SUP'COM
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Web of Things Project Scope Statement

Smart Street lighting

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2022-2023

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1 General Introduction

As the world evolves each day, everyday objects are becoming smart and able to communicate with each other. The internet of Things, IoT, is in a huge way, and people are inventing new gadgets that enhance lives. Objects are now equipped with sensors and can measure different units and execute orders received from users.
Street light is considered to be one of the vital sources of light used by the people for various purposes. It is commonly used along walkways and streets especially when the environment is dark. In the conventional street light system, identification of the faulty bulb and energy saving by systematic switching on/off requires human intervention and takes lots of time.
The street lights remain in the ON condition with full brightness level throughout the night time even when there is less or no vehicle density. Due to which there is a lot of waste of Energy. To overcome this issue, a system was proposed which can identify faulty street lights (non-operating) automatically and send that information along with the location to the android application with the help of IoT technology. In addition to that systematic switching on/off of street lights and progressive dimming of street lights based on vehicle's movement can be achieved with this which aids in energy saving.

2 Objectives

This project aims to integrate IoT into street light systems to avoid waste of Energy and detect faulty street light. We aim to:

- **Develop a street light remote system:** Conception and realize a prototype of a street light remote system with the ability to connect and control it remotely.
- **Use devices that are easy to install:** : When choosing the components to install and work with, an optimal combination of components needs to be chosen to reduce the cost, can be easily installed in existing buildings, easy to work with, and interact with.
- **Reduce the human intervention:** Making the user experience as easy as possible is one of the main objectives, by reducing the human intervention in the street light systems.
- **Scalability:** The network should be salable, which means we could add new street lights to the IoT network's system easily.

3 Functionalities

In this section, a detail of the functionalities of the project. We can split the functionalities into two parts: The first one details the sensors and the IoT network, and the second is the details of the mobile application used to control the appliances.

3.1 Sensors and IoT network

Different sensors will be used for different measures:

- **Energy saving:** Detect the presence of vehicles on the road and light the way. Otherwise, street lights should be switched off. Recognize day night cycle and manage lighting accordingly.
- **Detect faulty street light:** In case there's a defected street light, the technicians should be notified.

3.2 Mobile Application

- The mobile application can be installed on different platforms like Android, iOS and Web.
- The head of the Smart-Lighting system of the municipality can register and create and account with full access and he can register the technicians as simple users.
- The head of the Smart-Lighting system can add new sensors to the network by adding its sensor_id.
- The head of the Smart-Lighting system can follow the state of all sensors and get visualizations in real-time.
- The technicians get notified when a street light is defective to repair it.

4 Components

After considering our options, market availability and the different advantages and disadvantages of each component, we ended up picking the following parts:

- Arduino Uno: Arduino Uno is a cheap and power efficient microcontroller board based on the Microchip ATmega328P microcontroller. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits such as WiFi and Bluetooth modules and. This card will be responsible for processing sensor data and diffusing them to our backend.
- Sensors:
  - **HC SR-04 Ultrasound**: To detect passing vehicles.
  - **LDR** (Light dependent resistor): Also known as a **photo-resistor** to detect time and deduce to either turn of all lights if it is daytime or activate smart lighting mode if it is dark.
- **LEDs**: Will be used to simulate street lights.
- **Resistors**.
- **ESP8266 WiFi Module**.

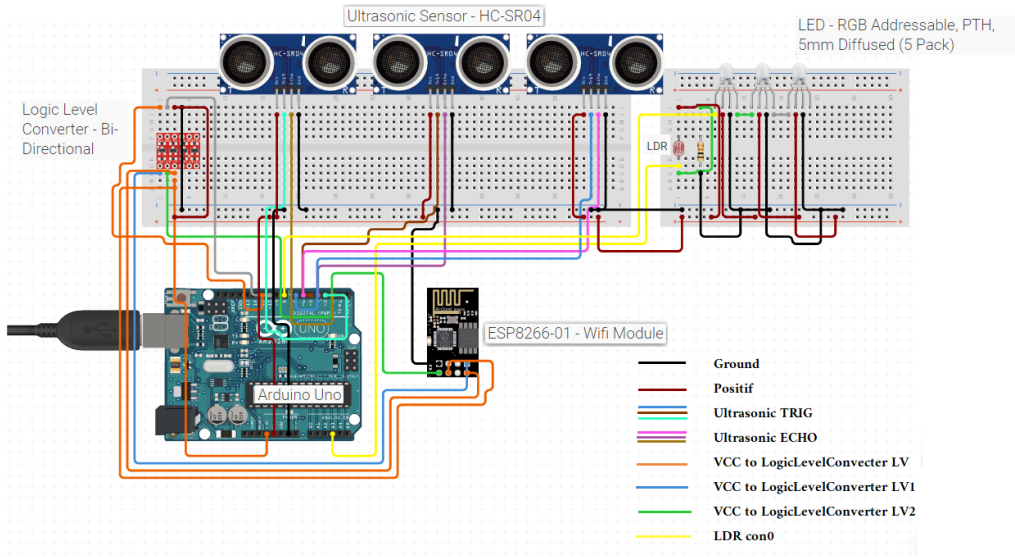

Figure 1: Smart street light module Schema

5 Technologies

When it comes to the software side of things, we will be using the following technologies to develop the different parts of our application:

- **Back-end**:
  - **MongoDB**: MongoDB is a source-available cross-platform document-oriented database program. Classified as a NoSQL database program, MongoDB uses JSON-like documents with optional schemas.
  - **Node RED**: Node-RED is a flow-based development tool for visual programming developed originally by IBM for wiring together hardware devices, APIs and online services as part of the Internet of Things. Node-RED provides a web browser-based flow editor, which can be used to create JavaScript functions. **We will use it to handle sensor events**.
  - **MQTT**: MQTT is a lightweight, publish-subscribe, machine to machine network protocol for Message queuing service. **It will be used to communicate data to a cloud MQTT broker**.
  - **Mosquitto**: Mosquitto is an open source message broker that implements the MQTT protocol. It is lightweight and is suitable for use on all devices from low power single board computers to full servers.
- **Middle-ware**:
  - **Jakarta EE**: Jakarta EE is a set of software components, APIs, for developing specifically enterprise Java applications. These components are often referred to as specifications. Jakarta EE specifications extend Java SE (standard edition Java programming language) with ways to perform the functions particulary useful for an enterprise application.
  - **WildFly**: WildFly is a powerful, modular, secure lightweight application server compatible with Jakarta EE.
- **Front-end**:
  - **Flutter**: Flutter is Google's mobile UI framework for crafting high-quality native interfaces on iOS, Android, web, and desktop using native components and functionalities.

6 Deployment Diagram

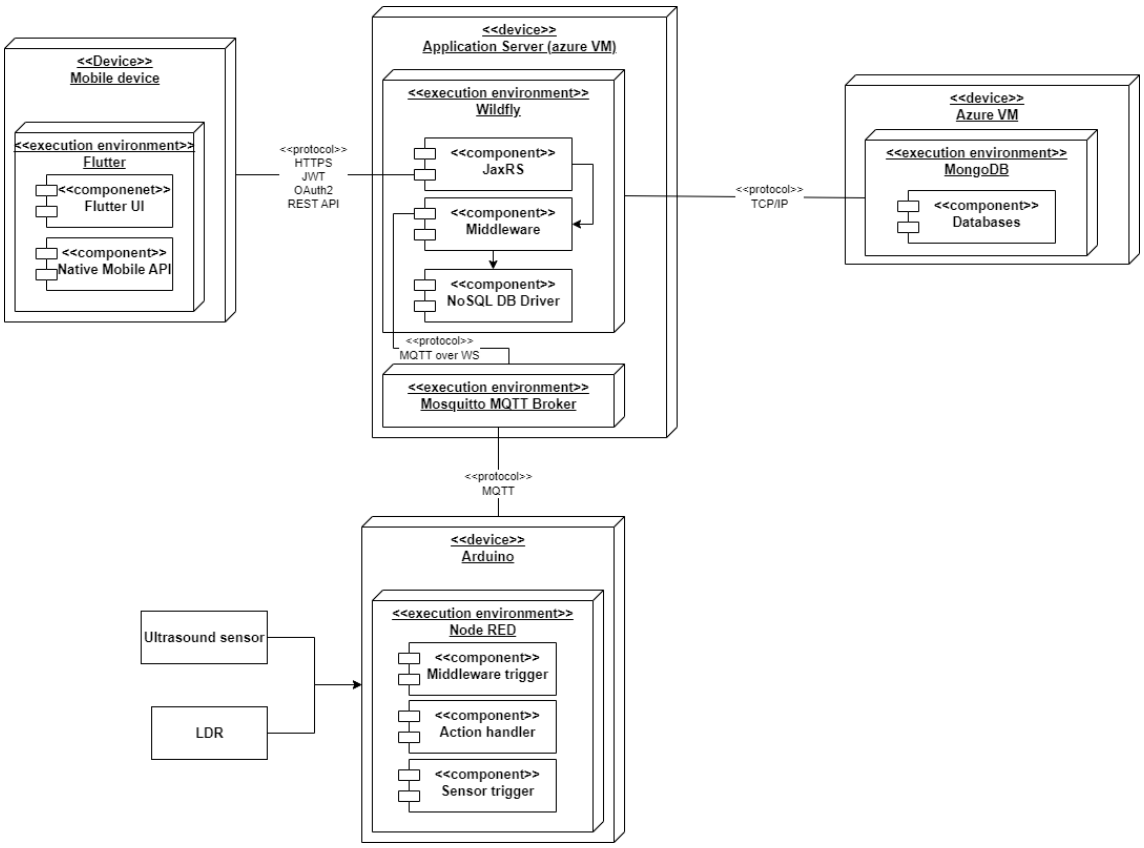

Figure 2: Smart Street Lighting Application Deployment Diagram

7 Project Timeline

The project development will undergo different steps:

- Planning Smart Lighting architecture an connecting objects.
- Handling collected data and connecting to cloud MQTT broker.
- Implementing database logic.
- Developing necessary APIs and connecting to database.
- Hosting Jakarta EE on a cloud server.
- Developing Flutter mobile application and connecting to the web server endpoint.
- Creating a Smart Lighting prototype and simulation.
- Organize and update the project repository with a Design Book, Full source code, Technical documentation and a Demo video.

8 Deliverables

When all Tasks are done and testing wraps up, the following items will be handed in over the GitHub repository used during the whole development:

- The Mobile Application executable.
- The source code.
- A miniature prototype for demonstration purposes.
- A markdown listing a description of the project, the used components deployment steps.

9 Assumptions and Constraints

We will assume that the head of Smart Lighting system have a full access to all sensors and their addresses.

10 Business Study: Business Model Canvas

Figure 3: Smart Street Lighting Business Model Canvas

11 Marketing Study

Figure 4: Smart Street Lighting 4P Matrix

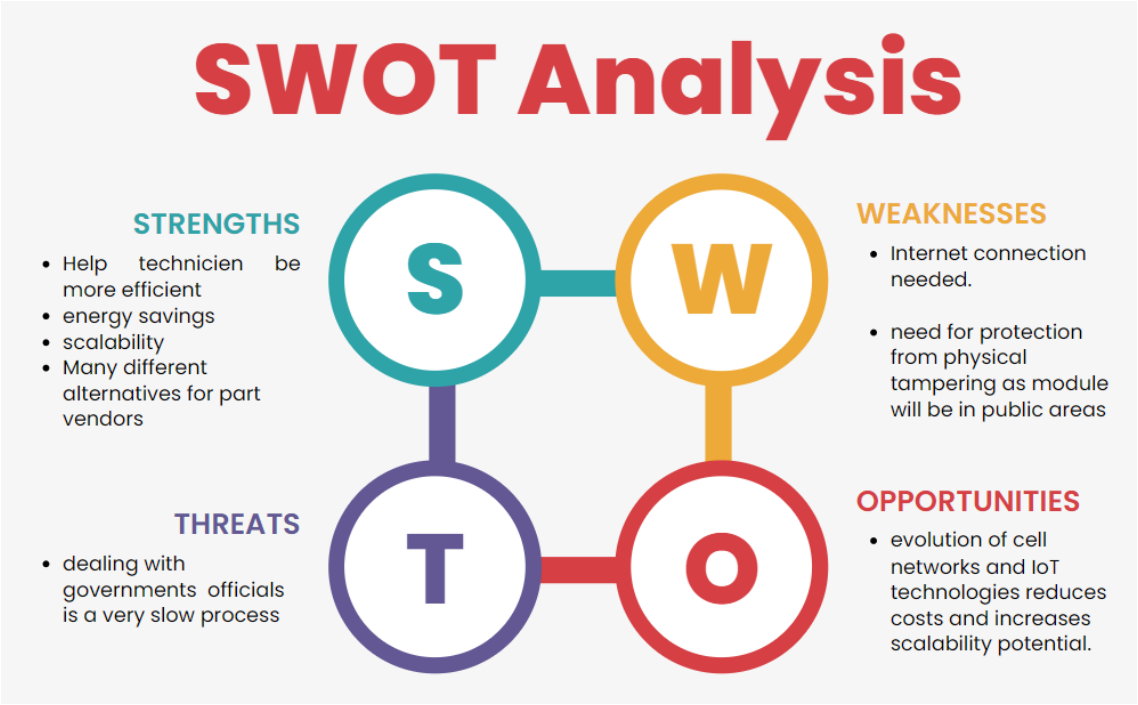

Figure 5: Smart Street Lighting SWOT Diagram