Next Generation Smart Street Light Monitoring System using Cloud Computing

Abstract

Multifunctional and unique cloud-based smart street lighting control system with central management system (CMS) software. It is a perfect solution to manage large-scale outdoor lighting networks in order to control and monitor street lighting infrastructure while saving energy and reducing maintenance costs. Street Lighting CMS is just the first step of more sophisticated Smart City platform development process. Smart street lighting control system allows a city to schedule lights on or off easily and set dimming levels of lights so a city can provide the right level of lighting intelligently. Smart and intelligent street lighting control systems are designed primarily for energy efficiency. Cities using smart street lighting control system reduces their street lighting energy. Smart street lighting control systems accurately detect light failure and other maintenance problems in real time so malfunctions can be fixed quickly. This intelligent system provides the operator with web access for automatic or manual monitoring and control over illumination performance. Cities, public organizations, and industries around the world are joining the Smart City Initiative. One of the important components of Smart City is “Connected LIGHTING”. Cities, municipal corporations around the world are adopting the Connected lighting solution by replacing their old street light infrastructure with the Internet of Things based lighting which brings more efficiency in energy consumption and operational issues. Smart Street Lighting solution gives cities and municipalities the capability to remotely monitor & control the street lights in a much effective way. Our Smart Street Lighting Solution CCMS (Centralized Control and Monitoring System). CCMS is the product, designed indigenously by us for Street Lighting Projects in India to control lighting schedule, monitor energy consumption and faults. With CCMS, the street lights can be scheduled according to the time of the day or as per predefined lighting requirements. Our smart street lighting solution can be used for highways, urban/rural streets, sports arenas, buildings, parks, and industries to monitor and control the lighting system from anywhere.

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CHAPTER 1
INTRODUCTION

1.1. Overview

In recent years, the emergence of smart technologies has revolutionized urban infrastructure management, paving the way for more efficient, sustainable, and connected cities. Among these innovations, smart street lighting systems have garnered significant attention due to their potential to enhance energy efficiency, reduce operational costs, and improve overall urban livability. This chapter provides an overview of the Next Generation Smart Street Light Monitoring System, leveraging the power of cloud computing to optimize street light management and monitoring.

Traditional street lighting systems are characterized by their inefficiency and lack of intelligence. They often rely on manual inspection and maintenance routines, leading to unnecessary energy consumption and higher operational expenses. The advent of smart street lighting solutions has addressed these challenges by incorporating advanced technologies such as LED luminaires, motion sensors, and wireless connectivity. However, to fully realize the benefits of smart street lighting, an intelligent monitoring and management system is essential.

1.2. Problem Statement

In urban areas, traditional street lighting systems are being replaced with smart street lights to enhance energy efficiency, reduce operational costs, and improve overall sustainability. However, managing and monitoring these smart street lights efficiently poses significant challenges. Therefore, the problem statement revolves around developing a next-generation smart street light monitoring system utilizing cloud computing to address these challenges effectively.

Key Challenges:

- **Real-Time Monitoring**

  Current monitoring systems often lack real-time data collection and analysis capabilities, leading to delays in identifying issues such as malfunctions or energy wastage.

Data Management and Storage

Handling large volumes of data generated by numerous street lights requires robust data management and storage solutions to ensure scalability, reliability, and data integrity.

- **Remote Control and Management**

Efficient remote control and management of street lights are crucial for optimizing energy usage, scheduling maintenance tasks, and addressing operational issues promptly.

- **Energy Optimization**

Optimizing energy consumption of street lights based on factors like traffic density, weather conditions, and time of day is essential for reducing costs and minimizing environmental impact.

- **Fault Detection and Maintenance**

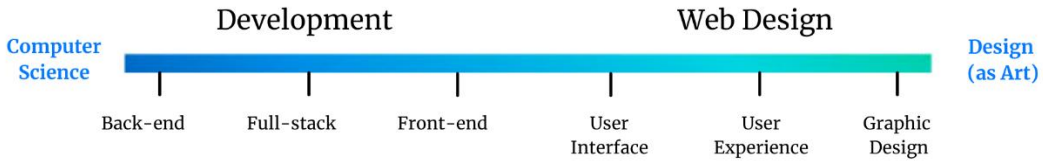
Early detection of faults and proactive maintenance scheduling are vital for ensuring uninterrupted operation of street lights and minimizing downtime.

- **Integration with Existing Infrastructure**

Seamless integration of the monitoring system with existing street lighting infrastructure and control mechanisms is necessary to facilitate easy deployment and adoption.

1.3. Web Design and Development

Web design and development is an umbrella term that describes the process of creating a website.



1.3.1. Web Design

Web design governs everything involved with the visual aesthetics and usability of a website color scheme, layout, information flow, and everything else related to the visual aspects of the UI/UX (user interface and user experience). Some common skills and tools that distinguish the web designer from the web developer are:

- Adobe Creative Suite (e.g., Photoshop, Illustrator) or other design software
- Graphic design
- UI design
- UX design
- Logo design
- Layout/format
- Placing call-to-action buttons
- Branding
- Wireframes, mock-ups, and storyboards
- Color palettes
- Typography

Web design is concerned with what the user actually sees on their computer screen or mobile device, and less so about the mechanisms beneath the surface that make it all work. Through the use of color, images, typography and layout, they bring a digital experience to life.

1.3.2. Web Development

Web development governs all the code that makes a website tick. It can be split into two categories—front-end and back-end. The front-end or client-side of an application is the code responsible for determining how the website will actually display the designs mocked up by a designer. The back-end or server-side of an application is responsible for managing data within the database and serving that data to the front-end to be displayed. As you may have guessed, it's the front-end developer's job that tends to share the most overlap with the web designer. Some common skills and tools traditionally viewed as unique to the front-end developer are listed below:

- HTML/CSS/JavaScript
- CSS preprocessors (i.e., LESS or Sass)
- Frameworks (i.e., AngularJS, ReactJS, Ember)
- Web template design
- Libraries (i.e., jQuery)
- Git and GitHub
- On-site search engine optimization (SEO)

Front-end web developers don't usually create mock-ups, select typography, or pick color palettes—these are usually provided by the designer. It's the developer's job to bring those mock-ups to life. That said, understanding what the designer wants requires some knowledge of best practices in UI/UX design so that the developer is able to choose the right technology to deliver the desired look and feel and experience in the final product.

Back-end developers handle the business logic and data management on the back-end of an application. They write the APIs and routing that allow data to flow between the front and back end of an application. Programming languages and tools unique to back-end developers are listed below:

- Server-side programming languages (e.g., PHP, Python, Java, C#)
- Server-side web development frameworks (e.g., Ruby on Rails, Symfony, .NET)
- Database management systems (e.g., MySQL, MongoDB, PostgreSQL)
- RESTful APIs
- Authentication and security (e.g., OAuth, PassportJS)
- Servers (e.g., Linux, Apache, Express)

Web developers who possess a working knowledge across the frontend and backend of a technology stack are called full-stack developers.

.CHAPTER 2
PROJECT DESCRIPTION

2.1. AIM AND OBJECTIVES

Aim

The aim of the Next Generation Smart Street Light Monitoring System using Cloud Computing is to revolutionize urban lighting infrastructure by leveraging cloud-based technologies to enhance monitoring, control, and management of street lighting networks. This system aims to optimize energy consumption, improve maintenance efficiency, enhance safety, and contribute to sustainable urban development.

Objectives

1. Energy Optimization: Implement intelligent algorithms and sensor technologies to dynamically adjust street light brightness based on real-time environmental conditions, traffic flow, and pedestrian activity. The objective is to minimize energy consumption while ensuring adequate lighting levels for safety and security.
2. Remote Monitoring and Control: Develop a cloud-based platform to remotely monitor and control street lights in real-time. Enable authorities to adjust lighting schedules, brightness levels, and detect faults or malfunctions promptly, improving operational efficiency and reducing maintenance costs.
3. Data Analytics for Insights: Utilize cloud computing capabilities to collect and analyze vast amounts of data generated by street light sensors and control systems. Extract actionable insights to optimize lighting strategies, predict maintenance needs, and support data-driven decision-making for urban planning.
4. Integration with Smart City Ecosystem: Integrate the street light monitoring system with other smart city initiatives and infrastructure, such as traffic management systems, environmental monitoring networks, and public safety platforms. Foster interoperability and collaboration to create a cohesive and sustainable urban environment.

5. Scalability and Flexibility: Design the system architecture to be scalable and adaptable to varying urban landscapes and evolving technological advancements. Ensure compatibility with different types of street lights, sensors, and communication protocols to facilitate seamless deployment and expansion.
6. Enhanced Security and Resilience: Implement robust security measures to protect data privacy, prevent unauthorized access, and mitigate cybersecurity risks. Ensure the reliability and resilience of the system infrastructure to withstand disruptions and maintain continuous operation under various scenarios.
7. Community Engagement and Awareness: Promote public awareness and engagement by providing transparency about the benefits of the smart street light monitoring system, including energy savings, environmental impact reduction, and improved urban livability. Encourage collaboration with local communities to gather feedback and enhance system usability and effectiveness.

2.2. SCOPE OF THE PROJECT

The purpose of developing a Next Generation Smart Street Light Monitoring System using Cloud Computing encompasses several key objectives aimed at enhancing efficiency, reducing energy consumption, improving maintenance, and promoting sustainability in urban environments.

1. Energy Efficiency:
    - To optimize energy usage by implementing intelligent control algorithms that adjust street light brightness based on real-time factors such as ambient light levels, traffic flow, and pedestrian activity.
    - To reduce energy wastage by remotely monitoring and managing street lights, ensuring they operate only when necessary.
2. Cost Savings:
    - To reduce electricity bills and maintenance costs associated with traditional street lighting systems through the implementation of energy-efficient technologies and predictive maintenance.

- To provide cost-effective solutions for municipalities and local governments by leveraging cloud computing for data storage, processing, and analysis.

3. Remote Monitoring and Management:
    - To enable remote monitoring and control of street lights, allowing administrators to monitor performance, detect faults, and schedule maintenance activities without the need for physical inspection.
    - To provide real-time insights into street light operations, allowing for proactive measures to address issues such as malfunctions, vandalism, or power outages.
4. Enhanced Visibility and Safety:
    - To improve visibility and safety in urban areas by ensuring that street lights are operational and appropriately configured based on environmental conditions and time of day.
    - To provide dynamic lighting solutions that adjust brightness levels in response to specific situations such as emergencies, accidents, or special events.
5. Data-driven Decision Making:
    - To collect and analyze data on street light usage, energy consumption, and environmental factors to inform urban planning and policy decisions.
    - To gain insights into traffic patterns, pedestrian movements, and crime rates through the integration of street light data with other urban infrastructure systems.
6. Scalability and Flexibility:
    - To design a scalable and flexible system architecture that can accommodate future expansion and integration with emerging technologies such as IoT devices, sensors, and smart city platforms.
    - To leverage cloud computing resources for elastic scalability, enabling the system to handle varying workloads and accommodate growth in the number of connected devices.
7. Environmental Sustainability:

- To promote environmental sustainability by reducing carbon emissions associated with street lighting through energy-efficient technologies and optimized operational strategies.
- To support initiatives for green cities and climate resilience by demonstrating the benefits of smart street lighting in reducing environmental impact and enhancing urban livability..

CHAPTER 3

SYSTEM ANALYSIS

3.1. EXISTING SYSTEM

Presently, the street lamps mainly adopt manual management or light perception control, which both have certain disadvantages: Long maintenance period. Both manual management and light perception control adopt manual patrol to check broken street lamps. Therefore, the maintenance period is too long, especially for the suburban street lamps, it can be even longer than few months. However, the danger increases just after the street lamps are broken, thus there could happen more traffic accidents, more robbery and stealing. Hard fine grain control. It is obvious the manual management is not smart enough, and it can be difficulty controlled in real time. Moreover, in order to simplify manual management, one switch is used to control many street lamps simultaneously. For the light perception control, the flexibility is almost limited. Remote and real time controls are not part of current management systems. High energy consumption. Current street lamps have only two states, off and on. Moreover, they cannot adjust their brightness. Therefore, they consume unnecessary energy. Sometimes, the street lamps can be dim to reduce energy consumption. Easy stolen. There is no effective method to prevent stealing of street lamps. There are a large number of street lamps so it is particularly impossible to control all of them all the time. In order to avoid stealing, the effective way is to make street lamps have self-supervise ability.

3.1.1. Disadvantages

- **Dependency on Internet Connectivity**

Cloud-based systems rely heavily on stable internet connections. Any disruption in connectivity could affect the real-time monitoring and control of street lights.

- **Data Privacy and Security Concerns**

Storing data in the cloud raises concerns about data privacy and security. Unauthorized access to sensitive information could compromise the integrity of the system and pose risks to user privacy.

- **Cost of Cloud Services**

Utilizing cloud computing services incurs ongoing costs, including subscription fees and data storage charges. For municipalities or organizations with limited budgets, these costs may become prohibitive over time.

- **Latency Issues**

Despite advancements in cloud technology, there may still be latency issues in data transmission between the street lights and the cloud servers. This delay could impact the responsiveness of the system in adjusting lighting levels or detecting faults.

- **Compatibility and Integration Challenges**

Integrating existing infrastructure with cloud-based monitoring systems may pose compatibility challenges. Upgrading or retrofitting street lights to support cloud connectivity could be costly and time-consuming.

- **Reliability and Redundancy**

Dependence on cloud services means relying on the cloud provider's infrastructure for reliability and redundancy. Any downtime or service interruptions on the provider's end could affect the functionality of the street light monitoring system.

- **Regulatory Compliance**

Compliance with data protection regulations, such as GDPR or HIPAA, may pose challenges for cloud-based street light monitoring systems, especially concerning data storage, processing, and sharing.

- **Vendor Lock-In**

Adopting a specific cloud platform may result in vendor lock-in, making it challenging to switch to alternative solutions in the future. This could limit flexibility and innovation in the long term.

- **Environmental Impact**

Cloud computing relies on large data centers that consume significant amounts of energy. This may contribute to environmental concerns, such as carbon emissions and energy consumption, especially if the data centers are not powered by renewable energy sources.

- Skills and Training Requirements

Implementing and managing cloud-based street light monitoring systems require specialized skills and training. Municipalities or organizations may need to invest in training their staff or hiring external expertise to effectively operate and maintain the system**.**

3.2. PROPOSED SYSTEM

In this paper, we propose a smart street lamp (SSL) based on fog computing for smarter cities to meet the above four abilities. The proposed SSL consists of three main parts: an intelligent sensing street lamp, which can adjust lamp brightness, an autonomous alarm which reports about abnormal behavior; an efficient network, which is used for real-time communication between managers and massive street lamps; and lastly, a flexible management platform, which is easy and highly automated. We verified the proposed SSL by its application in Xiasha District of Hangzhou, China, and very good results were obtained. The average maintenance period, which denotes the time period from the moment the street lamp is broken to the moment that is noticed by the server, is less than 20 minutes. Moreover, the proposed SSL can reduce human resources avoiding an inefficient manual patrol. The main contributions of the proposed SSL are: The hybrid network is adopted, the Narrow Band Internet of Things (NB-IoT) is used for real-time communication between server and massive street lamps, and the Internet is used for real-time communication between managers and server; A flexible management platform is implemented, and it notifies the managers about broken street lamps at real time and automatically dispatches the maintenance staff to repair broken street lamps. The states of all street lamps can be traced and adjusted in real time.

3.2.1. ADVANATGES

- **Scalability**

Cloud computing allows for seamless scalability, enabling the street light monitoring system to accommodate varying numbers of street lights and adapt to the growth of urban areas without the need for significant infrastructure changes.

- **Cost-Efficiency**

By leveraging cloud services, municipalities can avoid hefty upfront investments in hardware and maintenance costs associated with traditional on-premises solutions.

They can pay only for the resources they use, leading to cost savings and predictable operational expenses.

- **Remote Monitoring and Management**

Cloud-based solutions enable remote monitoring and management of street lights from anywhere with internet access. This capability allows for real-time monitoring of light status, energy consumption, and performance metrics, facilitating proactive maintenance and troubleshooting.

- **Data Analytics and Insights**

Cloud computing provides robust data analytics capabilities, allowing municipalities to analyze street light data collected from sensors. Insights gained from this data can inform decisions to optimize energy usage, improve lighting efficiency, and enhance overall urban planning and safety.

- **Integration with IoT Devices**

Cloud platforms seamlessly integrate with Internet of Things (IoT) devices, such as sensors and controllers installed in street lights. This integration enables data aggregation, analysis, and control of street light operations through a centralized cloud-based dashboard.

- **Enhanced Energy Efficiency**

By leveraging cloud-based analytics, municipalities can identify opportunities to optimize street light schedules, dimming levels, and energy consumption patterns. This optimization leads to significant energy savings and reduces carbon emissions, contributing to sustainability goals.

- **Real-Time Alerts and Notifications**

Cloud-based street light monitoring systems can generate real-time alerts and notifications for various events, such as malfunctioning lights, maintenance needs, or unusual energy consumption patterns. Prompt alerts enable rapid response and resolution of issues, ensuring continuous functionality of street lighting infrastructure.

- **Enhanced Security**

Cloud computing providers offer robust security measures and compliance certifications to protect data stored and transmitted through their platforms. Implementing a smart street light monitoring system on a secure cloud infrastructure helps safeguard sensitive information and prevent unauthorized access or cyberattacks.

- **Accessibility and Collaboration**

Cloud-based solutions enable easy access to street light data and analytics for multiple stakeholders, including city officials, maintenance crews, and utility providers. This accessibility fosters collaboration and data-driven decision-making to address urban challenges effectively.

- **Future-Proofing**

Cloud computing platforms regularly update and introduce new features, ensuring that the smart street light monitoring system remains up-to-date with the latest technologies and industry advancements. This future-proofing aspect allows municipalities to stay agile and adapt to evolving needs and requirements over time..

CHAPTER 4

SYSTEM SPECIFICATION

4.1. Hardware Requirements:

- Processors: Intel® Core™ i5 processor 4300M at 2.60 GHz or 2.59 GHz (1 socket, 2 cores, 2 threads per core), 8 GB of DRAM
- Disk space: 320 GB
- Operating systems: Windows® 10, macOS*, and Linux*

4.2. Software Requirements:

- Server Side : PHP
- Client Side : HTML, CSS, Bootstrap
- Back end : MySQL 5.
- Server : WampServer 2i
- BC DLL : pyBlock, pyenv, pyFHE

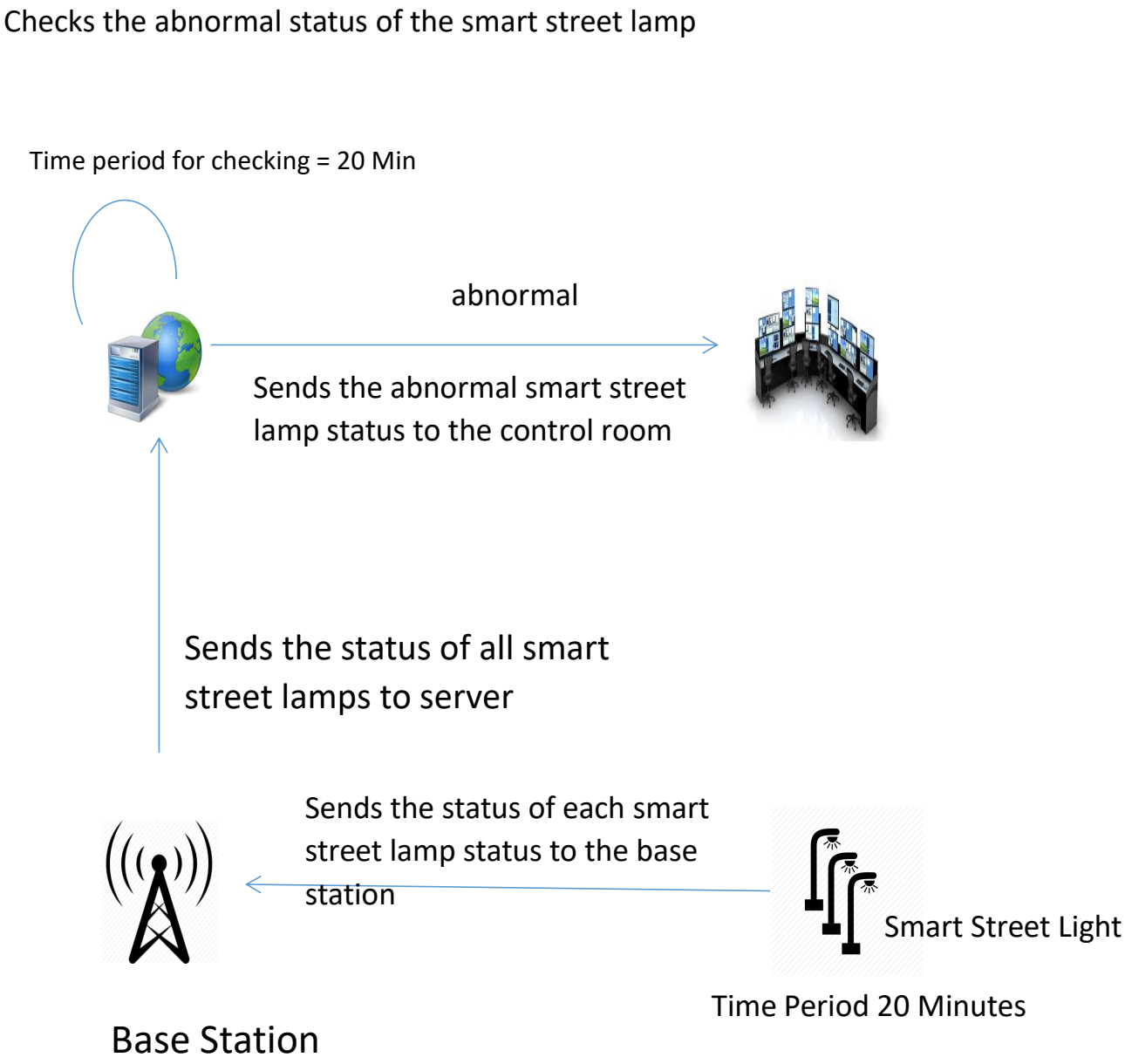
CHAPTER 5
SYSTEM DESIGN

5.1. SYSTEM ARCHITECTURE

A system architecture or systems architecture is the conceptual model that defines the structure, behavior, and more views of a system. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviors of the system. System architecture can comprise system components, the externally visible properties of those components, the relationships (e.g. the behavior) between them. It can provide a plan from which products can be procured, and systems developed, that will work together to implement the overall system. There have been efforts to formalize languages to describe system architecture; collectively these are called architecture description languages (ADLs).

Various organizations define systems architecture in different ways, including:

- An allocated arrangement of physical elements which provides the design solution for a consumer product or life-cycle process intended to satisfy the requirements of the functional architecture and the requirements baseline.
- Architecture comprises the most important, pervasive, top-level, strategic inventions, decisions, and their associated rationales about the overall structure (i.e., essential elements and their relationships) and associated characteristics and behavior.
- If documented, it may include information such as a detailed inventory of current hardware, software and networking capabilities; a description of long-range plans and priorities for future purchases, and a plan for upgrading and/or replacing dated equipment and software
- The composite of the design architectures for products and their life-cycle processes.

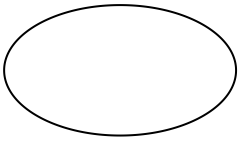


5.1. Fig 1: System Architecture Diagram

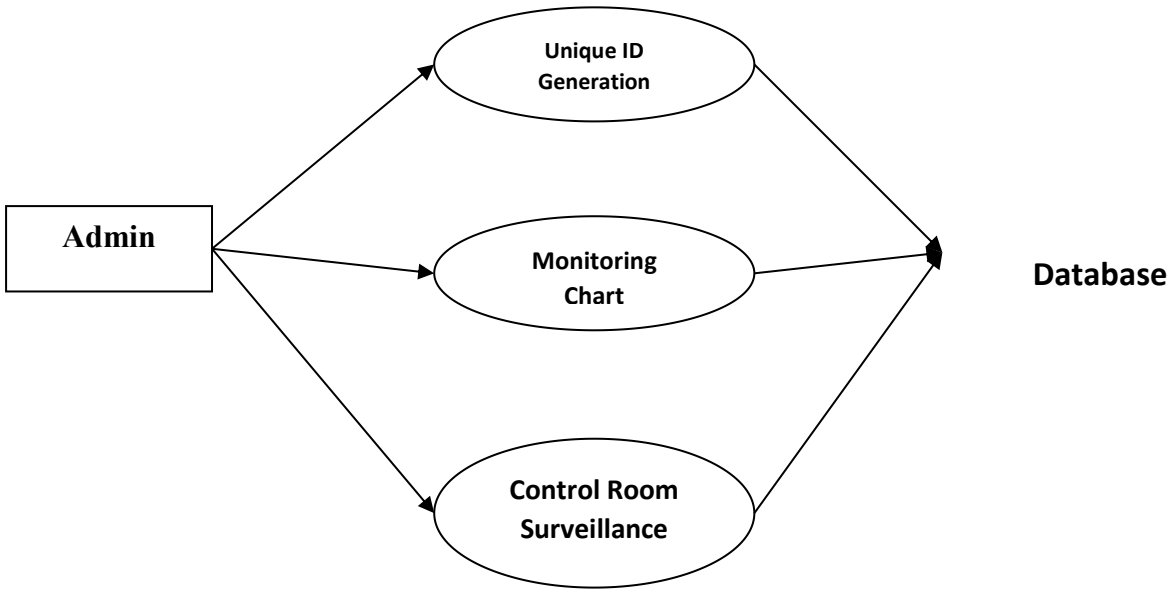
5.2. DATA FLOW DIAGRAM

A **data flow diagram** (**DFD**) is a graphical representation of the "flow" of data through an information system, modeling its process aspects. DFDs can also be used for the visualization of data processing (structured design)

5.1. Data flow Symbols:

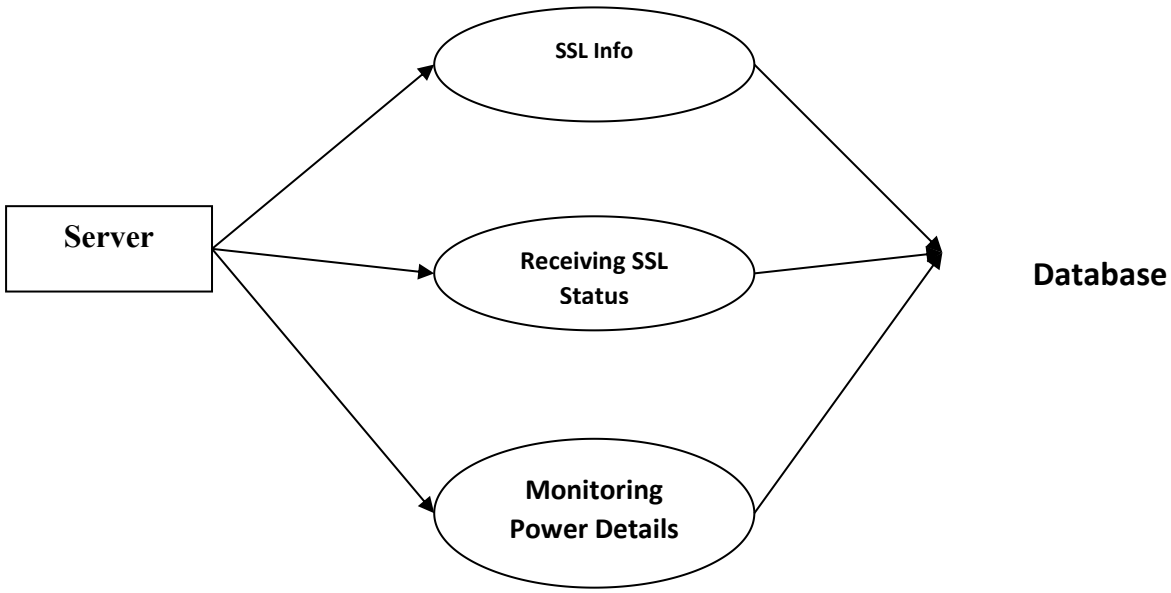
Symbol	Description
	An **entity**. A source of data or a destination for data.
	A **process** or task that is performed by the system.
	A **data store**, a place where data is held between processes.

5.2.1. LEVEL 0



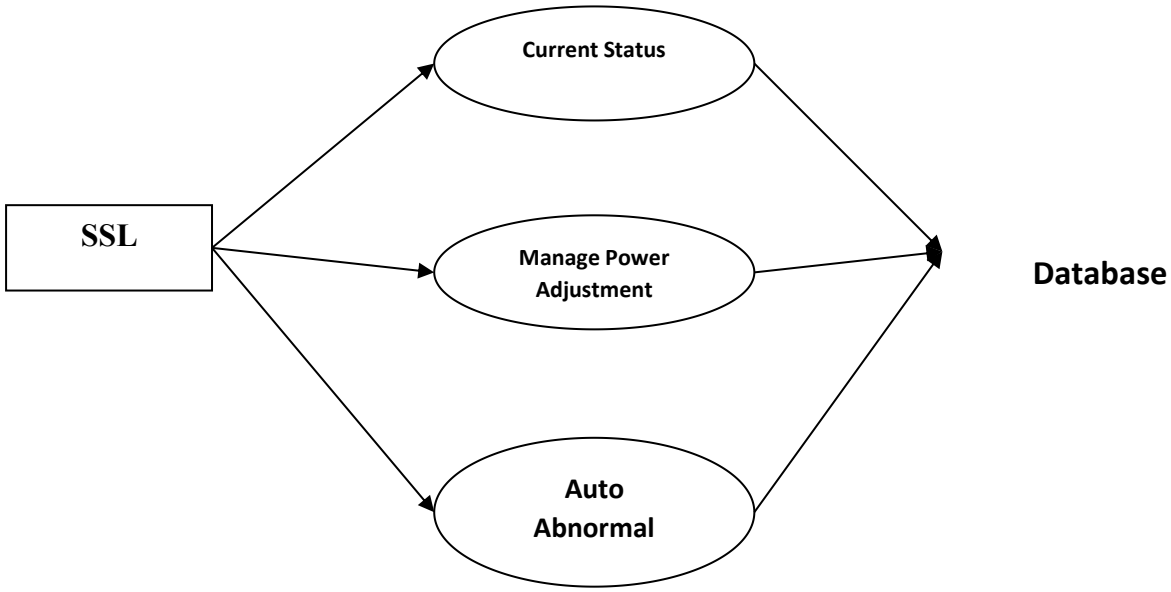
5.2. Fig 2: Data Flow Level Zero Diagram

5.2.2. LEVEL 1



5.3. Fig 3: Data Flow Level One Diagram

5.2.3. LEVEL 3



5.4. Fig 4: Data Flow Level Two Diagram

5.3. DATABASE DESIGN

5.3.1. Table Name : Street Detection

Field	Type	Null	Default
id	int(11)	Yes	NULL
city	varchar(30)	Yes	NULL
area	varchar(30)	Yes	NULL
street	varchar(30)	Yes	NULL
light	varchar(10)	Yes	NULL
level	int(11)	Yes	NULL
status	int(11)	Yes	NULL
not_work	int(11)	Yes	NULL
abnormal	int(11)	Yes	NULL
alert_st	int(11)	Yes	NULL
dtime	timestamp	Yes	CURRENT_TIMESTAMP

5.3.2. Table Name : Street Login

Field	Type	Null	Default
username	varchar(30)	Yes	NULL
password	varchar(30)	Yes	NULL
light1	int(11)	Yes	NULL
light2	int(11)	Yes	NULL
level	int(11)	Yes	NULL

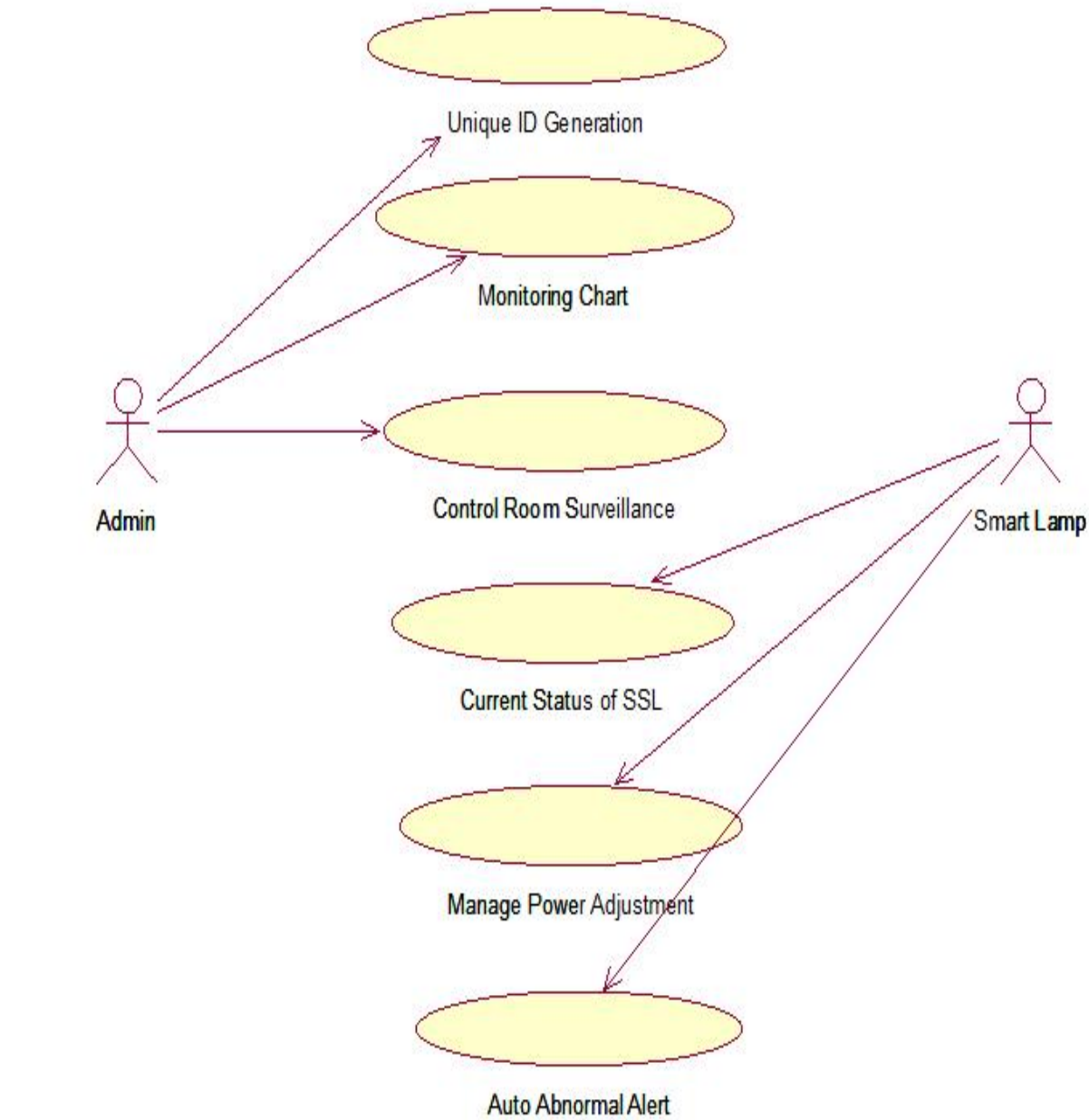
message	varchar(30)	Yes	NULL
light_mode	int(11)	Yes	NULL

5.3.3. Table Name : Usage Table

Field	**Type**	**Null**	**Default**
id	int(11)	Yes	NULL
light	varchar(10)	Yes	NULL
seconds	int(11)	Yes	NULL
power_usage	double	Yes	NULL
month	int(11)	Yes	NULL
year	int(11)	Yes	NULL

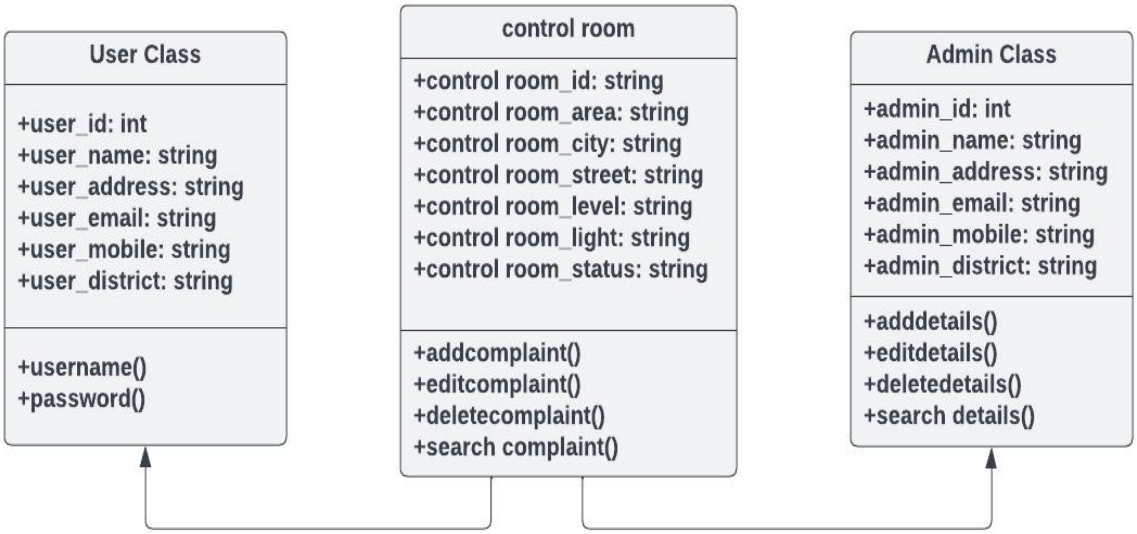
5.4. UML Diagrams

5.4.1. Use Case



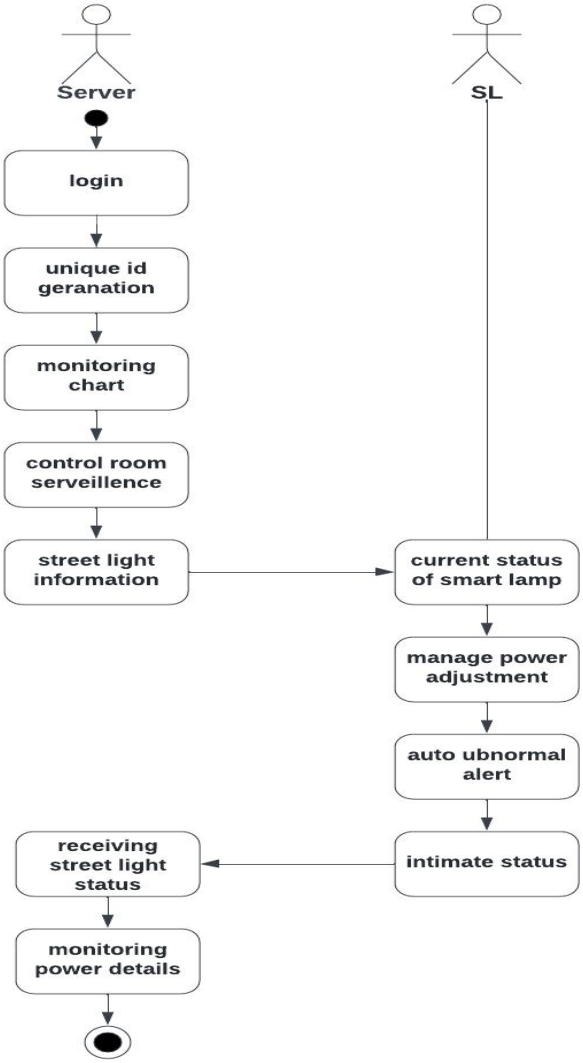
5.5. Fig 5: Use Case Diagram

5.4.2.Class Diagram



5.6. Fig 6: Use Case Diagram

5.4.3. Activity diagram



5.7. Fig 7: Activity Diagram

CHAPTER 6
SOFTWARE DESCRIPTION

6.1. PHP

Hypertext Preprocessor (or simply PHP) is a general-purpose programming language originally designed for web development. It was originally created by Rasmus Lerdorf in 1994 the PHP reference implementation is now produced by The PHP Group. PHP originally stood for Personal Home Page, but it now stands for the recursive initialism PHP: Hypertext Preprocessor.

PHP code may be executed with a command line interface (CLI), embedded into HTML code, or used in combination with various web template systems, web content management systems, and web frameworks. PHP code is usually processed by a PHP interpreter implemented as a module in a web server or as a Common Gateway Interface (CGI) executable. The web server outputs the results of the interpreted and executed PHP code, which may be any type of data, such as generated HTML code or binary image data. PHP can be used for many programming tasks outside of the web context, such as standalone graphical applications and robotic drone control.

The standard PHP interpreter, powered by the Zend Engine, is free software released under the PHP License. PHP has been widely ported and can be deployed on most web servers on almost every operating system and platform, free of charge.

The PHP language evolved without a written formal specification or standard until 2014, with the original implementation acting as the de facto standard which other implementations aimed to follow. Since 2014, work has gone on to create a formal PHP specification.

PHP - Overview

PHP is a recursive acronym for "PHP: Hypertext Preprocessor". PHP is a server side scripting language that is embedded in HTML. It is used to manage dynamic content, databases, session tracking, even build entire e-commerce sites. The PHP Hypertext Preprocessor (PHP) is a programming language that allows web developers to create dynamic content that interacts with databases. PHP is basically

used for developing web based software applications. This tutorial helps you to build your base with PHP.

PHP Objects

Basic object-oriented programming functionality was added in PHP 3 and improved in PHP 4. This allowed for PHP to gain further abstraction, making creative tasks easier for programmers using the language. Object handling was completely rewritten for PHP 5, expanding the feature set and enhancing performance. In previous versions of PHP, objects were handled like value types. The drawback of this method was that code had to make heavy use of PHP's "reference" variables if it wanted to modify an object it was passed rather than creating a copy of it. In the new approach, objects are referenced by handle, and not by value.

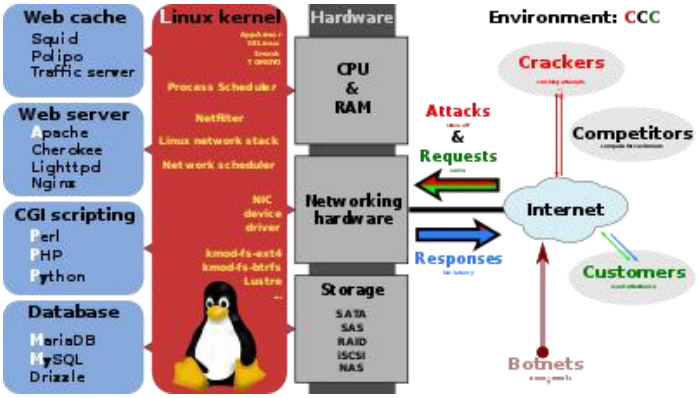
Implementations

The only complete PHP implementation is the original, known simply as PHP. It is the most widely used and is powered by the Zend Engine. To disambiguate it from other implementations, it is sometimes unofficially called "Zend PHP". The Zend Engine compiles PHP source code on-the-fly into an internal format that it can execute, thus it works as an interpreter. It is also the "reference implementation" of PHP, as PHP has no formal specification, and so the semantics of Zend PHP define the semantics of PHP. Due to the complex and nuanced semantics of PHP, defined by how Zend works, it is difficult for competing implementations to offer complete compatibility.

Licensing

PHP is free software released under the PHP License, which stipulates that: Products derived from this software may not be called "PHP", nor may "PHP" appear in their name, without prior written permission from group@php.net. You may indicate that your software works in conjunction with PHP by saying "Foo for PHP" instead of calling it "PHP Foo" or "phpfoo". This restriction on use of "PHP" makes the PHP License incompatible with the General Public License (GPL), while the Zend License is incompatible due to an advertising clause similar to that of the original BSD license.

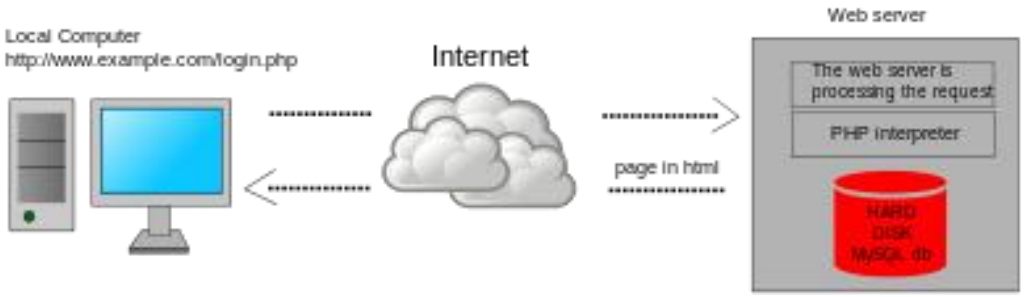
Use



6.1. Fig 8: License Diagram

A broad overview of the LAMP software bundle, displayed here together with Squid

PHP is a general-purpose scripting language that is especially suited to server-side web development, in which case PHP generally runs on a web server. Any PHP code in a requested file is executed by the PHP runtime, usually to create dynamic web page content or dynamic images used on websites or elsewhere. It can also be used for command-line scripting and client-side graphical user interface (GUI) applications. PHP can be deployed on most web servers, many operating systems and platforms, and can be used with many relational database management systems (RDBMS). Most web hosting providers support PHP for use by their clients. It is available free of charge, and the PHP Group provides the complete source code for users to build, customize and extend for their own use.



6.2. Fig 9: Networking Diagram

Dynamic web page: example of server-side scripting (PHP and MySQL)

PHP acts primarily as a filter taking input from a file or stream containing text and/or PHP instructions and outputting another stream of data. Most commonly the output will be HTML, although it could be JSON, XML or binary data such as image or audio formats. Since PHP 4, the PHP parser compiles input to produce bytecode for processing by the Zend Engine, giving improved performance over its interpreter predecessor.

Originally designed to create dynamic web pages, PHP now focuses mainly on server-side scripting, and it is similar to other server-side scripting languages that provide dynamic content from a web server to a client, such as Microsoft's ASP.NET, Sun Microsystems' Java Server Pages, and mod_perl. PHP has also attracted the development of many software frameworks that provide building blocks and a design structure to promote rapid application development (RAD). Some of these include PRADO, CakePHP, Symfony, CodeIgniter, Laravel, Yii Framework, Phalcon and Zend Framework, offering features similar to other web frameworks.

The LAMP architecture has become popular in the web industry as a way of deploying web applications. PHP is commonly used as the P in this bundle alongside Linux, Apache and MySQL, although the P may also refer to Python, Perl, or some mix of the three. Similar packages, WAMP and MAMP, are also available for Windows and macOS, with the first letter standing for the respective operating system. Although both PHP and Apache are provided as part of the macOS base install, users of these packages seek a simpler installation mechanism that can be more easily kept up to date.

As of April 2007, over 20 million Internet domains had web services hosted on servers with PHP installed and mod_php was recorded as the most popular Apache HTTP Server module. As of August 2019, PHP was used as the server-side programming language on 79.1% of websites, down from 83.5% previously, where the language could be determined. Web content management systems written in PHP include MediaWiki, Joomla, eZ Publish, eZ Platform, SilverStripe, WordPress, Drupal, and Moodle. Websites written in PHP, in back-end and/or user-facing portion, include Facebook, Digg, Tumblr, Dailymotion, and Slack.

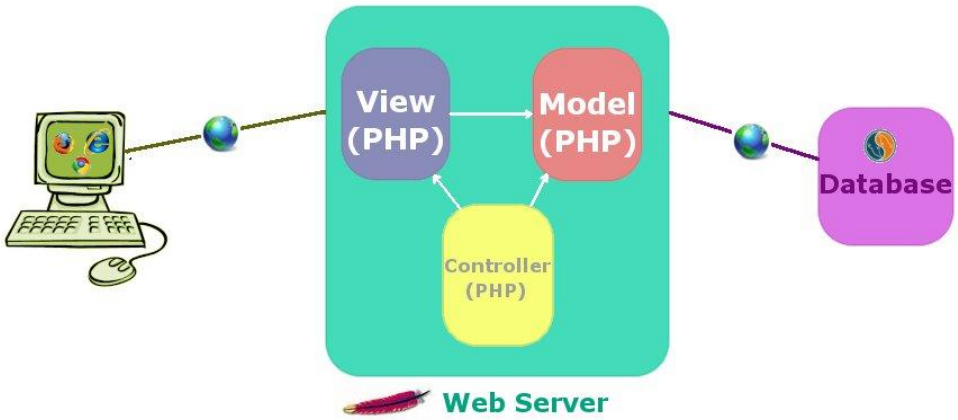
For specific and more advanced usage scenarios, PHP offers a well-defined and documented way for writing custom extensions in C or C++. Besides extending the language itself in form of additional libraries, extensions are providing a way for improving execution speed where it is critical and there is room for improvements by using a true compiled language. PHP also offers well defined ways for embedding itself into other software projects. That way PHP can be easily used as an internal scripting language for another project, also providing tight interfacing with the project's specific internal data structures. PHP received mixed reviews due to lacking support for multithreading at the core language level, though using threads is made possible by the "pthreads" PECL extension. As of January 2013, PHP was used in more than 240 million websites (39% of those sampled) and was installed on 2.1 million web servers. A command line interface, php-cli, and two ActiveX Windows Script Host scripting engines for PHP have been produced. As of 2019, PHP 5 is most used on the web; which was last updated with security updates in January 2019, with PHP 5.6.40.

Why to Learn PHP?

PHP started out as a small open source project that evolved as more and more people found out how useful it was. RasmusLerdorf unleashed the first version of PHP way back in 1994.

PHP is a MUST for students and working professionals to become a great Software Engineer specially when they are working in Web Development Domain. I will list down some of the key advantages of learning PHP:

- PHP is a recursive acronym for "PHP: Hypertext Preprocessor".
- PHP is a server side scripting language that is embedded in HTML. It is used to manage dynamic content, databases, session tracking, even build entire e-commerce sites.
- It is integrated with a number of popular databases, including MySQL, PostgreSQL, Oracle, Sybase, Informix, and Microsoft SQL Server.
- PHP is pleasingly zippy in its execution, especially when compiled as an Apache module on the Unix side. The MySQL server, once started, executes even very complex queries with huge result sets in record-setting time.
- PHP supports a large number of major protocols such as POP3, IMAP, and LDAP. PHP4 added support for Java and distributed object architectures (COM and CORBA), making n-tier development a possibility for the first time.
- PHP is forgiving: PHP language tries to be as forgiving as possible.
- PHP Syntax is C-Like.



6.3. Fig 10: Server Side Diagram

Fig 1: Basic View of PHP

Characteristics of PHP

Five important characteristics make PHP's practical nature possible −

- Simplicity
- Efficiency

- Security
- Flexibility
- Familiarity

Hello World using PHP.

Just to give you a little excitement about PHP, I'm going to give you a small conventional PHP Hello World program, You can try it using Demo link.

<html>

<head>

<title>Hello World</title>

</head>

<body>

<?php echo "Hello, World!";?></body></html>

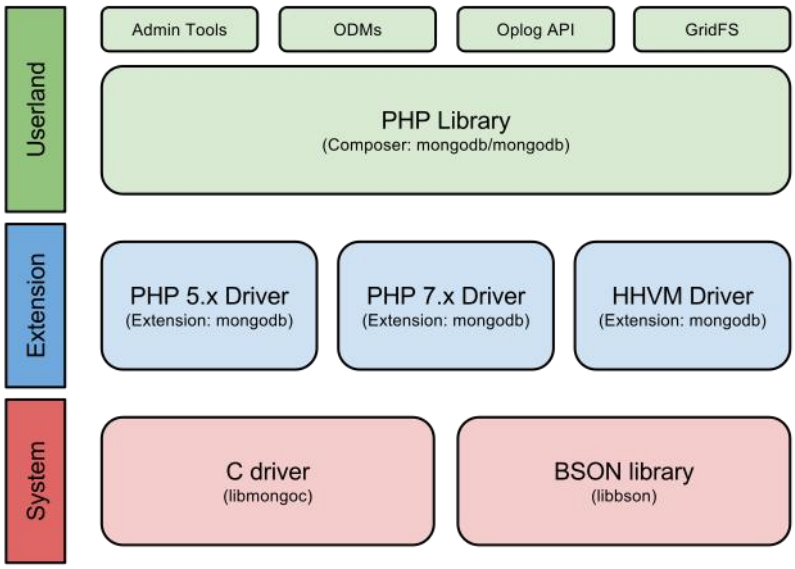
Applications of PHP

1.1.1.1.1.1.1.1.1 As mentioned before, PHP is one of the most widely used language over the web. I'm going to list few of them here:

1.1.1.1.1.1.1.1.2 PHP performs system functions, i.e. from files on a system it can create, open, read, write, and close them.andcan handle forms, i.e. gather data from files, save data to a file, through email you can send data, return data to the user.You add, delete, modify elements within your database through PHP and access cookies variables and set cookies.Using PHP, you can restrict users to access some pages of your website and encrypt data.

1.1.1.1.1.1.1.1.3 Architecture Overview

1.1.1.1.1.1.1.1.4 This section explains how all the different parts of the driver fit together. From the different language runtimes, through the extension and to the PHP libraries on top. This new architecture has replaced the old mongo extension. We refer to the new one as the *mongodb* extension.



6.4. Fig 11: PHP Side Diagram

1.2 Fig 2: Overview of PHP

At the top of this stack sits a pure » PHP library, which we will distribute as a Composer package. This library will provide an API similar to what users have come to expect from the old mongo driver (e.g. CRUD methods, database and collection objects, command helpers) and we expect it to be a common dependency for most applications built with MongoDB. This library will also implement common » specifications, in the interest of improving API consistency across all of the » drivers maintained by MongoDB (and hopefully some community drivers, too).Sitting below that library we have the lower level driver. This extension will effectively form the glue between PHP and our system libraries. This extension will expose an identical public API for the most essential and performance-sensitive functionality:

- Connection management
- BSON encoding and decoding
- Object document serialization (to support ODM libraries)

- Executing commands and write operations
- Handling queries and cursors

Prerequisites

1.2.1.1.1.1.1.1.1 Before proceeding with this tutorial you should have at least basic understanding of computer programming, Internet, Database, and MySQL etc is very helpful.

PHP started out as a small open source project that evolved as more and more people found out how useful it was. RasmusLerdorf unleashed the first version of PHP way back in 1994.

- PHP is a recursive acronym for "PHP: Hypertext Preprocessor".
- PHP is a server side scripting language that is embedded in HTML. It is used to manage dynamic content, databases, session tracking, even build entire e-commerce sites.
- It is integrated with a number of popular databases, including MySQL, PostgreSQL, Oracle, Sybase, Informix, and Microsoft SQL Server.
- PHP is pleasingly zippy in its execution, especially when compiled as an Apache module on the Unix side. The MySQL server, once started, executes even very complex queries with huge result sets in record-setting time.

Common uses of PHP

- PHP performs system functions, i.e. from files on a system it can create, open, read, write, and close them.
- PHP can handle forms, i.e. gather data from files, save data to a file, through email you can send data, return data to the user.
- You add, delete, modify elements within your database through PHP.Access cookies variables and set cookies. Using PHP, you can restrict users to access some pages of your website. It can encrypt data.

Characteristics of PHP

Five important characteristics make PHP's practical nature possible −

- Simplicity
- Efficiency
- Security
- Flexibility
- Familiarity

1.2.1.1.1.1.1.1.2 In order to develop and run PHP Web pages three vital components need to be installed on your computer system.

- **Web Server** − PHP will work with virtually all Web Server software, including Microsoft's Internet Information Server (IIS) but then most often used is freely available Apache Server. Download Apache for free here − https://httpd.apache.org/download.cgi
- **Database** − PHP will work with virtually all database software, including Oracle and Sybase but most commonly used is freely available MySQL database. Download MySQL for free here − https://www.mysql.com/downloads/
- **PHP Parser** − In order to process PHP script instructions a parser must be installed to generate HTML output that can be sent to the Web Browser. This tutorial will guide you how to install PHP parser on your computer.

PHP Parser Installation

1.2.1.1.1.1.1.1.3 Before you proceed it is important to make sure that you have proper environment setup on your machine to develop your web programs using PHP.

1.2.1.1.1.1.1.1.4 Type the following address into your browser's address box.

http://127.0.0.1/info.php

1.2.1.1.1.1.1.1.5 If this displays a page showing your PHP installation related information then it means you have PHP and Webserver installed properly. Otherwise you have to follow given procedure to install PHP on your computer.

1.2.1.1.1.1.1.1.6 This section will guide you to install and configure PHP over the following four platforms −

- PHP Installation on Linux or Unix with Apache
- PHP Installation on Mac OS X with Apache
- PHP Installation on Windows NT/2000/XP with IIS
- PHP Installation on Windows NT/2000/XP with Apache

Apache Configuration

1.2.1.1.1.1.1.1.7 If you are using Apache as a Web Server then this section will guide you to edit Apache Configuration Files.

1.2.1.1.1.1.1.1.8 Just Check it here − PHP Configuration in Apache Server

PHP.INI File Configuration

1.2.1.1.1.1.1.1.9 The PHP configuration file, php.ini, is the final and most immediate way to affect PHP's functionality.

1.2.1.1.1.1.1.1.10 Just Check it here − PHP.INI File Configuration

Windows IIS Configuration

1.2.1.1.1.1.1.1.11 To configure IIS on your Windows machine you can refer your IIS Reference Manual shipped along with IIS.

1.2.1.1.1.1.1.1.12 The main way to store information in the middle of a PHP program is by using a variable.

1.2.1.1.1.1.1.1.13 Here are the most important things to know about variables in PHP.

- All variables in PHP are denoted with a leading dollar sign ($).
- The value of a variable is the value of its most recent assignment.
- Variables are assigned with the = operator, with the variable on the left-hand side and the expression to be evaluated on the right.
- Variables can, but do not need, to be declared before assignment.

- Variables in PHP do not have intrinsic types - a variable does not know in advance whether it will be used to store a number or a string of characters.
- Variables used before they are assigned have default values.
- PHP does a good job of automatically converting types from one to another when necessary.
- PHP variables are Perl-like.

1.2.1.1.1.1.1.1.14 PHP has a total of eight data types which we use to construct our variables

- **Integers** − are whole numbers, without a decimal point, like 4195.
- **Doubles** − are floating-point numbers, like 3.14159 or 49.1.
- **Booleans** − have only two possible values either true or false.
- **NULL** − is a special type that only has one value: NULL.
- **Strings** − are sequences of characters, like 'PHP supports string operations.'
- **Arrays** − are named and indexed collections of other values.
- **Objects** − are instances of programmer-defined classes, which can package up both other kinds of values and functions that are specific to the class.
- **Resources** − are special variables that hold references to resources external to PHP (such as database connections)

6.2. MYSQL

MySQL tutorial provides basic and advanced concepts of MySQL. Our MySQL tutorial is designed for beginners and professionals. MySQL is a relational database management system based on the Structured Query Language, which is the popular language for accessing and managing the records in the database. MySQL is open-source and free software under the GNU license. It is supported by Oracle Company. MySQL database that provides for how to manage database and to manipulate data with the help of various SQL queries. These queries are: insert records, update records, delete records, select records, create tables, drop tables, etc. There are also given MySQL interview questions to help you better understand the MySQL database.

MySQL is currently the most popular database management system software used for managing the relational database. It is open-source database software, which is supported by Oracle Company. It is fast, scalable, and easy to use database management system in comparison with Microsoft SQL Server and Oracle Database. It is commonly used in conjunction with PHP scripts for creating powerful and dynamic server-side or web-based enterprise applications. It is developed, marketed, and supported by MySQL AB, a Swedish company, and written in C programming language and C++ programming language. The official pronunciation of MySQL is not the My Sequel; it is My Ess Que Ell. However, you can pronounce it in your way. Many small and big companies use MySQL. MySQL supports many Operating Systems like Windows, Linux, MacOS, etc. with C, C++, and Java languages.

6.3. WAMPSERVER

WampServer is a Windows web development environment. It allows you to create web applications with Apache2, PHP and a MySQL database. Alongside, PhpMyAdmin allows you to manage easily your database.

WAMPServer is a reliable web development software program that lets you create web apps with MYSQL database and PHP Apache2. With an intuitive interface, the application features numerous functionalities and makes it the preferred choice of developers from around the world. The software is free to use and doesn't require a payment or subscription.

6.4. BOOTSTRAP 4

Bootstrap is a free and open-source tool collection for creating responsive websites and web applications. It is the most popular HTML, CSS, and JavaScript framework for developing responsive, mobile-first websites.

It solves many problems which we had once, one of which is the cross-browser compatibility issue. Nowadays, the websites are perfect for all the browsers (IE, Firefox, and Chrome) and for all sizes of screens (Desktop, Tablets, Phablets, and Phones). All thanks to Bootstrap developers -Mark Otto and Jacob Thornton of Twitter, though it was later declared to be an open-source project.

Easy to use: Anybody with just basic knowledge of HTML and CSS can start using Bootstrap

Responsive features: Bootstrap's responsive CSS adjusts to phones, tablets, and desktops

Mobile-first approach: In Bootstrap, mobile-first styles are part of the core framework

Browser compatibility: Bootstrap 4 is compatible with all modern browsers (Chrome, Firefox, Internet Explorer 10+, Edge, Safari, and Opera)

CHAPTER 7
SYSTEM IMPLEMENTATION

7.1. SYSTEM DESCRIPTION

A Next Generation Smart Street Light Monitoring System using Cloud Computing aims to enhance efficiency, reduce energy consumption, and improve maintenance through real-time monitoring and intelligent control. Here's a system description:

System Components:

1. Smart Street Lights:
    - Equipped with sensors to detect ambient light levels, motion, and environmental conditions.
    - Integrated with wireless communication modules (such as Wi-Fi, Bluetooth, or LoRa) for data transmission.
2. Cloud Infrastructure:
    - Utilizes cloud computing platforms (e.g., AWS, Azure, Google Cloud) for data storage, processing, and analysis.
    - Provides scalability, reliability, and accessibility for the system.
3. Data Collection and Processing:
    - Street lights transmit data to the cloud in real-time, including light intensity, motion detection, and energy consumption.
    - Cloud-based data processing algorithms analyze incoming data to identify patterns, anomalies, and optimization opportunities.
4. Monitoring and Control Dashboard:
    - Web-based interface accessible via desktop or mobile devices for administrators and maintenance personnel.
    - Displays real-time status updates, including light intensity levels, energy usage, and any detected faults or malfunctions.
    - Allows for remote control of individual or groups of street lights, enabling adjustments to brightness levels and scheduling of on/off times.
5. Predictive Maintenance:
    - Utilizes machine learning algorithms to predict potential failures or maintenance needs based on historical data and sensor readings.

- Generates alerts and notifications for proactive maintenance, minimizing downtime and reducing repair costs.

6. Energy Optimization:
    - Analyzes data to optimize energy usage by dynamically adjusting light brightness levels based on environmental conditions and usage patterns.
    - Implements dimming strategies during low-traffic hours to conserve energy while maintaining safety and visibility.
7. Integration with External Systems:
    - Integrates with weather forecasting services to anticipate weather-related changes and adjust street light settings accordingly.
    - Interfaces with city management systems for urban planning, traffic management, and emergency response coordination.

7.2. Modules Description

Server Side Modules

- Admin
- Unique ID Generation
- Monitoring Chart
- Control Room Surveillance
- Street Light Information
- Receiving Street Light Status
- Monitoring Power Details

Smart Lamp Module

- Current Status of Smart Lamp
  Check Status (ON/OFF)
  Intimate Status
- Manage Power Adjustment
- Auto Abnormal Alert

Module Descriptions:

Admin

The admin controls the entire system through online in which the whole smart street lights has been covered. The admin has the proper authentication to operate the total number of street lights that has been involved in the system.

Unique ID Generation:

After the process has been undertaken by the admin each smart street light has been provided with an unique ID from which the admin can easily identify the exact smart street lamp for further operations like ON/OFF, maintenance, stolen, broken etc. By assuming the unique ID every smart lamp can be handled under the control of the admin.

Monitoring Chart

We evaluate the effectiveness of the proposed SSL by simulation of abnormal states of street lamps based on fog computing server which implements flexible management platform. We analyze the periodic maintenance of abnormal states of street lamps. The results of SSL reliability; and finally, the energy conservation has been solved.

Control Room Surveillance

The server will check the abnormal states, the server will automatically send the information on abnormal lamp state consisting of street lamp ID, lamp location, and abnormal state description to the managers and nearest serviceman. Therefore, the maintenance period can be decreased seriously. The managers can send commands using mobile application or Web browser. Therefore, the serviceman can receive the tasks through mobile application or SMS.

Street Light Information

The Smart Street Light SSL consists of three main parts: an intelligent sensing street lamp, which can adjust lamp brightness, an autonomous alarm which reports about abnormal behavior; an efficient network, which is used for real-time communication between managers and massive street lamps; and lastly, a flexible management platform, which is easy and highly automated.

Receiving Street Light Status:

Using both the intelligent sensing street lamps and efficient network, the server gets the information of all street lamps, consisting of lamps states, locations, external environment brightness, and so on. Therefore, the management platform is a key factor of the street lamp management system. Here, we implement a flexible management platform based on fog computing, which simplifies the management system. Moreover, the fog computing based server offers better real time response, while cloud computing delivers the elastic computing power and storage at a lower cost.

As already mentioned, all street lamps periodically send information of their states to the server, and the server stores received information in the database. In order to find the abnormal states of street lamps, the server periodically checks.

Monitoring Power Details:

The check cycle can be set by managers. The longer the check cycle is, the longer the maintenance cycle of a broken street lamp is, and the lower the system cost is. Contrary, the shorter the check cycle is, the shorter the maintenance cycle of a broken street lamp is, and the higher the system cost is. 20 minute can be tolerable for both maintenance cycle and system cost. Therefore, to balance these two sides, we set the check cycle to 20 minutes, i.e. server checks states in database every 20 minutes.

Smart Lamp Module:

Current Status of Smart Lamp

Check Status (ON/OFF)

The states of all street lamps can be traced and adjusted in real time The street lamp periodically send reports on its current and voltage values. Based on the current and voltage values of the street lamp, the server can determine the street lamp state. If the current of the street lamp is zero, but the voltage is not zero, then the server can conclude that the light bulb may be broken.

Intimate Status

By the location sensors in the street lamp, the server can be informed whether the street lamp is stolen. Moreover, the street lamp can be found when the street lamp is lost. Further, when the server finds the light bulbs of street lamps are broken, the

server can send the detail location to the serviceman for repairing, so the serviceman can locate the broken street lamp accurately which improves efficiency.

Manage Power Adjustment

In intelligent sensing street lamp, the brightness of street lamp can be adjusted with flexible management platform, the management platform can optimize resource scheduling for easy and highly automated management. The street lamp is equipped with some sensors, such as location sensor, infrared sensor, and light sensor, to form an intelligent sensing street lamp. Consequently, brightness of street lamps can be adjusted.

The infrared sensor in street lamp makes the street lamp more intelligence. The street lamps can distinguish the demands for brightness. Namely, for street lamps in the unmanned area, the brightness should be turn down, and for the street lamps in the crowded area, the brightness needs to be turned up. Therefore, safety in the crowded areas can be guaranteed, and turning down of unmanned street lamps meets energy conservation requirement.

Auto Abnormal Alert

The abnormal states are:

1) The street lamp bulb is broken. When server checks the street lamp and finds its current is equal to zero but its voltage differs from zero, it concludes the street lamp has a broken bulb.

2) The street lamp is offline. When server checks the street lamp and finds that no data are received from the lamp, it concludes the street lamp is in offline state.

3) The street lamp is in the power saving mode. When server checks the street lamp and finds both its current and voltage are lower than their normal values, it concludes the street lamp is in the power saving mode.

4) Fault. When server checks the street lamp and finds that both lamp current and voltage are equal to zero, and all street lamps in that region have the same state, the server concludes that a fault occurred, which may be caused by a power failure.

5) Close. When server checks the street lamp and finds that both lamp current and voltage are equal to zero, but not all street lamps in that region have the same state, the server concludes that the street lamp is closed.

Autonomous alarm is to avoid stealing. Every street lamp needs to have a self-protection ability. When it is stolen, it should autonomously send the alarm. In this way, the street lamp stealing can be avoided. A flexible management platform is implemented, and it notifies the managers about broken street lamps at real time and automatically dispatches the maintenance staff to repair broken street lamps.

SOURCECODE

Server Login

```
<?php
session_start();
include("dbconnect.php");
extract($_REQUEST);
$msg="";
if(isset($btn))
{
        if($uname=="server")
        {
$qry=mysql_query("select * from street_login where username='$uname' && password='$pass'");
$num=mysql_num_rows($qry);
                if($num==1)
                {
                $_SESSION['uname']=$uname;
                header("location:home.php");
                }
                else
                {
                $msg="Invalid User!";
                }
        }
        else
        {
        $msg="Invalid User!";
        }
```

```
}

?>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1" />
<title><?php include("title.php"); ?></title>

<link href="style.css" rel="stylesheet" type="text/css" />
</head>

<body>
<form id="form1" name="form1" method="post" action="">
  <div align="center" class="hd"><?php include("title.php"); ?></div>
   <?php include("link_home.php"); ?>
  <p> </p>
  <div align="center">
    <table width="380" height="299" border="0" align="center" cellpadding="5" cellspacing="0">
      <tr>
        <th class="bg1" scope="col">Server</th>
      </tr>
      <tr>
        <td align="center" class="bg2"><input name="uname" type="text" class="inp" placeholder="Username" /></td>
      </tr>
      <tr>
        <td align="center" class="bg2"><input name="pass" type="password" class="inp" placeholder="Password" /></td>
      </tr>
      <tr>
```

```
      <td align="center" class="bg2"><input name="btn" type="submit" class="inp" value="Login" /></td>
    </tr>
    <tr>
      <td align="center" class="bg2"><span class="style1"><?php echo $msg; ?></span></td>
    </tr>
   </table>
  </div>
  <p align="center"> </p>
  <p> </p>
  <p align="center" class="sd"><?php include("title.php"); ?></p>
</form>
</body>
</html>
```

Monitoring

```
<?php
session_start();
include("dbconnect.php");
extract($_REQUEST);
$msg="";
$uname=$_SESSION['uname'];
$user=$_SESSION['user'];
?>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1" />
<title><?php include("title.php"); ?></title>
<script language="javascript">
function del()
{
        if(!confirm("Are you sure want to delete?"))
```

```
        {
        return false;
        }
        return true;
}
</script>
<link href="style.css" rel="stylesheet" type="text/css" />
</head>

<body>
<form id="form1" name="form1" method="post" action="">
  <div class="sd"><!--<a href="index.php">Home</a>-->
    <div align="center"> Server </div>
  </div>

  <h3 align="center">Monitoring </h3>
  <table width="100" border="0" align="center">
    <tr>
      <th scope="col"><iframe src="monitor.php" width="1000"
height="400"></iframe></th>
    </tr>
    <tr>
      <th scope="row"> </th>
    </tr>
  </table>
  <p align="center"> </p>

  <p align="center"> </p>
  <?php include("link_control.php"); ?>
</form>

</body>
</html>
```

Control Room Login

```
<?php
session_start();
include("dbconnect.php");
extract($_REQUEST);
$msg="";
if(isset($btn))
{
$qry=mysql_query("select * from street_login where username='$uname' && password='$pass'");
$num=mysql_num_rows($qry);
        if($num==1)
        {
        $_SESSION['uname']=$uname;
        header("location:admin.php");
        }
        else
        {
        $msg="Invalid User!";
        }

}

?>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1" />
<title><?php include("title.php"); ?></title>

<link href="style.css" rel="stylesheet" type="text/css" />
</head>

<body>
```

```
<form id="form1" name="form1" method="post" action="">
  <div align="center" class="hd"><?php include("title.php"); ?></div>
   <?php include("link_home.php"); ?>
  <p> </p>
  <div align="center">
   <table width="380" height="299" border="0" align="center" cellpadding="5" cellspacing="0">
     <tr>
      <th class="bg1" scope="col">Control [Administrator] </th>
     </tr>
     <tr>
      <td align="center" class="bg2"><input name="uname" type="text" class="inp" placeholder="Username" /></td>
     </tr>
     <tr>
      <td align="center" class="bg2"><input name="pass" type="password" class="inp" placeholder="Password" /></td>
     </tr>
     <tr>
      <td align="center" class="bg2"><input name="btn" type="submit" class="inp" value="Login" /></td>
     </tr>
     <tr>
      <td align="center" class="bg2"><span class="style1"><?php echo $msg; ?></span></td>
     </tr>
   </table>
  </div>
  <p align="center"> </p>
  <p> </p>
  <p align="center" class="sd"><?php include("title.php"); ?></p>
</form>
</body>
</html>
```

Light Status

```
<?php
session_start();
include("dbconnect.php");
extract($_REQUEST);
$msg="";
$uname=$_SESSION['uname'];
$user=$_SESSION['user'];

$month=date("m");
$year=date("Y");
$q11=mysql_query("select * from street_login where username='admin'");
        $r11=mysql_fetch_array($q11);
//Spring---march,apr,may
//Summer---jun,jul,aug
//Autumn---sep,oct,nov
//Winter---dec,jan,feb
if(isset($btn))
{
        $q1=mysql_query("select * from street_usage where month=$month && year=$year");
        $n1=mysql_num_rows($q1);
        if($n1==0)
        {
                $q2=mysql_query("select * from street_det");
                while($r2=mysql_fetch_array($q2))
                {
        $mq=mysql_query("select max(id) from street_usage");
        $mr=mysql_fetch_array($mq);
        $id=$mr['max(id)']+1;
        $light=$r2['light'];
        mysql_query("insert into street_usage(id,light,power_usage,month,year) values($id,'$light','0','$month','$year')");
```

```
                mysql_query("update street_det set level=$level where id=".$r2['id']."");
                }
        mysql_query("update street_det set status=1");
        }
        else
        {
                $q2=mysql_query("select * from street_det");
                while($r2=mysql_fetch_array($q2))
                {
        mysql_query("update street_det set status=1,level=$level where id=".$r2['id']."");
                }
        }
mysql_query("update street_login set light_mode='1',level=$level where username='admin'");
?>
<script language="javascript">
window.location.href="status.php";
</script>
<?php
}
if(isset($level))
{
mysql_query("update street_det set level=$level");
mysql_query("update street_login set level='$level' where username='admin'");
?>
<script language="javascript">
window.location.href="status.php";
</script>
<?php
}
if(isset($btn2))
{
```

```
mysql_query("update street_det set status=0");
mysql_query("update street_login set light_mode='0' where username='admin'");
?>
<script language="javascript">
window.location.href="status.php";
</script>
<?php
}

?>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1" />
<title><?php include("title.php"); ?></title>

<link href="style.css" rel="stylesheet" type="text/css" />
</head>

<body>
<form id="form1" name="form1" method="post" action="">
  <?php include("link_admin.php"); ?>
  <p align="center">
    <select name="level" onChange="this.form.submit()">
      <option value="3" <?php if($r11['level']=="3") echo "selected"; ?>>High Power</option>
      <option value="2" <?php if($r11['level']=="2") echo "selected"; ?>>Medium Power</option>
      <option value="1" <?php if($r11['level']=="1") echo "selected"; ?>>Low Power</option>
    </select>
    <input type="submit" name="btn" value="Switch ON" />
    <input type="submit" name="btn2" value="Switch OFF" />
```

```
  </p>
  <table width="1032" border="0" align="center">
    <tr>
      <th width="1000" valign="top" scope="col"><iframe src="monitor2.php"
            /*if($month>=3 && $month<=5)
            {
            ?><img src="images/spring.jpg" width="235" height="131" /><?php
            }
            else if($month>=6 && $month<=8)
            {
            ?><img src="images/summer.jpg" width="235" height="131" /><?php
            }
            else if($month>=9 && $month<=11)
            {
            ?></th>
    </tr>
    <tr>
      <th valign="top" scope="row"> </th>
      <td valign="top"> </td>
    </tr>
  </table>
  <h3 align="center"> </h3>
  <p align="center"> </p>
  <h3 align="center"> </h3>
  <p align="center"> </p>
 <p> </p>
  <iframe src="alert.php" width="200" height="100" style="display:block"
frameborder="0"></iframe>
  <p align="center" class="sd"><?php include("title.php"); ?></p>
</form>
</body>
</html>
```

CHAPTER 8
SYSTEM TESTING

8.1. SOFTWARE TESTING

Testing

- Software testing ensures that the entire integrated software system meets requirements. It tests a configuration to ensure known and predictable results. An example of system testing is the configuration oriented system integration test. System testing is based on process descriptions and flows, emphasizing pre-driven process links and integration points.
- The purpose of testing is to discover errors. Testing is the process of trying to discover every conceivable fault or weakness in a work product. It provides a way to check the functionality of components, sub assemblies, assemblies and/or a finished product It isthe process of exercising software with the intent of ensuring that the Software system meets its requirements and user expectations and does not fail in an unacceptable manner.There are various types of test. Each test type addresses a specific testing requirement.

Type of Testing

Testing is the process of trying to discover every conceivable fault or weakness in a work product. The different type of testing is given below:

Unit Testing:

Unit testing involves the design of test cases that validate that the internal program logic is functioning properly, and that program inputs produce valid outputs. All decision branches and internal code flow should be validated. It is the testing of individual software units of the application .it is done after the completion of an individual unit before integration.

This is a structural testing, that relies on knowledge of its construction and is invasive. Unit tests perform basic tests at component level and test a specific business process, application, and/or system configuration. Unit tests ensure

that each unique path of a business process performs accurately to the documented specifications and contains clearly defined inputs

Functional Test:

Functional tests provide systematic demonstrations that functions tested are available as specified by the business and technical requirements, system documentation, and user manuals.

Systems/ Procedures: interfacing systems or procedures must be invoked.

Organization and preparation of functional tests is focused on requirements, key functions, or special test cases. In addition, systematic coverage pertaining to identify Business process flows; data fields, predefined processes, and successive processes must be considered for testing. Before functional testing is complete, additional tests are identified and the effective value of current tests is determined.

White Box Testing:

White Box Testing is a testing in which in which the software tester has knowledge ofthe inner workings, structure and language of the software, or at least its purpose. It is purpose. It is used to test areas that cannot be reached from a black box level.

Black Box Testing:

Black Box Testing is testing the software without any knowledge of the inner workings, structure or language of the module being tested. Black box tests, as most other kinds of tests, must be written from a definitive source document, such as specification or requirements document, such as specification or requirements document. It is a testing in which the software under test is treated, as a black box .you cannot “see” into it. The test provides inputs and responds to outputs without considering how the software works.

Acceptance Testing:

User Acceptance Testing is a critical phase of any project and requires significant participation by the end user. It also ensures that the system meets the functional requirements.

Validation Testing

Validation testing is the process of ensuring if the tested and developed software satisfies the client /user needs. The business requirement logic or scenarios have to be tested in detail. All the critical functionalities of an application must be tested here.

As a tester, it is always important to know how to verify the business logic or scenarios that are given to you. One such method that helps in detail evaluation of the functionalities is the Validation Process.

Whenever you are asked to perform a validation test, it takes a great responsibility as you need to test all the critical business requirements based on the user needs. There should not be even a single miss on the requirements asked by the user. Hence a keen knowledge on validation testing is much important.

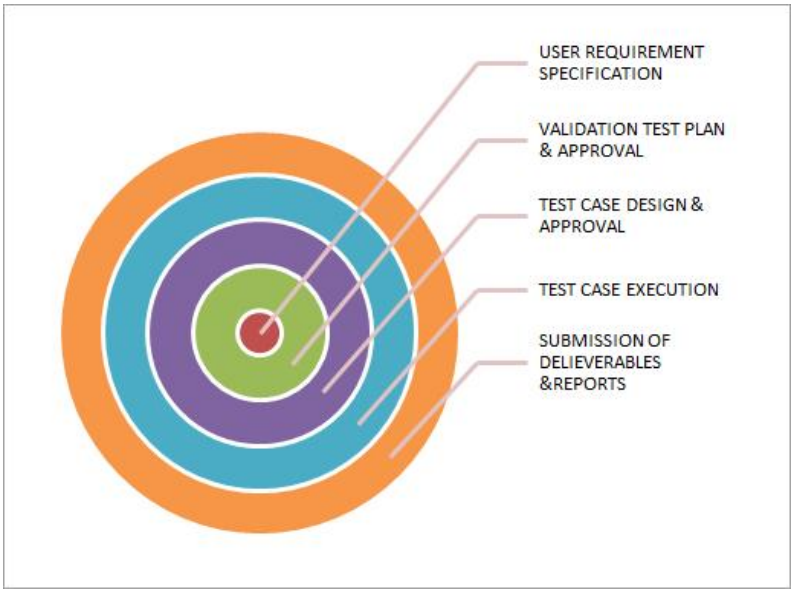
As a tester, you need to evaluate if the test execution results comply with that mentioned in the requirements document. Any deviation should be reported immediately and thatdeviation is thus called a bug.

From a company perspective, the validation test in simple is carried out by thefollowing steps:

- You gather the business requirements for validation testing from the end user.
- Prepare the business plan and send it for the approval to the onsite/stakeholdersinvolved.
- On approval of the plan, you begin to write the necessary test cases and send themfor approval.
- Once approved you begin to complete testing with the

required software, environment and send the deliverables as requested by the client.

- Upon approval of the deliverables, UAT testing is done by the client.
- After that, the software goes for production.



8.1. Fig 12: Validation Testing Diagram

Fields Testing

This testing is done in the last phase when the regression is done for the application and the application is called stable by the 'Team' before the release. There may or may not be a requirement given for this from the customer. The type of testing mainly include the functional and usability of the application. This is strictly done on Mobile Networks. QA's need to step out and test while walking around or at home or driving. Testing is done onlyon real devices.

Test Results

All the test cases mentioned above passed successfully. No defects encountered.

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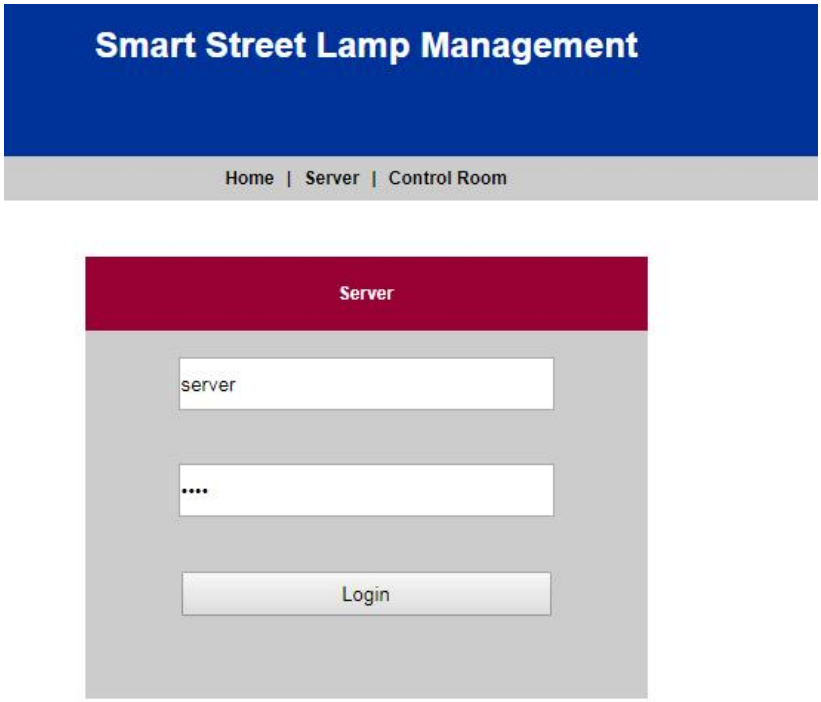
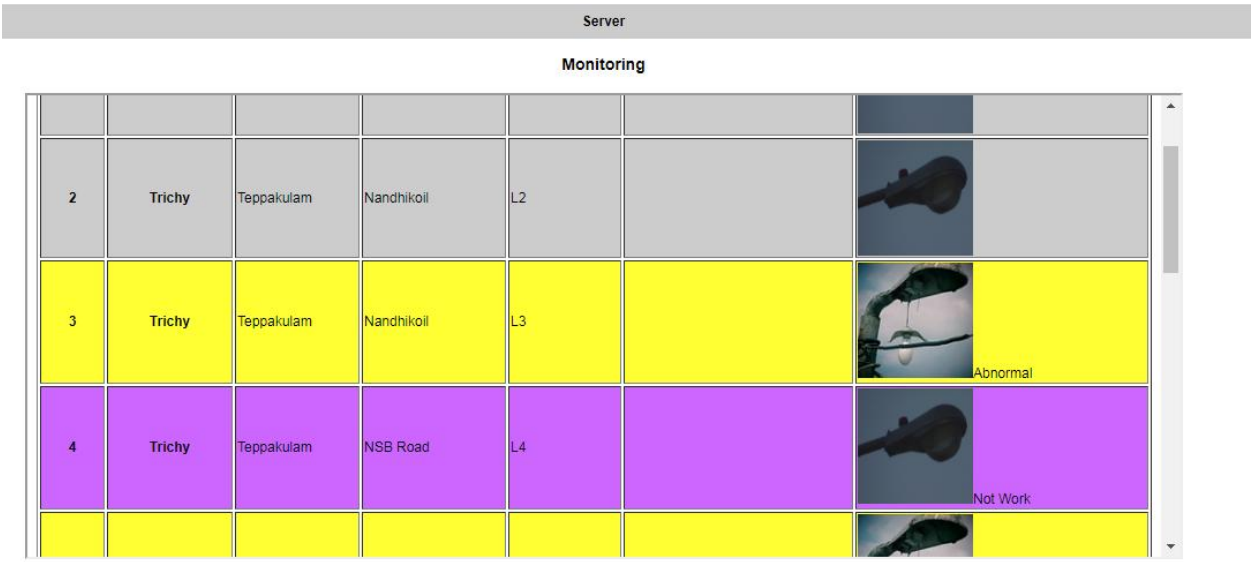
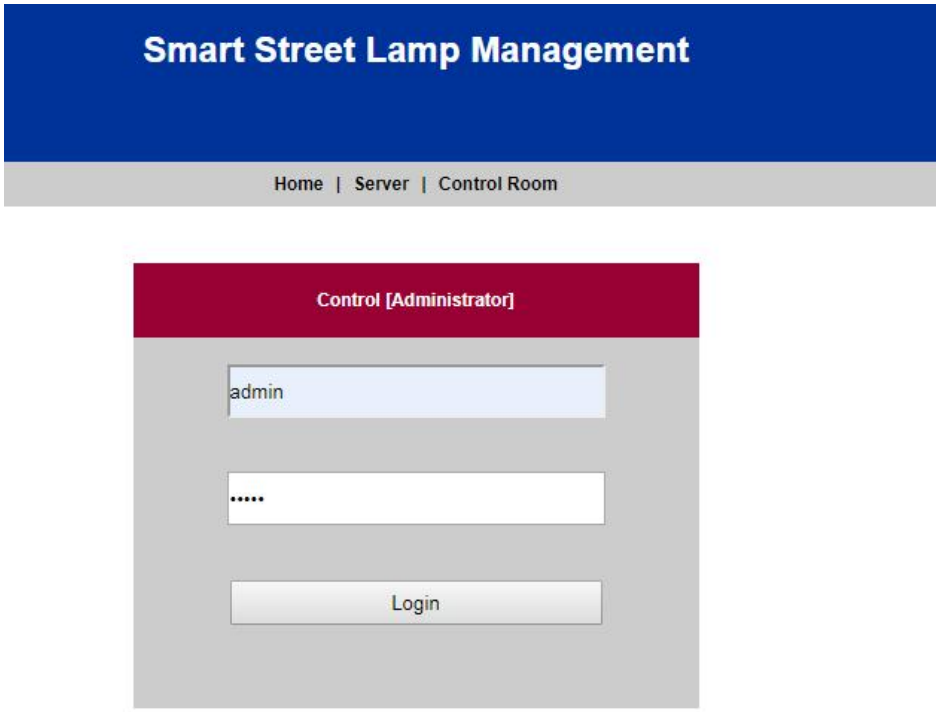
CHAPTER 9
SCREENSHOTS



Monitoring

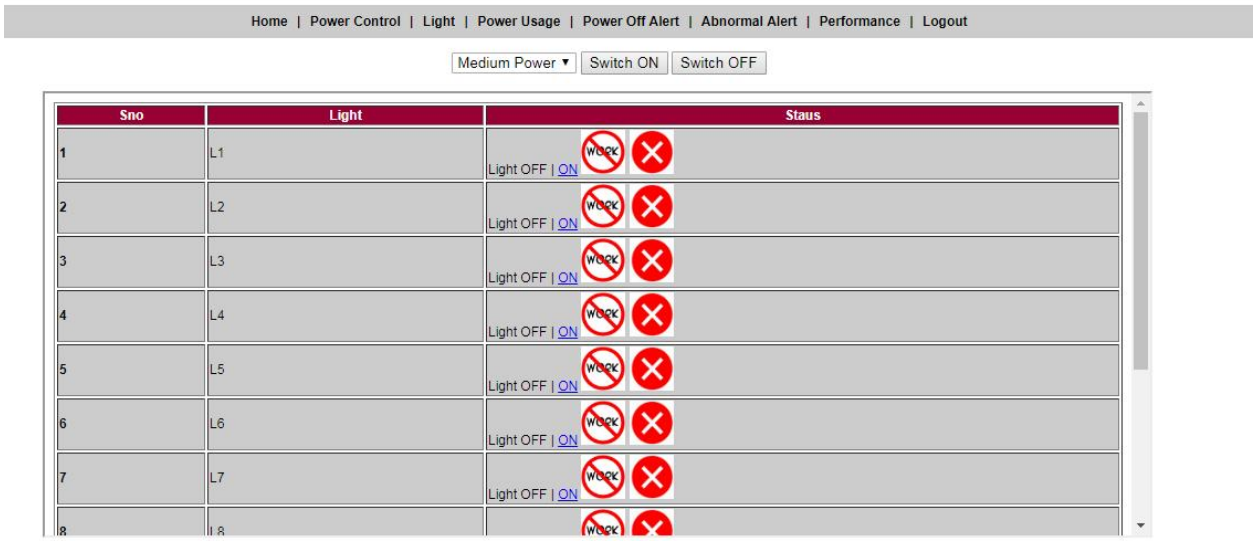


Control Login

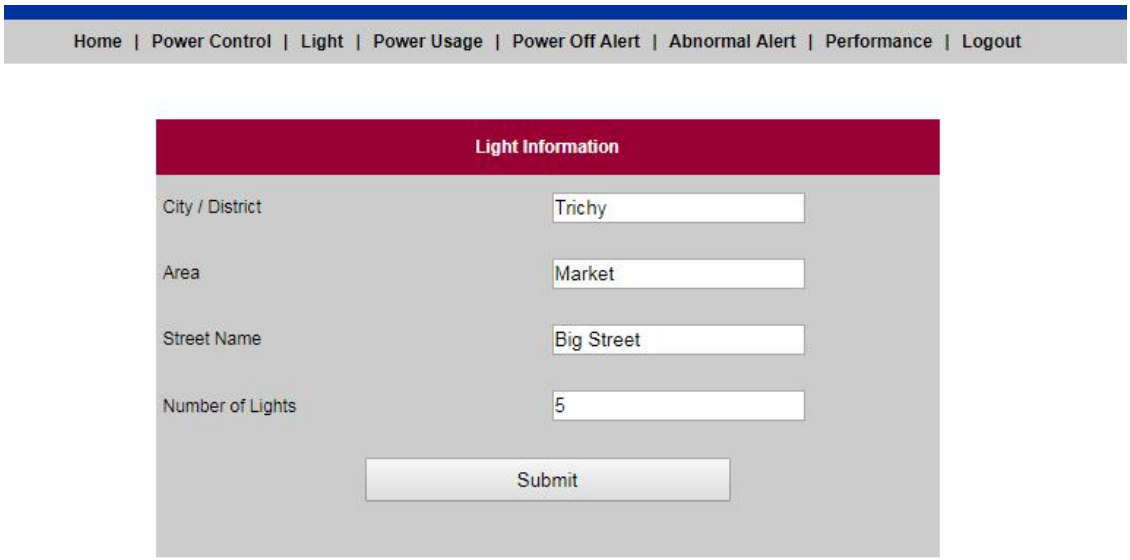


Alert

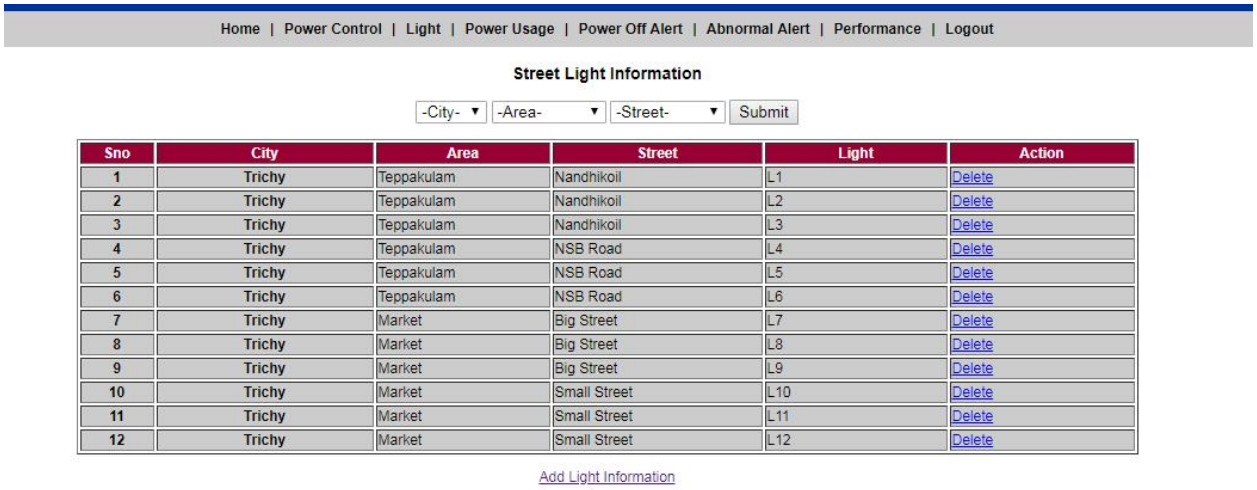
Light On/Off



Add New Light

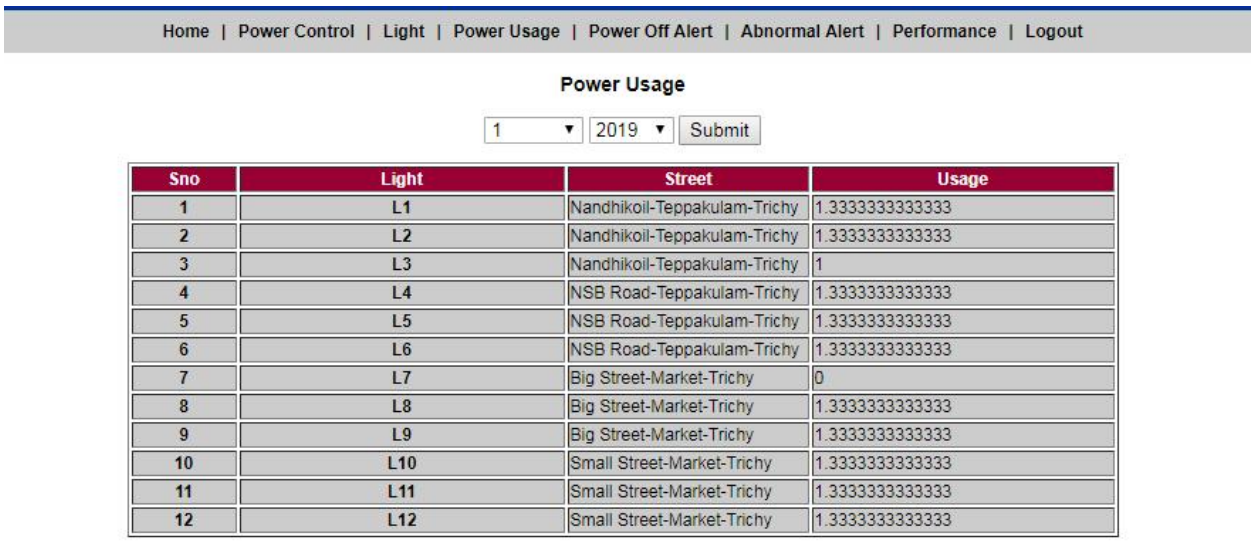


View Light



Sno	City	Area	Street	Light	Action
1	Trichy	Teppakulam	Nandhikoil	L1	Delete
2	Trichy	Teppakulam	Nandhikoil	L2	Delete
3	Trichy	Teppakulam	Nandhikoil	L3	Delete
4	Trichy	Teppakulam	NSB Road	L4	Delete
5	Trichy	Teppakulam	NSB Road	L5	Delete
6	Trichy	Teppakulam	NSB Road	L6	Delete
7	Trichy	Market	Big Street	L7	Delete
8	Trichy	Market	Big Street	L8	Delete
9	Trichy	Market	Big Street	L9	Delete
10	Trichy	Market	Small Street	L10	Delete
11	Trichy	Market	Small Street	L11	Delete
12	Trichy	Market	Small Street	L12	Delete

Power usage



Sno	Light	Street	Usage
1	L1	Nandhikoil-Teppakulam-Trichy	1.3333333333333
2	L2	Nandhikoil-Teppakulam-Trichy	1.3333333333333
3	L3	Nandhikoil-Teppakulam-Trichy	1
4	L4	NSB Road-Teppakulam-Trichy	1.3333333333333
5	L5	NSB Road-Teppakulam-Trichy	1.3333333333333
6	L6	NSB Road-Teppakulam-Trichy	1.3333333333333
7	L7	Big Street-Market-Trichy	0
8	L8	Big Street-Market-Trichy	1.3333333333333
9	L9	Big Street-Market-Trichy	1.3333333333333
10	L10	Small Street-Market-Trichy	1.3333333333333
11	L11	Small Street-Market-Trichy	1.3333333333333
12	L12	Small Street-Market-Trichy	1.3333333333333

Power Off Light

Home | Power Control | Light | Power Usage | Power Off Alert | Abnormal Alert | Performance | Logout

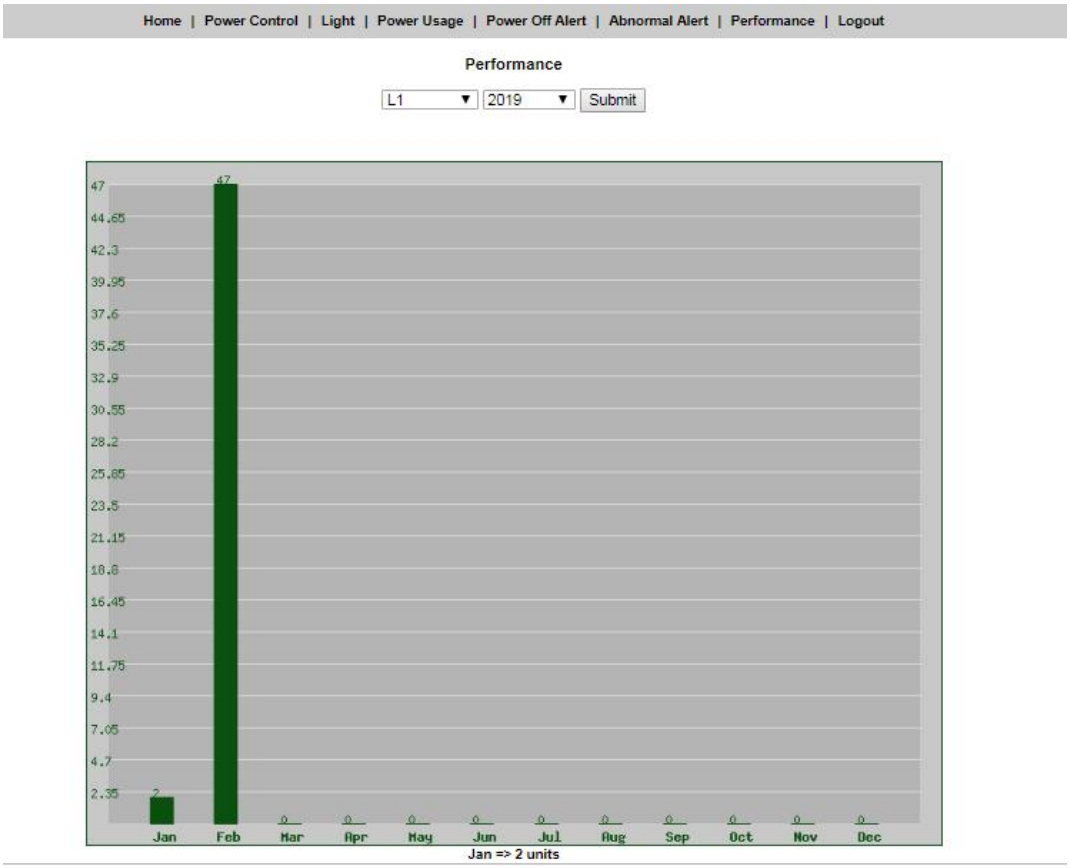
Sno	Street	Light	Date/Time	Staus
1	NSB Road-Teppakulam-Trichy	L4	2019-03-07 23:00:39	 Click to Solve
2	Big Street-Market-Trichy	L9	2019-03-07 23:00:39	 Click to Solve

Abnormal Alert

Home | Power Control | Light | Power Usage | Power Off Alert | Abnormal Alert | Performance | Logout

Sno	Street	Light	Date/Time	Staus
1	Nandhikoil-Teppakulam-Trichy	L3	2019-03-07 23:00:39	 Click to Solve
2	NSB Road-Teppakulam-Trichy	L5	2019-03-07 23:00:39	 Click to Solve
3	NSB Road-Teppakulam-Trichy	L6	2019-03-07 23:00:39	 Click to Solve

Performance Chart



CHAPTER 10
CONCLUSION

In order to satisfy the requirements of smart cities, this paper proposes a smart street lamp (SSL) based on fog computing. The SSL mainly consists of three parts: intelligent sensing street lamp (street lamp brightness can be adjusted and autonomous alarm notifies about lamp abnormal state); efficient network (real-time communication is achieved, the NBIoT is adopted for communication between server and massive street lamps, and the Internet communication technology, such as Wi-Fi and 4G, is adopted for communication between server and managers); and flexible management platform (management platform can optimize resource scheduling for easy and highly automated management of street lamp system). The proposed SSL was verified by its application in Xiasha district of Hangzhou, China, and obtained results proved high efficiency. The average maintenance period, which denoted the time between the abnormal lamp state appeared and the server checked it, was about 20 minutes. Moreover, the proposed SSL can reduce human resources by eliminating unnecessary periodic inspections.

CHAPTER 11
FUTURE ENHANCEMENT

In the future, we have two mainly works:

1.Make the proposed SSL be used in current smart cities.

2.Adopt the proposed technique to some other fields in smart city, such as parking, environmental monitoring, and so on.

3. Li - Fi concept can be implemented.

4. CCTV can be fixed from which traffic analysis can be done..

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