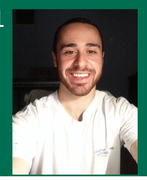
A Raspberry Pi-based Autonomous Home Lighting System Controlled by Google Calendar Events

1 

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ABSTRACT

The advent of the Internet of Things and small computer systems such as the Raspberry Pi has allowed objects to collect data and react to their environments regardless of their geographic location. The ability to remotely control objects over the Internet has begun to play a vital role in the "Green Movement," by allowing people to control energy-consuming electronics, such as lights, remotely. Many of these systems have relied on explicit user input, but little research has been done to make this form of energy conservation autonomous. We propose a Raspberry Pi-based and autonomous energy-saving system which relies on the user's Google calendar data to determine when the lights are supposed to be off, and accordingly turns the lights off. The proposed system has been split into three phases of implementation: retrieving the events data from the Google Calendar, analyzing the data, and finally, adjusting the lights. In this poster, we focus on three potential methods to tackle the first phase of the proposed system and evaluate the pros and cons of each method.

MOTIVATION

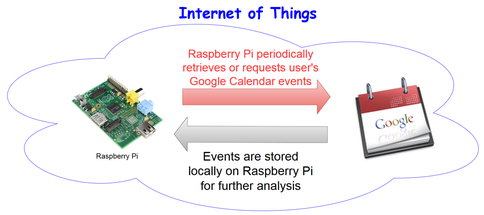
- One-third of all lighting (amounting to 30 million barrels of oil and 8.2 million tons of coal) in the U.S. is wasted. This wasted lighting causes the unnecessary release of 14.1 million tons of CO_2 into the atmosphere. [1]
- Lighting is responsible for one-fourth of all electricity consumption worldwide. [2]
- In Australia, light is the single largest source of greenhouse gas emissions. [2]

OBJECTIVES

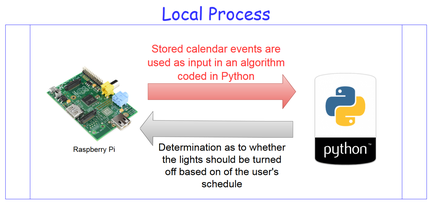
- Reducing the devastating effects of light pollution by assuring that lights are turned off when they aren't needed.
- Automating the process of conserving electricity by analyzing a user's Google calendar to determine when their lights can be powered off.
- Integrating a widely-available and affordable Raspberry Pi as an object of the Internet of Things in order to optimize the effectiveness of the automation and conveniently minimize user interaction.

THREE PHASES OF THE PROPOSED SYSTEM

I Getting Google Calendar data



II Processing calendar data



III Adjusting the lights

PHASE I POTENTIAL METHODS

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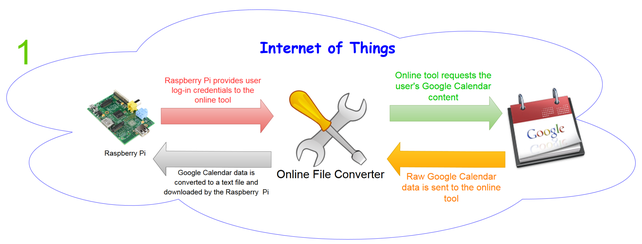

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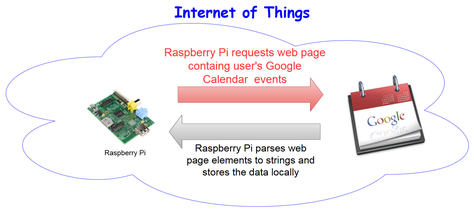

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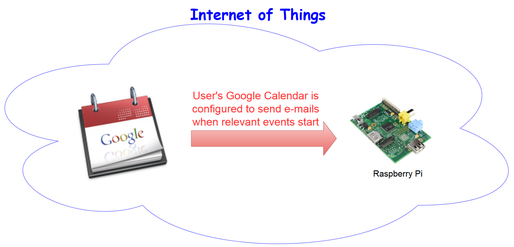

PROS AND CONS FOR EACH METHOD OF PHASE I

Method 1 – Converting Google Calendar to a CSV file using an online tool

Pros	Cons
.CSV format is easier for analysis	Storing user credentials is a security risk
Users will only provide their log in credentials once	Raspberry Pi will have to periodically check the calendar for updates
	Converting to a .csv requires an extra step as compared to direct download

Method 2 – Having the Raspberry Pi extract events directly from the Google calendar.

Pros	Cons
User provides log in credentials and a private link only once	Security issue: Storing log in information and the private link
No online tools or Raspberry Pi-specific e—mail address required	Raspberry Pi will have to periodically check the calendar for updates
All Google calendar information available for analysis	

Method 3 – Sending calendar events to the Raspberry Pi via e-mail.

Pros	Cons
Algorithm to operate lights in this manner has already been researched	User must modify account settings
User credentials will not be stored or transmitted	User will have to create a new calendar and/or change how they enter events
No need to check the calendar for periodic updates	Future changes in user settings may impede effectiveness of the system

FUTURE WORK

- Weighing the pros and cons of each method for Phase I and selecting one to incorporate in the proposed system
- Developing a working prototype of the proposed system by following the same steps for design and implementation of Phase II and III
- Integration of a mobile application

Motivation Citations

1. Florida Atlantic University. (2012, May 14). Light Pollution Hurts Our Economy and Our Resources.
2. Australian Government Department of Environment, Heritage and the Arts.(2009, Jul. 11). Public Lighting – Energy Efficient Street Lighting.