

Smart Street Lights Management System

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Abstract

The proposed device is a smart wireless sensor that can establish an auto-adaptive mesh network and concentrate all devices information in a data center. Each device has a current sensor, designed to identify whether a lamp is turned on or off. A microcontroller receives the sensor state and delivers it to a wireless module (NRF24L01), responsible to communicate with others devices. The system allows verifying, in real-time, each light spot's state and save it in an operational log.

Key words: Mesh Network, Smart Sensor, Street Light Management.

Introduction

Based on the ANEEL (Brazilian Electric Regulatory Agency) 414/2000 resolution¹, streetlights management and maintenance are public responsibility since January 2015. For example, Campinas has one hundred lamp replacements on a single day².

This project intends to manufacture system to simplify this duty, as the diagram block shown in Figure 1.

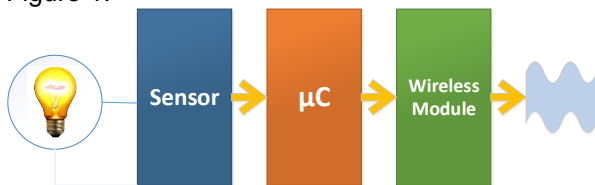


Figure 1. System Block Diagram

A current sensor identifies whether a lamp is turned on or off and sends the information to a microcontroller (Arduino Pro). The Arduino receives the sensor state and delivers it to a wireless module (NRF24L01), responsible to communicate with others devices and create an auto-adaptive mesh network. All information will be stored in a master device.

Results and Discussion

Initially, using the NRF24L01, a low cost wireless 2.4GHz transceiver module, mesh networks controlled by Arduinos were established. Then, a current transformer sensor designed using Spice simulation and PCB EDA Tools (Altium Designer) was manufactured.

Finally, a shield to obtain a compact three-module device was implemented, interfacing the Arduino and NRF module, as the 3D model shown in Figure 2:

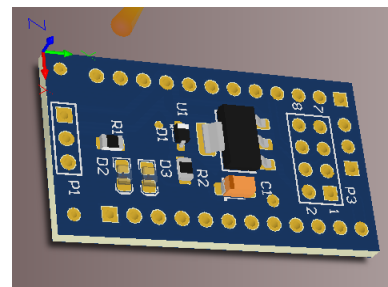


Figure 2. Altium 3D Model of a Device Shield

As a result, a device list with the state of each lamp and the last response time were obtained through a serial communication (COM port), allowing saving an operational log.

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DEVICES LIST:
Device 0:      Status: 1      Last Ping: 2347073
Device 1:      Status: 1      Last Ping: 347346
Device 2:      Status: 1      Last Ping: 345221
Device 3:      Status: 0      Last Ping: 2347073
```

Figure 3. Four devices network example

Conclusions

The proposed device works properly and drives all sensor states to a data center. Other 10 shields devices will be included in the system in order to increase the network range. The device may be used to simplify streetlights maintenance and management, reducing energy loss and producing a real-time sensor network.

Acknowledgement

This work was supported by a FEEC-IC scholarship program.

¹ ANEEL (Brazilian Electric Regulatory Agency): "Prefeituras terão até 31/12/2014 para assumir os ativos de iluminação". (Jan 2015) http://www.aneel.gov.br/aplicacoes/noticias/Output_Noticias.cfm?Id entidade=7558&id_area=90

² Street Light Plan – Campinas (2006) (Jan 2015) http://www.campinas.sp.gov.br/governo/seplama/plano-diretor-2006/doc/tr_ilum.pdf