

LUSIP-2023 Project

JULY 2023

By - Harshita Fogat

Manipal University Jaipur

PROBLEM FORMULATION

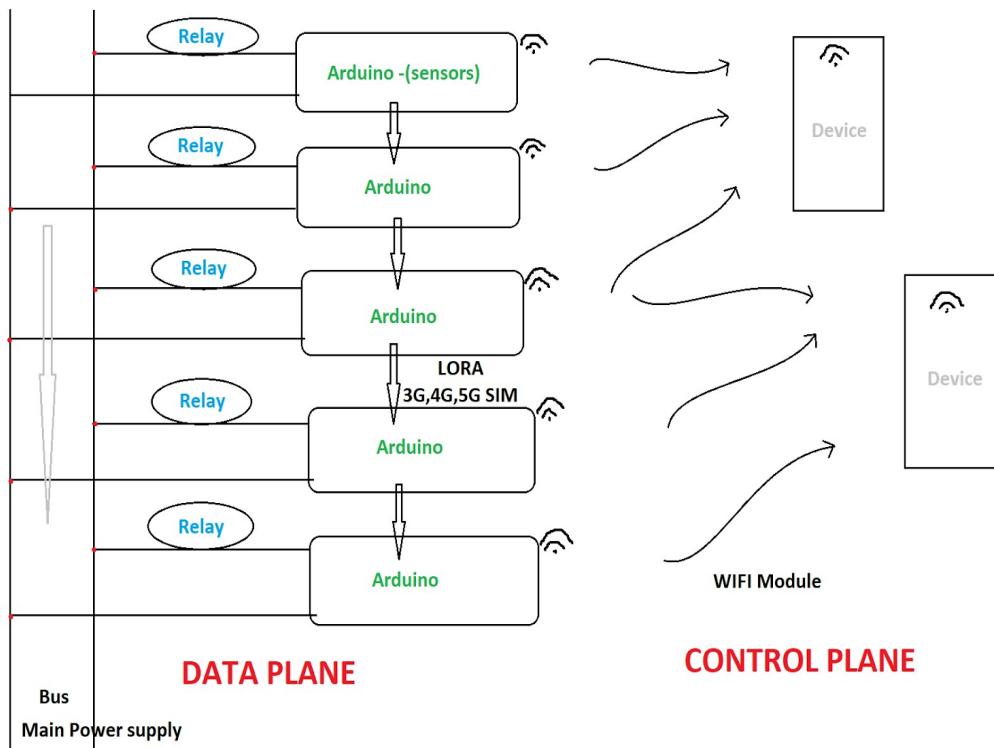
Smart street light system and its Monitoring system.

PROBLEM SCENARIO

Constraints

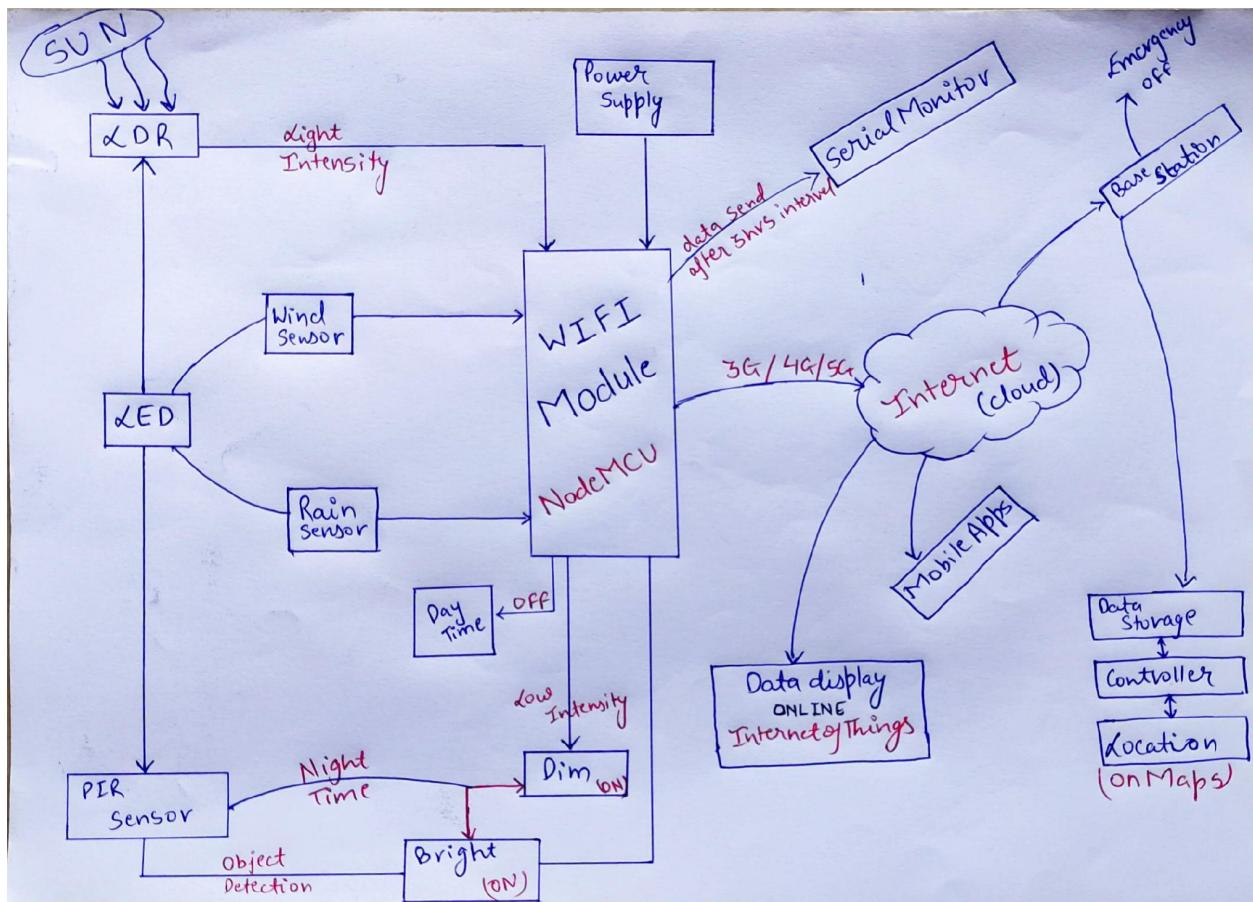
1	No of poles	5
2	Light on each pole	2
3	Height of each street light pole	20ft
4	Distance between 2 pole	standard
5	Full cutoff fixture Angle between pole and light	180 degree 90 degree (max intensity)
6	Road Width and Length	10ft and 300ft
7	LED light Intensity	3000 to 5000 lumens
8	Wifi module covering area LoRa covering area	150 ft indoor..300 ft outdoor 10 miles - 15 km

BLOCK DIAGRAM



FUNCTIONS	<p>Electricity supply through the main line is distributed by BUS networking and is controlled by RELAY.</p> <p>Communication between the LED's is done so as to solve the short range device connection to every LED problem.</p> <p>So LED's are interconnected using LoRa or 3G,4G,5G connectivity using sim cards.</p> <p>Wiring is also possible but is less preferred due to multiple damages experienced.</p> <p>These LEDs are then controlled by mobile devices and control stations.</p> <p>LED's and devices communicate using the WIFI module.</p> <p>Data movement bw diff arduinos is done using ROUTER bcz server is not always in vicinity.</p>
REQUIREMENTS	<p>RELAY Arduino Sensors Wifi module LoRa 3G,4G,5G sim</p>

SENSOR DIAGRAM



	1	2	3	4	5
FUNCTIONS	<p>Automatically switch ON the light after sunset and OFF around sunrise.</p> <p>Sun intensity calibration- 250 lux</p> <p>Sunlight is an imp factor because otherwise the light might turn off just because of multiple cars or street lights.</p> <p>12-2am glow 2-4am off *Because there is no need for light at these timings due to less traffic human movement.</p> <p>Brighten the previously dim lights only when movement is detected.</p> <p>Intensity calibration- 2000 lux(max) 500(min)</p>	<p>Automatically switch ON the light after sunset and OFF around sunrise.</p> <p>Sun intensity calibration- 250 lux</p> <p>Sunlight is an imp factor because otherwise the light might turn off just because of multiple cars or street lights.</p> <p>12-2am glow 2-4am off *Because there is no need for light at these timings due to less traffic human movement.</p> <p>Brighten the previously dim lights only when movement is detected.</p> <p>Intensity calibration- 2000 lux(max) 500(min)</p>	<p>Automatically switch ON the light after sunset and OFF around sunrise.</p> <p>Sun intensity calibration- 250 lux</p> <p>Sunlight is an imp factor because otherwise the light might turn off just because of multiple cars or street lights.</p> <p>12-2am glow 2-4am off *Because there is no need for light at these timings due to less traffic human movement.</p> <p>Brighten the previously dim lights only when movement is detected.</p> <p>Intensity calibration- 2000 lux(max) 500(min)</p>	<p>Automatically switch ON the light after sunset and OFF around sunrise.</p> <p>Sun intensity calibration- 250 lux</p> <p>Sunlight is an imp factor because otherwise the light might turn off just because of multiple cars or street lights.</p> <p>12-2am glow 2-4am off *Because there is no need for light at these timings due to less traffic human movement.</p> <p>Brighten the previously dim lights only when movement is detected.</p> <p>Intensity calibration- 2000 lux(max) 500(min)</p> <p>Dim light glows with 1/4th intensity of</p>	<p>Automatically switch ON the light after sunset and OFF around sunrise.</p> <p>Sun intensity calibration- 250 lux</p> <p>Sunlight is an imp factor because otherwise the light might turn off just because of multiple cars or street lights.</p> <p>12-2am glow 2-4am off *Because there is no need for light at these timings due to less traffic human movement.</p> <p>Brighten the previously dim lights only when movement is detected.</p> <p>Intensity calibration- 2000 lux(max) 500(min)</p>

	<p>Dim Bright Bright Dim Dim Dim Delay for dim=2min</p> <p>Precipitation rate Wind Speed Sell these data in the raw form to companies or to google maps in a simplified form (safe,risky,be cautious,etc) So that transportation becomes convenient. The simplified data will vary for 2,4 wheelers and heavy motor vehicles.</p>	<p>Dim Bright Bright Dim Dim Dim Delay for dim=2min</p>	<p>Dim Bright Bright Dim Dim Dim Delay for dim=2min</p>	<p>Dim Dim Dim Bright Bright Bright Delay for dim=2min</p>	<p>bright light</p> <p>Dim Dim Dim Bright Bright Bright Delay for dim=2min</p> <p>Precipitation rate Wind Speed Sell these data in the raw form to companies or to google maps in a simplified form (safe,risky,be cautious,etc) So that transportation becomes convenient. The simplified data will vary for 2,4 wheelers and heavy motor vehicles.</p>
REQUIREMENTS	Sensors- 1.LDR 3.PIR 4.Rain 5.Wind vanes	Sensors- 1.LDR 3.PIR	Sensors- 1.LDR 3.PIR	Sensors- 1.LDR 3.PIR	Sensors- 1.LDR 3.PIR 4.Rain 5.Wind vanes

DEVICE FUNCTIONS	<p>NODE pushes data to SERVER</p> <p>Remote management and Monitoring</p> <p>Data analysis and Visualization like google maps</p> <p>Emergency manual switch ON/OFF</p> <p>Precipitation rate</p> <p>Wind speed</p> <p>Faulty lights</p> <p>Which region light is not working</p> <p>Data sending frequency- x hrs</p>
-------------------------	--

Reference –



COMMUNICATION

Communication paradigm

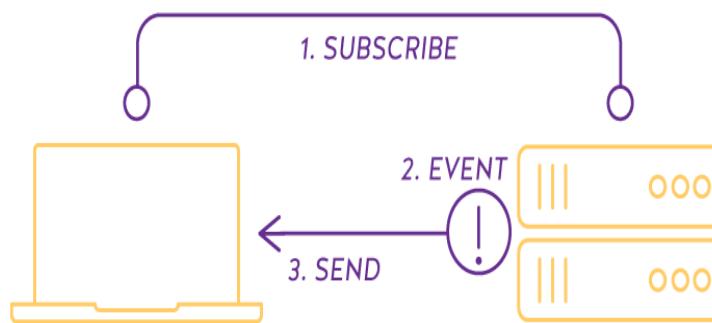
A model of thinking communication that combines subjectivism and objectivism orientations or assumes only one of them.

Publisher subscriber model

The Publish/Subscribe pattern allows for mass distribution of information to interested parties in an efficient manner. It reduces network traffic by up to half, by allowing the publisher of information to send its information only once to a publish/subscribe server, who then retransmits it to subscribers.

For eg. of the movie theater caller wanting to know when a specific movie is showing. Suppose the user didn't want to know about a specific time or date. Instead, they want the theater to send them a list of all their daily showings every day.
This is the foundation of the publisher-subscriber relationship.

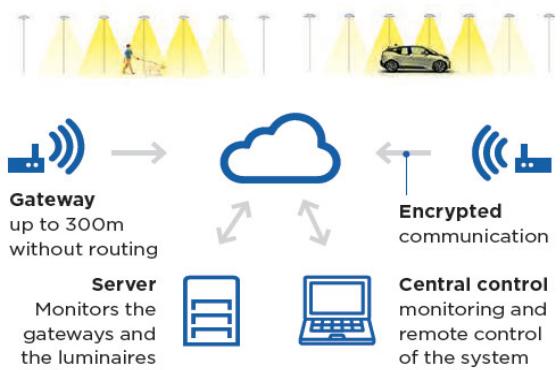
Unlike **client-server communication**, publisher-subscriber is not centered upon an immediate request-response paradigm. Information can be shared even if not expressly requested. The exchange is unidirectional because no request is sent after the subscription, which establishes the relationship.



Communication Diagram

Communication is done in 3 modes

1. Between LEDS (lorawan,zigbee)
2. LED to network tower (done by 3G,4G)
3. Network tower to SERVER (IP based link)



Remote Control and Monitoring

By connecting street lights with this hybrid communication system, users can control the street light operation from a remote area.

1. CiCAMS (City Connected Asset Management System)
2. Energy Consumption Monitoring
3. Auto-dimming Setup

BASIC ROLES of the following

CiCAMS (maps)

Basically CiCAMS is (City Connected Asset Management System) or MAPS

This can directly point the led area with malfunction

So easy to locate area and take action

Energy Consumption Monitoring

It helps us to read data and analyze it easily related to the energy consumption with different areas and according to time.

Auto-dimming Setup

Track the data of the dimming pattern of a LED at the particular area.

Requirements theory:

NodeMcu

NodeMCU is an open-source electronics platform that uses the ESP8266 Wi-Fi microchip, providing advantages like low energy consumption and built-in Wi-Fi network support.

Limitations: NodeMCU has one analog pin and is designed for prototyping and small-scale projects.

LoRa with Arduino UNO

LoRa is a wireless technology for low-power, wide-area networks (LPWANs), enabling long-range, low-power communication in challenging environments. LoRa networks support numerous devices, facilitating extensive IoT deployments.

Limitations of LoRa: LoRa has low data rates, usually ranging from a few hundred bits per second (bps) to tens of kilobits per second (kbps), and does not provide advanced security features like encryption or authentication.

LDR(Light Dependent Resistor)

LDRs are passive electronic components that decrease in resistance with light exposure and increase in resistance in darkness. Additionally, LDRs consume minimal power.

Limitations: LDRs have a slow response time and can be affected by ambient temperature, humidity, and contaminants, which can impact their accuracy and reliability in light sensing applications.

PIR

PIR sensors are passive, relying on detecting changes in existing infrared radiation. They have a wide detection range of 90 to 180 degrees and are unaffected by ambient light conditions.

Limitations: PIR sensors have a limited detection range and can be prone to false triggers from temperature changes, air currents, or small animals. Their detection pattern or field of view varies depending on the sensor design, which can be cone-shaped or segmented.

Rain sensor

Rain sensors are weatherproof and can communicate with lighting controllers or intelligent lighting management systems to adjust lighting levels based on real-time rain data.

Limitations of rain sensor:

Rain sensors may not provide precise detection accuracy for measuring rainfall intensity or small amounts of precipitation due to environmental factors. Compatibility with existing street lighting infrastructure or control systems is necessary for seamless integration.

Wind vanes sensor

Wind vane sensors analyze wind data and provide wind speed information for specific areas. They are durable, weatherproof, and reliable in harsh conditions. This data can be shared through platforms like Google Maps.

Limitations of Wind vanes sensor:

Wind vane sensors need a minimum wind speed to function accurately. Regular calibration and alignment are necessary for precise measurements. Environmental conditions, mechanical wear, and changes in sensor orientation can impact their performance.

Relay

A relay is an electromagnetic switch that controls electrical power flow. It consists of a coil and contacts, which open or close when a current passes through the coil. Relays are used when a low-power signal needs to control a high-power or high-voltage circuit. They provide electrical isolation, protecting the control circuit from voltage spikes or noise.

Limitations: Each relay has specific current and voltage ratings that it can handle. Exceeding these ratings can lead to overheating or damage to the relay contacts.

Data plane

The data plane handles the transmission, processing, and forwarding of data packets in a network. It focuses on routing and forwarding. Its main role is to ensure data packets reach their intended destinations.

Control plane

The control plane is the part of a network that controls how data packets are forwarded — meaning how data is sent from one place to another. The process of creating a routing table, for example, is considered part of the control plane.