Cost Efficient Smart Street Lighting System

Poster · January 2017

DOI: 10.13140/RG.2.2.36255.41127

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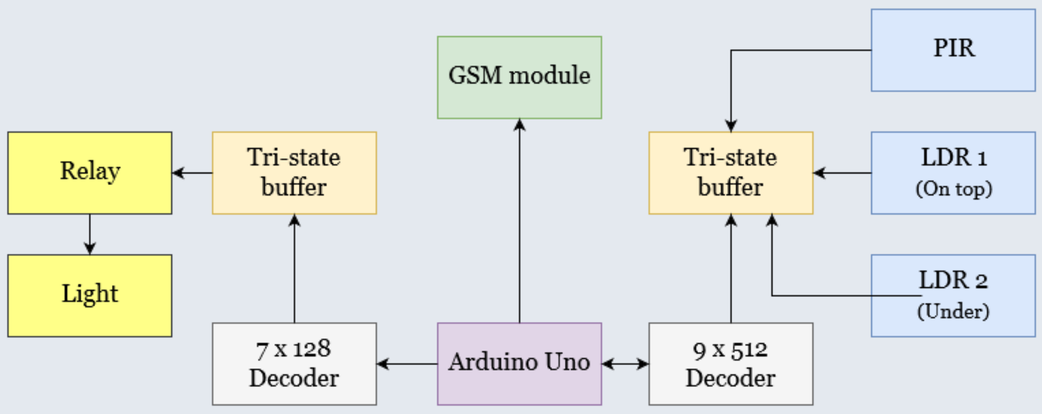
Background

This poster presents a cost efficient street lighting system. For the time being, many researchers have made different solutions for smart street lighting system. These different solutions for smart street lighting system provide different facilities such as: automatic switching on/off the lights in absence/presence of daylight [1], controlling of lights based on the movement of pedestrians or vehicles [2] and central control over the whole system [1-3]. Energy has always been a valuable resource. Therefore such smart system can be helpful for us to save energy. Besides, existing system is expensive to implement. Hence this expensive system can not be used in large scale. Here we propose a low expensive embedded system that can be implemented in large scale. Beside this, our proposed system supports a maintenance procedure which will be remotely maintained using an application over smartphones. Our system saves the information of sensors and keeps track of light failures for future reference.

Motivation and Problem Formulation

Street lighting is one of the basic infrastructures of a city. Pedestrians and vehicles use streets differently at different hours in regular basis. If we carefully observe their movement, we notice that the streets may not be busy all the time. That means we can find out some random times in which the streets remain unused . We model this observation in a probabilistic manner to find out absence or presence of pedestrians in the streets. These observations are useful to switch on/off the lights. Our aim is to develop a system that would serve several purposes. It will turn on the street lights in case of absence of daylight and turn them off otherwise. Subsequently at night both pedestrians and vehicles are less likely to use the streets after a certain period. Therefore to keep the lights turned on at that time is a waste of energy. Our smart system senses movement of the pedestrians as well as vehicles in the streets and turn the lights off or on accordingly. If the intensity level of any light falls below a certain threshold level, our smart system will notify the concerned person about this faulty behavior through the application or the system will send an SMS to the concerned person. It will also store these data in a database for future reference.

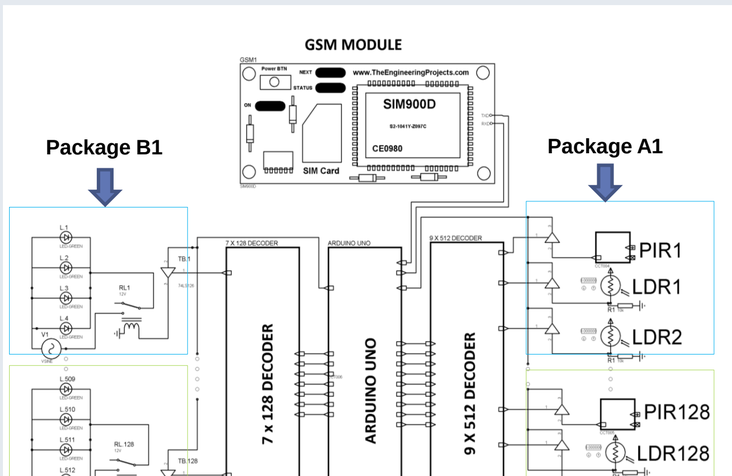
Proposed Methodology



- Arduino continuously polls the 9x512 decoder to read the states of PIRn, LDRn
- A tri-state buffer enables a single sensor at a time retrieving its data
- Arduino takes decision from the received data of sensors to turn on specific lights
- 7x128 decoder is used to turn on these specific lights
- LDR1n detects light intensity of atmosphere
- PIR detects if a pedestrian passes by
- If light intensity is low and a pedestrian passes by then light turns on
- LDR2n measures light intensity of street lamp
- If value of LDR2n is less than a threshold value given that street lamp is turned on, system considers the lamp as out of service
- System detects the lamp identification (id) number and sends this id number to authorities using GSM module
- Using that id number location of lamp is detected

Circuit Diagram

- Arduino is the central component of whole system.
- There are total 128 packages. Subdivided by Package A and B.
- Package A contains input components (PIR, LDR1,LDR2, 3 tri-state buffers)
- Package B contains 4 parallelly connected lights, connected to an AC source using a relay
- GSM module is connected to the Arduino via RX, TX pins



Feasibility Analysis

Feasibility Sector	Resources Required	Comments
Technical Feasibility	**Existing system:** Cost = 60W*128*12hr/1000 = 92.16 Unit **Our system:** $P_{Arduino}+P_{GSM}+P_{PIR}+P_{Decoder}+P_{tri-state}+P_{Relay}+P_{Light}$=(5*40+3.5*2+ (3.3*150+5*10+5*10+5*100)*128) *24+ 60*128*6 = 49.45 Unit	Electronic devices reduce the electric energy usage by a large amount.
Socio-economic Feasibility	Complete control of the system is autonomous. Simple SMS system with ID of faulty light that is easy enough to understand.	People irrespective of technical knowledge can understand the system.

With our system, we save approximately (92.16-49.45) = 42.71 Unit daily, total savings is 306.23 BDT daily considering the electricity cost. Our initial setup cost is 36030 BDT. Hence after operating only for 118 days we will gain our set up cost.

Comparative Analysis

Our system uses a single microcontroller unit to operate multiple modules whereas the existing systems use one microcontroller unit per module. This optimization makes a significant improvement from the existing system. We propose to use decoders and tri-state buffers to control 128 street lights with a single Arduino Uno. Even with the most inexpensive microcontroller unit used in a large scale that increases the cost geometrically, this is a significant cost optimization. Thus comparing with most of the existing systems, our smart system is both energy and cost efficient. Moreover, unlike others our system is associated with an application over smartphone to communicate with the centralized database.

Conclusion and Future Work

We are working on the system to make it more energy efficient. At present our system cannot distinguish among people, vehicles, animals and other objects. We are trying to improve our system so that it would distinguish these objects.

References

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NSysS 2017, January 5-8, 2017, Dhaka, Bangladesh