IoT Based Smart Street Light System

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Abstract

The electric power in most of the countries in the world is utilized in lighting the streets. The electrical energy consumed by street lights is not efficiently used because the need for streetlamps is not essential in every street in all periods. The researcher proposes a system that automatically switches off the light for the parts of the streets having no motion detection and turns on the light for the parts of streets where motion is detected when it is dark. Smart street lighting also controls the luminosity of light based on motion and performs automatic light dimming which is an aspect that serves to reduce energy consumption. The intensity of light can be controlled based on the number of vehicles and the weather conditions. The idea of this project is to provide smart street lighting by measuring the sunlight intensity and observing objects' movement on the street, to decide whether to turn on or off the lights that are implemented in a section of the street. Sensors will be connected through wires to the microprocessor providing instant data to be analyzed. The microprocessor will process coming data and compare it to predefined standards. The result of this process will come up with a new status for street lights. It can provide needed data to other sections of the street and collect enormous data used in smart city applications.

Introduction

It is seen in several cities that the street light is one of the huge expenses in a city. Saving of the spendings on the street light can be used for other development in the nation. Currently, a manual system is used where the light will be made to switch ON/OFF automatically i.e the light will be made to switch ON in the evening based on objects' existence on the road and switched OFF in the morning. Hence there is a lot of wastage of energy between the ON/OFF. This is one of the major causes of shifting to the automatic system since there is less wastage of power and thus saving a lot of energy and money.

Problem Statement

The electric power in most of the countries in the world is utilized in lighting the streets. However, the electrical energy consumed by street lights is not efficiently used because the need for streetlamps is not essential in every street in all periods. In this paper, the researcher proposes a system that automatically switches off the light for the parts of the streets having no motion detection and turns on the light for the parts of streets where motion is detected when it is dark. Smart street lighting also controls the luminosity of light based on motion and performs automatic light dimming which is an aspect that serves to reduce energy consumption. The intensity of light can be controlled based on the number of vehicles and the weather conditions.

Motivation

Smart Street Light System meets the targets to achieve Sustainable Development Goal 11 (SDG 11). It helps to make cities inclusive, resilient, and sustainable by providing a solution that cuts energy wastage using IoT technology.

Literature Review

It is necessary to analyze various aspects of the smart street light system that were anticipated by other researchers. The following is a description of the work done on Smart Street Light involving various components and different algorithms [1]. Different aspects of the project were developed and implemented across several platforms. Electricity is an essential component of rural development. In this paper, a smart system is proposed for implementing a bright control system. The street lights are controlled by an IR sensor and the LDR sensor identifies their power. A solar cell serves as the battery. As a significant part of this paper, surveillance cameras fixed on street light lamps are used to monitor the entire traffic system via the internet. Using the internet, street lighting can be turned on or off remotely. The road activities are tracked using a camera mounted over the street lights, and the footage is stored on a server [2].

There are various components used in IoT, in this paper some of them are covered according to [3]:

- **Raspberry Pi:** A Raspberry Pi can provide all the implicit forecast capabilities, at a low power expenditure level**.** It is an affinity (debit) card-sized computer designed by BBC Micro for education.
- **Ultrasonic Sensor:** A sonar or radar sensor that uses ultrasonic waves to detect the presence or calculate the distance to a target.
- **LDR Sensor:** An LDR (Light Dependent Resistor) is also called a photoresistor. These devices are light-dependent. By lowering the light on the LDR, the resistance level will become lower. When LDR is moved to the dark region, its resistance level increases since this is a dark region.

Proposed System

The idea of this project is to provide smart street lighting by measuring the sunlight intensity and observing objects' movement on the street, to decide whether to turn on or off the lights that are implemented in a section of the street. Mainly, sensors will be connected through wires to the microprocessor providing instant data to be analyzed. The microprocessor will process coming data and compare it to predefined standards. The result of this process will come up with a new status for street lights. However, the system can be controlled by authorized representatives to manage the lighting manually. This will interrupt current system behavior and change the lighting status for the desired time. Cloud communication happens through a web portal that communicates with the system's brain through secure lightweight APIs. Also, since the system is connected to the internet, it can provide needed data to other sections of the street and collect enormous data used in smart city applications.

Disadvantages of Existing System

- Manual switching off/on of street lights.
- More energy consumption.
- High expense.
- More manpower.

Advantages of the Proposed System

- Automatic switching of street lights.
- Maintenance cost reduction.
- Reduction of light pollution.
- Wireless communication.
- Energy-saving and environmentally friendly.
- Reduction of manpower.
- Money saving

Components

1. Raspberry Pi: A microprocessor that plays a thinking mind role in the system by deciding the state of the lights. It also will provide APIs to manually control the system.
2. LDR Sensor: It senses and measures the sunlight intensity which will be provided to the microprocessor.
3. Ultrasonic Sensor: Senor that represents possible object movement detectors.
4. LEDs: Diodes that represent the street lights
5. Breadboard, Resistors, and Cables: Provide the interconnection between other components.
6. Software deployed on the microprocessor [4].

Circuit Diagram

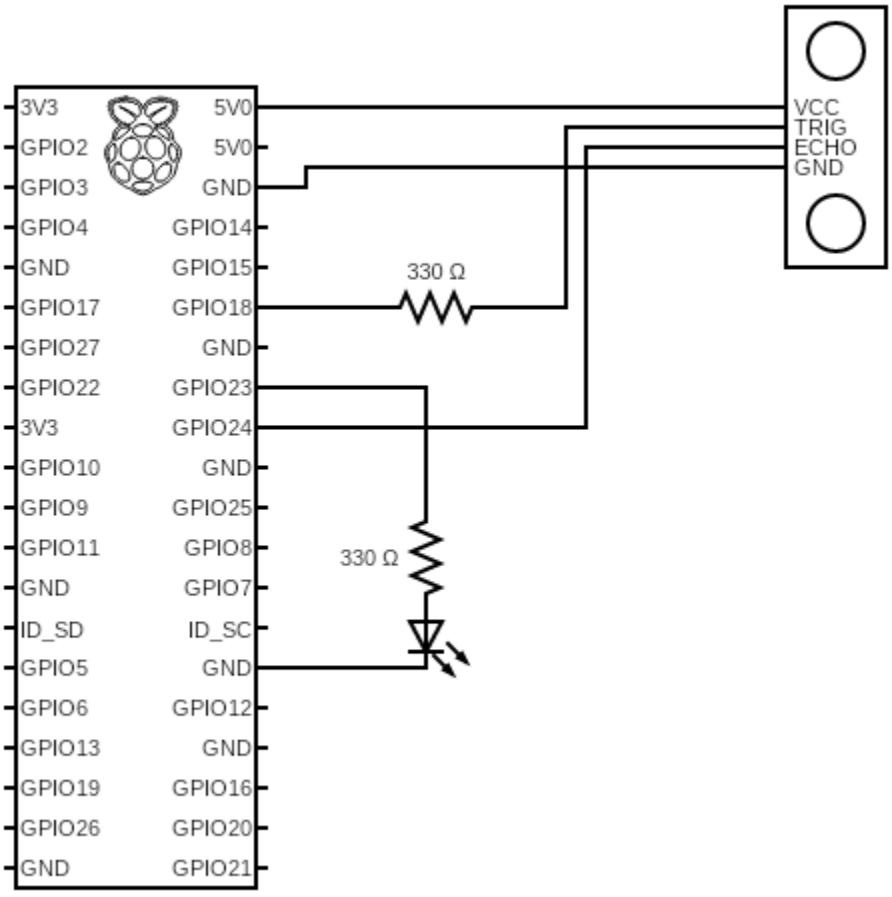

Figure 1

Flowchart

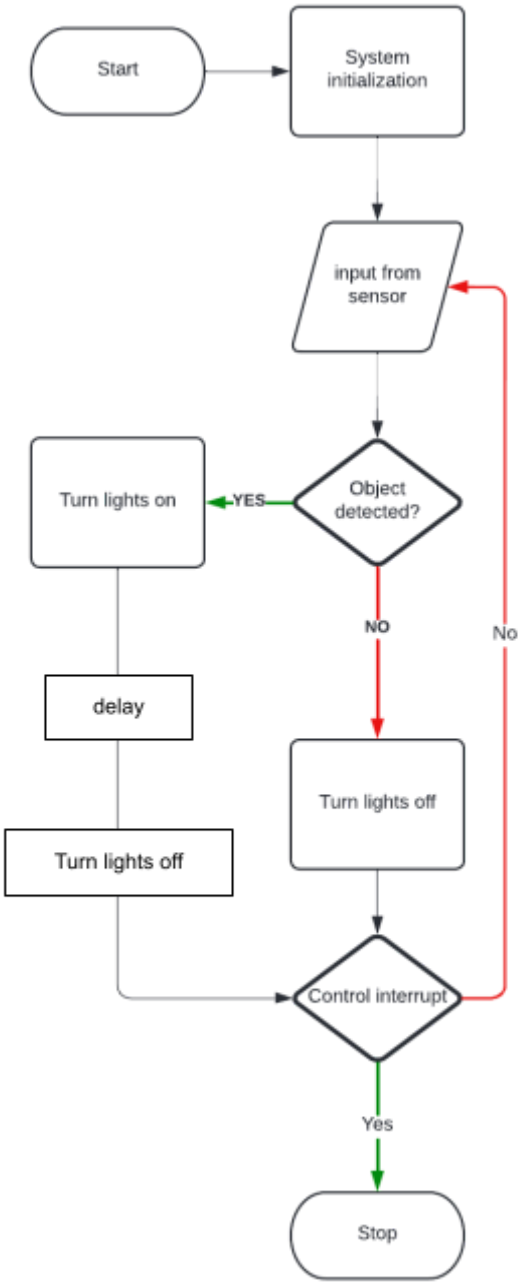

Figure 2

Security

These days security of IoT devices is a big concern that needs to be handled carefully. However, the proposed system will be implemented in the container box of the street lights connecting with grounded wires to the required sensors. This method will protect the system at the first layer. For internet connectivity, it can be done by mobile data or isolated wires. Communication will be only through RESTful APIs secured with OAuth in both cases.

Future Work

Although the current demonstration contains simple parts, the system can be upgraded with multiple sensors for advanced object movement detection. This can happen by implementing AI modules. Also, AI modules can contain tools for detecting objects' speed to relatively provide awareness to the near sections and calculate the necessary time to keep lights on. Moreover, the system can be enhanced by solar panels to provide the needed power for lightning, which will present a more isolated and even make it more environmentally friendly.

References

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