed systems that involve a separate client and server system, and a connecting network. The simplest form of client/server system involves a server application that is accessed directly by multiple clients, referred to as a 2-Tier architectural style.
Historically, client/server architecture indicated a graphical desktop UI application that communicated with a database server containing much of the business logic in the form of stored procedures, or with a dedicated file server. More generally, however, the client/server architectural style describes the relationship between a client and one or more servers, where the client initiates one or more requests (perhaps using a graphical UI), waits for replies, and processes the replies on receipt. The server typically authorizes the user and then carries out the processing required to generate the result. The server may send responses using a range of protocols and data formats to communicate information to the client.
Problems:
1. Because all business logic was implemented on the Client application, the code enforcing this business logic was spread all across the network and duplicated on each workstation. Changes to business logic or business rules usually implied redeploying

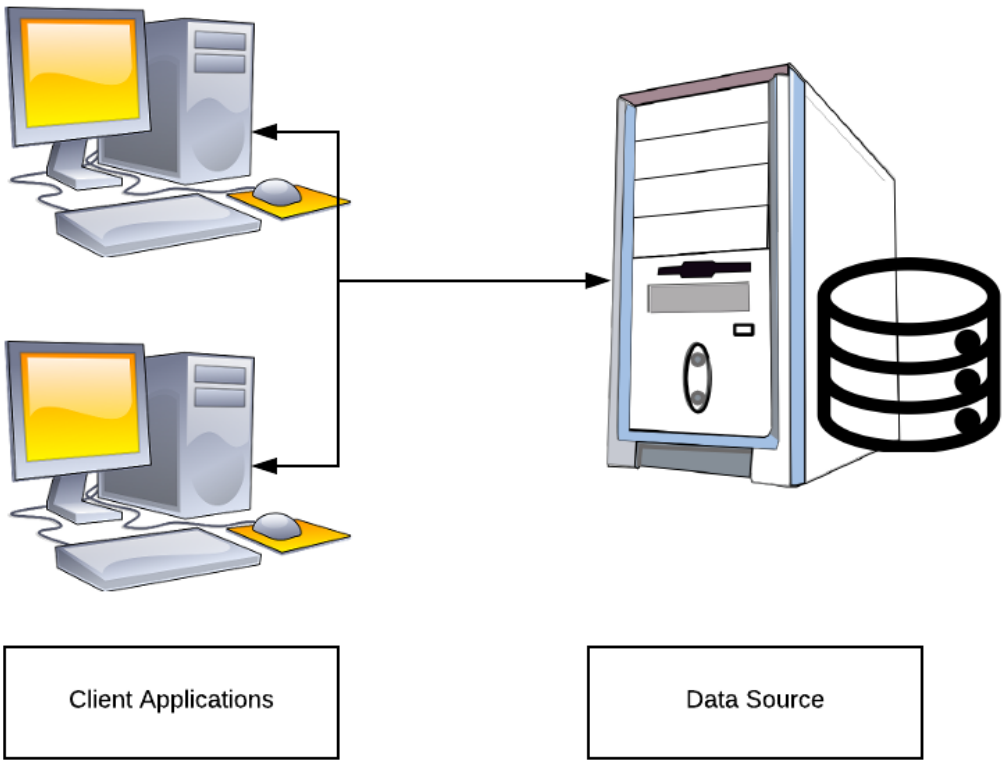


Figure 5.2: Two tier architecture

new client software to all users. A big administrative effort at best, and downtime for large parts of the workforce at worst.
2. It makes the system vulnerable to attacks, as client systems can be compromised. With client software deployed on hundreds of computers throughout the company or even outside the controlled network, it cannot be guaranteed that malicious users do not try and succeed at ”hacking” the client software or even write their own replacement software directly accessing the database and bypassing all enforcement of business rules altogether.
How chosen system architecture avoids these problems: Multi-tier architecture solves this problem by simply partitioning data access into more tiers than the traditional Client/Server model (which is also sometimes referred to as two tier), with each tier performing the tasks for which it is best suited and can be trusted.

5.2.3 System Interface Description

Description of user interface representations provided in section 4 of this document
As our project is completely hardware based, we won't be having any user interface in particular, but we have a number of components which have been explained in the same document further.

5.3 Detailed Description of Components

5.3.1 Component-1- Camera Component

Camera component will basically consist of a CCTV Cameras in order to record the video of whatever is going on in the classroom and accordingly taking the action. Basically this component will be important to get live video and find out whether students are present in the class or they're not.

Component-Validate.jsp

Responsibilities- Recording of whatever is going on the classroom at a given time and capturing frames in given intervals.

Constraints-This component will be active when required and not 24 hours and the lighting shall be taken into consideration too.

Composition-Since this is already a sub-component, all functional responsibilities are covered. In other words, there are no sub-components.

Interactions-This component interacts with the other components in order to automate the power supply.

5.3.2 Component-2- Raspberry Pi component

There is a need for us to Connect the computer with the hardware of relay circuit, this calls for an appropriate microcontroller, it is better to use Arduino or Raspberry Pi microcontroller as a utile platform.
Component-Associate.java

Responsibilities: The responsibility of this component is to provide a proper interface between the required components.

Constraints:Some libraries that are working fine on your laptop may give you some surprises when you try to use them on your RPI .

Composition-Since this is already a sub-component, all functional responsibilities are

covered. In other words, there are no sub-components.

Interactions-This component is basically used in order to provide an interface between the computer and relay circuit.

5.3.3 Component-3- Relay circuit component

It is used to control the power i.e. to on and off the lights(Here Led light in our project). i.e the decision made will be sent to the relay circuit in order to take the appropriate action.

5.4 Design Document

5.4.1 Level 0 DFD with description

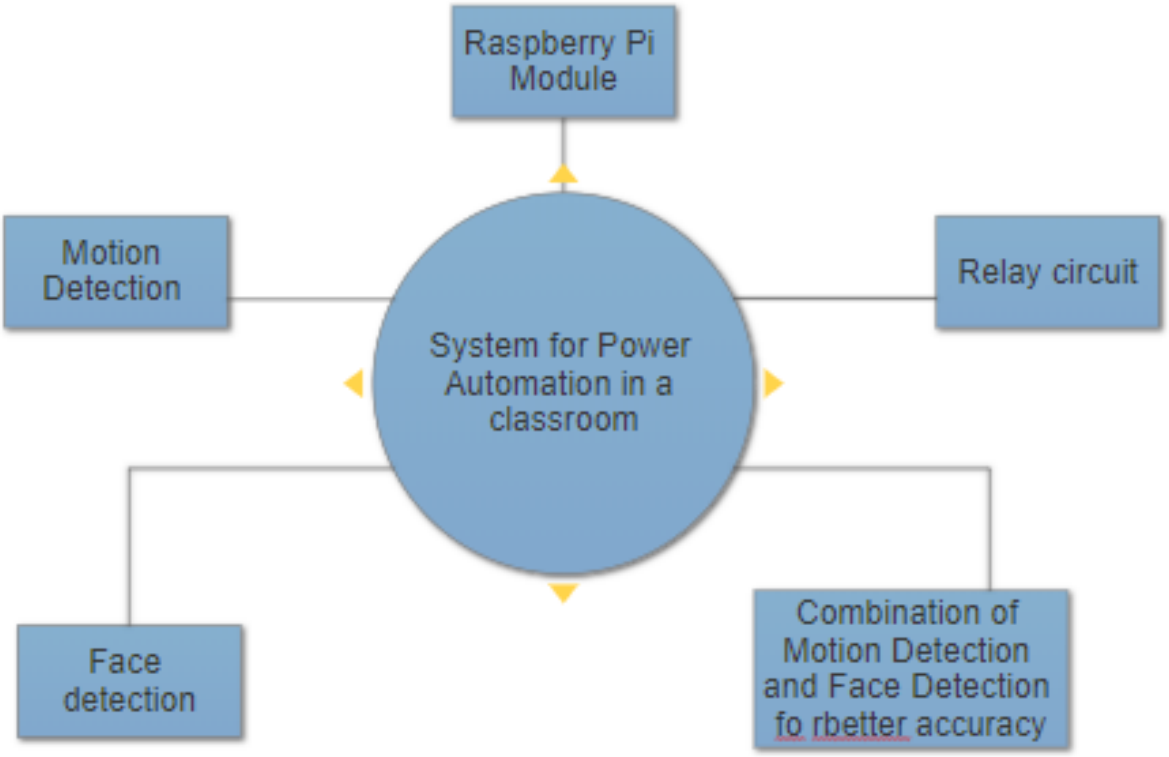


Figure 5.3: Level 0 DFD

5.4.2 DFD with description

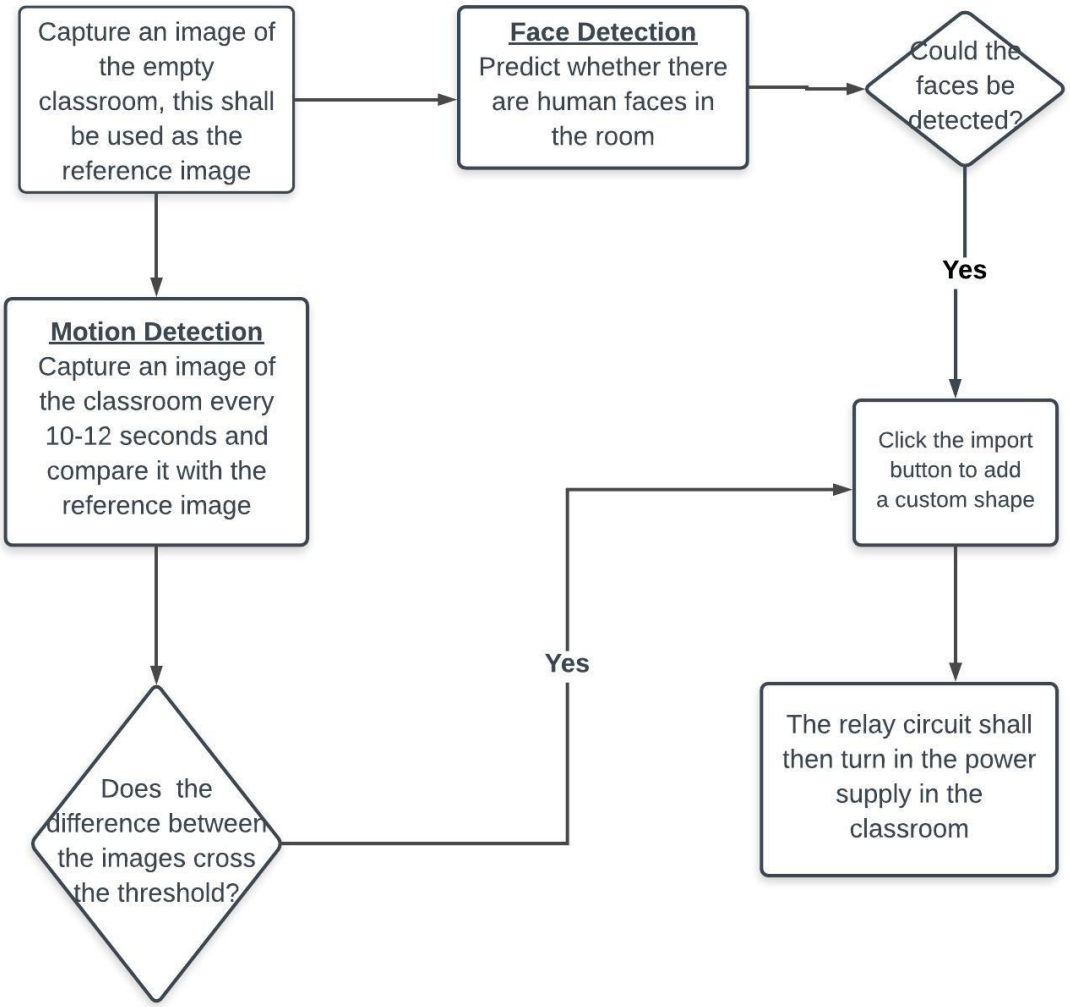


Figure 5.4: Level 1 DFD

Chapter 6

Implementation

6.1 Technologies used

The various technologies that we made use of are as follows:

1. Visual Studio: It is an integrated development environment from Microsoft. It is used to develop computer programs, as well as websites, web apps, web services and mobile apps. We used this platform to develop programs for various detections using C++ and OpenCV.

2. Raspberry Pi 3: The Raspberry Pi 3 Model B is a tiny credit card size computer. IT basically worked as a fully fledged computer and allowed us to integrate the breadboard circuit with our code.

3. Geany: Geany, an IDE for almost any language. The Geany Programmer's Editor is a small and lightweight Integrated Development Environment that supports coding in a ridiculous number of languages, including C, Java, PHP, HTML, Python, Perl and Pascal, and runs on everything including the Raspberry Pi.

6.2 Implementation

We've implemented a number of modules for thee completion of this project taken up by us. The details of the implementation is as follows:

1. Camera Module:
   Were utilising the Raspberry Pi Camera in order to capture images at specific intervals and take appropriate actions after detection. The efficiency of the system can be increased by using high quality cameras.

2. Detection of Human Presence in the room: This module is basically the procedure of capturing images for detection of motion.
   Face Detection:
   This is basically detection of the presence of human faces in the feed captured by web camera. Motion Detection:
   1. Well be having a reference image and it has to be compared continuously to the frames captured. The images are in RGB format which is then converted into grayscale image and then to Black and white image so that we can see blobs easily and then the comparison takes place.
   2. Well be capturing frames continuously at a time interval of 1000ms. Well then check the frames captures for a time span of 30 seconds and if motion in more than 15 frames is detected above a particular threshold, the power supply will be provided. If the result is otherwise, the power supply wont be given.

3. Raspberry pi:
   We will have to provide power supply in case motion is provided and we have made that possible with the help of Raspberry Pi 3. We show the result by showing the turning on of LED lights with the help of this module.

Motion Detection - I	Face Detection	Motion Detection - II
Even the slightest movement will have some amount of motion detection.	It detects the face of a person when it's within a particular distance.	The slightest amount of motion will be detected here as well.
Setting the right threshold is nearly impossible because a huge pile of mud will also create a huge amount of motion and turn on the power supply.	Only the front view of the face will be detected, so incase the student stands facing backwards, his presence won't be detected.	Setting the threshold is difficult in here too, but here we'll be taking in consideration multiple frames and not one and so getting appropriate results is highly likely.
Efficiency is really good and this works well.	Light here is a major issues as a particular amount of light is required and cannot be promised throughout the day.	Efficiency here is really good and it works well and as expected.
Only this algorithm cannot be used to detect the presence of a human.	High quality cameras will be required to detect the face to a wider range which in turn increases the overall budget	This algorithm can pretty efficiently detect the presence of a human as it is impossible for humans to stay perfectly still for long.

Figure 6.1: Algorithm Comparison

6.3 Algorithms

We've executed a number of algorithms in order to achieve the best results for our project. The algorithms we implemented are as follows:

1. Face detection using Haar Cascade Classifier
2. Motion Detection 1(Comparison of the continuously captured images with the referece image.
3. Motion Detection 2

Chapter 7

Software Test Document

7.1 Introduction

7.1.1 System Overview

In today's world, electricity plays a vital role and hence there's a necessity to find a way to save electricity in various places where its being used in abundance. People do not take this seriously and do not put in efforts in order to save electricity.Usage of electricity has been continually increasing and in most of the places its being wasted and hence we look forward to propose a way in which electricity can be saved at places where its being wasted. We here are considering an example of a classroom where electricity is essential. Due to the busy schedule in todays life, its often observed that people forget to switch off the lights and fans in a room which leads to an increment in the electricity bill. Over a number of years, many advancements have been made in order to automate the working of electrical appliances in a building. We propose a system in order to automate the electric appliances of a classroom in order to save electricity as much as possible. We look forward to make use of a combination of motion detection algorithms and face detection algorithms in order to automate the supply of electricity, i.e switch it off, in case no one is present in the room and switch it on in case of the presence of even one person in the room.
Module 1: Image Comparer: The reference image is compared with the image taken from the live feed.Similarity percentage is calculated using image processing.
Module 2: Face and Motion Detection: The Image processing algorithms are used to detect motion or Face in the Video.
Module 3: Hardware Component: Once the motion is detected the system connects with raspberry Pi and Relay circuit which controls the electrcity connection.

7.1.2 Test Approach

The system will require manual testing methods as it is an integration of both software and hardware. Each feature shall require manual testing one by one.

7.2 Test Plan

7.2.1 Features to be tested

Features to be tested are
The common features to be tested are

- Motion Detection
- Face Detection
- Accuracy of the Image comparing algorithm
- Proper switching of electricity by Rpi and Rc

Module 1:

- Image Comparing algorithm
- Tests for checking the efficiency of the image comparing algorithm.

Module 2:

- Tests for motion or face detection.

Module 3:

- Testing of hardware connection
- The systems connection with Raspberry Pi and Relay circuit is checked.

Module 4:

- presenting the Prototype.

7.3 Test Cases

7.3.1 Image Comparison

Purpose

To check how efficiently and accurately the algorithm works.

Inputs

1. Image 1
2. Image 2

Expected Outputs and Pass/Fail criteria

As inputs we will feed in various combination of similar and dissimilar images. 2 images whose similarity is already known will be entered in the system.If the similarity calculated will be approximately equal to the known similarity,the system will clear the test.

7.3.2 Motion And Face Detection

Purpose

To check if the system is able to detect any motion of face in the Video frames.

Inputs

1. A previously recorded video footage of the classroom.

Expected Outputs and Pass/Fail criteria

If the system is not able to detect a human face or any changes in the environment ,then it will be considered as a failure of the test.

7.3.3 Hardware Interface

Purpose

To check if the hardware functions as expected.

Inputs

1. A script will be executed which activates the Raspberry Pi

Expected Outputs and Pass/Fail criteria

On receiving the signal from the system,if the Raspberry Pi and Relay circuit switch on the electricity source then this test will be considered passed.

7.3.4 Test Cases

Table 7.1: Test Cases

Test ID	Test case	Input	Expected Output	Actual Output	Criteria
1.	Face Detection	Web camera feed	Detection of human faces in the room	Detection of human faces in the room	Pass
2.	Face Detection	Web camera feed	Detection of human faces in the range of 0-0.6 metre	Detection of human face	Pass
3.	Face Detection	Web camera feed	Detection of human faces above the range of 0.6 metre	Detection of human face	Fail
4.	Face Detection	Web camera feed	Detection of face in low light	Detection of human face	Pass
5.	Motion Detection	.png image	Conversion of RGB image to Grayscale Image	Image converted	Pass
6.	Motion Detection	.png image	Conversion of Grayscale image to Black and White image	Image Converted	Pass
7.	Motion Detection	Web camera feed	Capturing of frames every 20 seconds	Frame Captured every 1000ms	Pass
8.	Motion Detection	.png image	Image comparison between two black and white images (Reference image and frames captured later)	Frame Captured and comparision is done between two images	Pass

Table 7.2: Test Cases

Test ID	Test case	Input	Expected Output	Actual Output	Criteria
9.	Motion Detection	Web Camera feed	Capturing of images every 1000ms and analyzing the images captured every 30 ms later)	Frame captured and analysis is done of 30 images	Pass
10.	Motion Detection	.png image	Images are checked for motion and if over 15 images out of 30 cross the threshold power is supplied	Power is supplied if motion is present above a threshold for 15 images out of 30 images	Pass
11.	LED lights	Amount of motion	If the motion is above threshold the LED should turn ON in any case otherwise, the LED is OFF.	If the motion is above threshold the LED should turn ON in any case otherwise, the LED is OFF.	Pass

Chapter 8

Results and Discussion

The final algorithm we've utilized in order to get accurate results is the second motion detection algorithm, we've shown the results by an Led light which has been interfaced with the help of raspberry pi 3. Here are a few snapshots which will give you an idea about our execution:

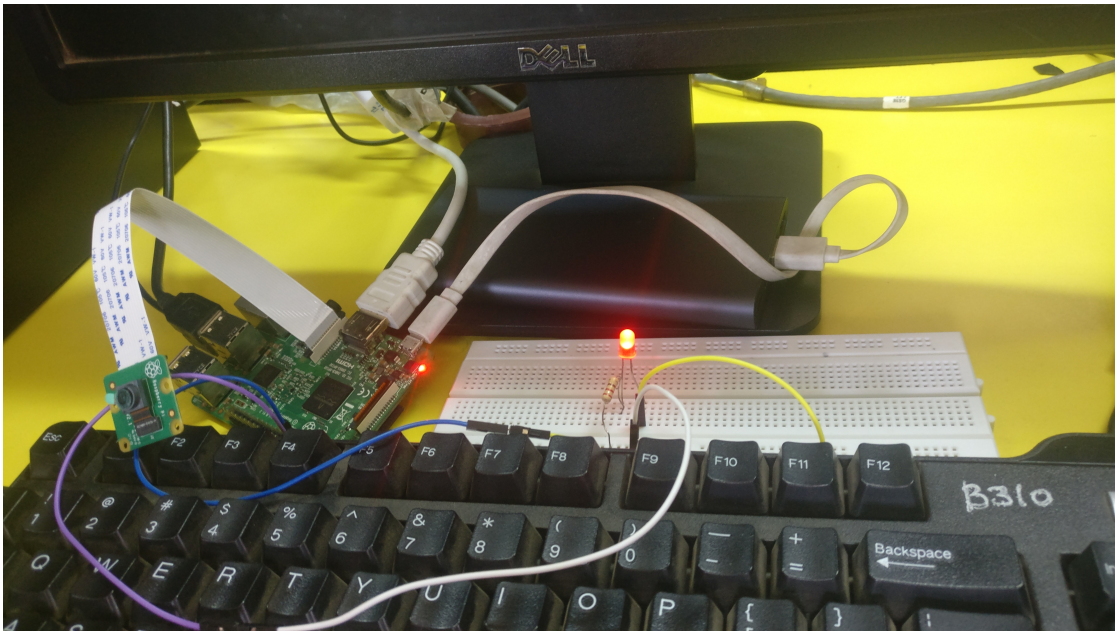


Figure 8.2: Output shown with the LED(Turned on)

Chapter 9

Conclusion and Scope for Future Work

9.1 Conclusion

Keeping in consideration, the amount of electricity being used in todays world, it is no doubt essential in order to come up with a system that is inexpensive as well as efficient enough, and can be used in various different places where the number of people is huge. This system will hence be useful in the long run and can be improvised in the future by the usage of human detection algorithms. The efficiency can also be increased by using high quality CCTV cameras.

9.2 Scope for Future Work

As of now, we've used a motion detection algorithm keeping in consideration a few condition that could occur. In future, more work on the face detection part could be done in order to make the algorithm efficient than ever. And if the classroom has a fixed number of people coming in and out with identities then face identification could also be done. That depends on what sort pf a place you'll be using this system at. This project can go a long way in future for sure.

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