Research Article *ISSN: 2319-507X*
Shweta Dawley, IJPRET, 2013; Volume 1(8):461-469 *IJPRET*

INTERNATIONAL JOURNAL OF PURE AND APPLIED RESEARCH IN ENGINEERING AND TECHNOLOGY

A PATH FOR HORIZING YOUR INNOVATIVE WORK

ADAPTIVE STREET LAMPS

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Accepted Date:

27/02/2013

Publish Date:

01/04/2013

Keywords

Street Lamps,

Switche,

Power Consumption

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Abstract

Providing street lighting is one of the most important and expensive responsibilities of a city. Street lighting is particularly critical concern for public authorities in developing countries because of its strategic importance for economic and social stability. Inefficient lighting wastes significant financial resources each year and poor lighting creates unsafe conditions. The important consideration in the field of electronics related technologies are automation, power consumption and cost effectiveness. Automation is intended to reduce manpower with the help of intelligent systems. Power saving is the main consideration forever. Now-a-days, human has become too busy and he unable to find time even to switch off the lights wherever not necessary. This can be seen more effectively in case of streetlights. The present system is like, the street lights will be switched on before the sun sets and they are switched off next day morning, after there is sufficient light on the roads. But the actual timings for these street lights to be switched on are when there is sufficient darkness. With this, the power will be wasted up to some extent. This project gives the best solution for electrical power wastage. Also the manual operation is completely eliminated. The term adaptive is used to define the concept of varying brightness levels. The main goal of the project is to control the switching of street lights automatically. This allows us to realize the task efficiently and effectively without the intervention of human by making it automated.

INTRODUCTION

In todays fast moving world innovations and inventions are being made on day to day means leading to maximize technology use in every industries and household that ultimately leads to use of electrical energy resulting in higher consumption of this electrical form of energy widely across the globe. In the same ratio production/ conversion of this form of energy is not happening leading again to think where energy can be saved. One situation is mostly considered where electricity can be saved , that is in street lighting, because in cities or villages or towns at night all street lamps are made on whereas very less are used for actual usage in traffic.This project deals with fabrications of model of adaptive street lamps.

The specific goals and objectives of the project are:

1. Determine the energy reduction potential of advanced street light technologies, LED and induction, as compared to traditional HPS source.
2. Evaluate the light characteristics of each technology to determine if energy efficiency is possible without a compromise in light performance.
3. Conduct an economic impact analysis on each technology as compared to the HPS
4. Identify alternate lighting technologies that are suitable substitutions for high pressure sodium technologies.

1.1 Background

Environmental Services Department (ESD) has been performing energy improvements in various existing City facilities. During lighting fixture conversions to new state-of-the-art florescent type lighting, it was discovered that the broad-spectrum light, 'white light' enhances visual acuity. They sought to expand the application of broad spectrum lighting to determine what advantages it may offer for outdoor lighting, including street lights in the right-of-way. To evaluate various types of broad spectrum street light technology, they collaborated on a project to identify and evaluate advanced street light technology which can benefit the public. Indonesian engineers are also developing a green street lighting system that bathes moving vehicles

in a pool of light but switches off after they've gone. Jakarta is one of the biggest cities in the world. With 10 million inhabitants, it is the most populous in south east Asia and the 10th biggest on the planet. Lighting such a city at night is an expensive business. Jakarta has over 200,000 street lights, which cost the equivalent of about $17 million dollars to run in 2007. The city has plans to double the number of street lights but would obviously like to minimise costs. So Suprijadi, Thomas Muliawan and Sparisoma Viridi at the Institut Teknologi Bandung in Indonesia have come up with a novel plan.

1.2 Block Diagram

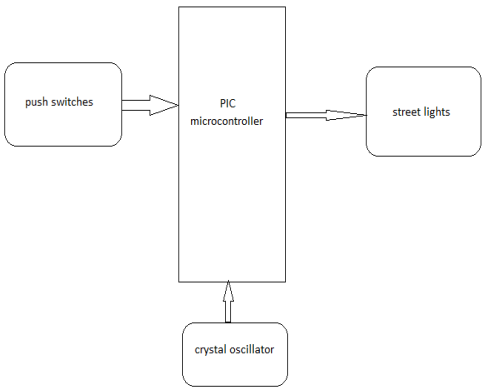

Figure 1: Block Digram

1.3 Circuit Diagram

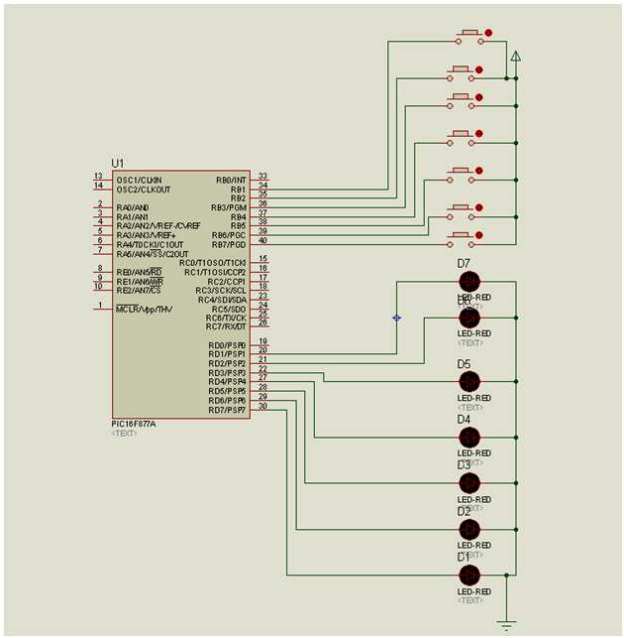

Figure2:Circuit diagram

2. CONSTRUCTION AND WORKING

The project work is divided into two parts a mechanical mode and an electronic control unit (ECU). The work is fabricated using parts like MDF sheet, acrylic sheet etc which forms mechanical part of the project. For the electronic form various components like PCB, microcontroller, capacitors, resistors,power supply units like transformer, voltage controller IC, capacitors rectifier bridge etc are used.

The construction goes like by forming a mechanical base. First of all MDF sheet of 8mm thickness and 4 foot long, 6 inches in

width and side supports are kept 4 inches in height. Thus a box of MDF sheet is made forming a size 4 foot x 6 inches x 4 inches. The underneath side is kept open for connection of wiring. The top of this box is provided with a cut window for wire connections to ECU.

For street lamps purpose 4mm thick acrylic sheet is used. These lamp points are 2cm thick and approx. 20cm in height. These lamp points are attached to the side of base box at a distance of approx. 11cm from each other. At the top end of these lamps points a 3.7V white focus LED facing downwards so as to look alike street lamps. FRC cable is attached to this LED and is connected to ECU.

At the central point of the base box various push to on type of switches are attached.

There are in all 10 number of lamp points and 6 switches in this project model.

Out of these 10 lamps only 6 are adaptive in nature. The sequence is kept like the street lamp number 1,4,7,10 are kept always on because if they are kept off, it will make the area dark leading to unwanted activities like thefts. So it is necessary to keep some part of that area lighted. On the other hand street lamps 2, 3, 5, 6, 8, 9 are kept adaptive in nature. Thus, those 6 push to on type of mechanical switches are sensors corresponds to above mentioned street lamp number. The mechanical switch sensor for each lamp are placed some distance before the actual lamp. For example: The first switch that corresponds the lamp 2 is actually placed in line with the street lamp 1 and the second switch that corresponds to the street lamp 3 is placed in line with the lamp 2 and the number 1 switch is placed in line with the lamp number 3 because lamp 4 is always in ON condition. Whereas the mechanical switch sensor number 3 is placed in line with street lamp number 4 and it corresponds to the street lamp number 5 and so on.

The mechanical switch sensors and the lamp on lamp posts are connected to ECU. The ECU senses pressure of any pedestrian passing by with the help of weight/ pressure exerted and makes the corresponding street lamp post ON for

sometime sufficient enough to make the person pass by the relative area of illuminations. A street lamp is made only ON when there is somebody passing by on using the relative area covered under the corresponding street lamp. This is the project is constructed and its working.

2.1 CONSTRUCTIONAL DIAGRAM

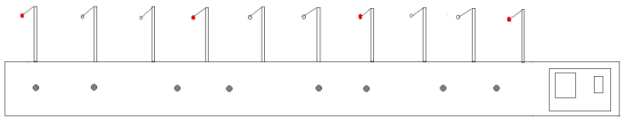

FIGURE 3: Constructional diagram

2.2 DIAGRAMMATIC EXPLANATION OF WORKING

2.2.1: STEP 1

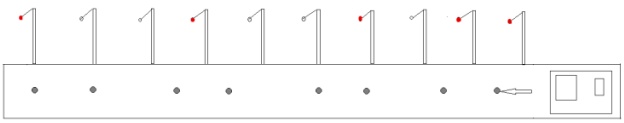

Figure 4: Step 1

2.2.2: STEP 2 and STEP 3:

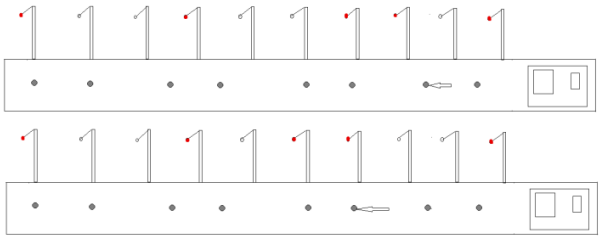

Figure 5: Step 2 and 3

2.2.3: STEP 4 and STEP 5:

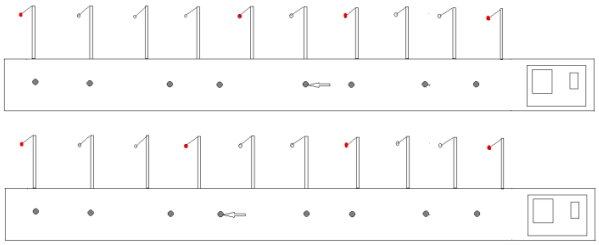

Figure 6: Step 4 and 5

2.2.4: STEP 6 and STEP 7:

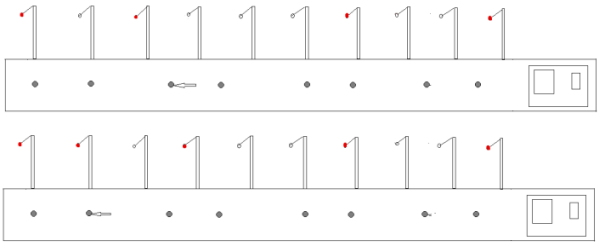

Figure 7: Step 6 and Step 7

2.2.5: STEP 8:

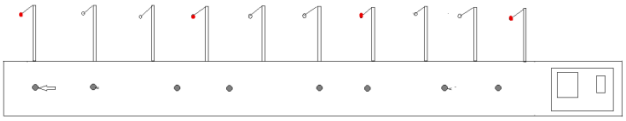

Figure 8: Step 8

3. TECHNOLOGY USED

3.1 LED Technology

Light-emitting diode (LED) technology is a fast-evolving technology with significant energy-saving potential. Operating for an average of 10 hours per day, LEDs have a life span of up to 13 years, and provide a pleasant spectrum of light (Masthead LED Lighting, 2009). The lifetime and performance depends on quality of the LED, system design, operating environment, and other factors such as the lumen depreciation factor over a period of time. Although the upfront cost of the LED is more than the cost of most HID lamps, the energy consumed by the LED is half of the lamp's energy (or less) and LEDs last longer than conventional lamps, resulting in significant savings. The LED fixture does not require a ballast or a capacitor; instead it converts the supply voltage to low voltage direct current, using a small electronic power supply.

3.2 Light-Emitting Diode (LED) Street Lights

Advantages:

- Very long life
- Reduced maintenance costs due to long lifetimes
- Do not contain toxic chemicals (e.g., mercury)
- No warm up needed (no time delay to reach optimum brightness levels)
- No production of ultraviolet light (which is what attracts insects)
- Useful for directing light on specific areas, since they produce "directional" light -- light emitted in one direction, rather than a diffused glow
- Can be dimmed (unlike CFLs), allowing for flexibility in controlling light levels
- High color index, providing bright, true colors during nighttime hours
- No glare effect, reducing visual fatigue for both drivers and pedestrians

Disadvantages:

- High initial costs can lead to long (several year) paybacks

- Provision of only directional light (inability to produce a "glow" emanating in all directions) limits usefulness to only streetlights that are hanging or facing downward
- Adequate heat-sinking is required to ensure long life with high-powered LEDs.

4. PUSH SWITCH

A push switch is a momentary or non-latching which causes a temporary change in the state of an electrical circuit only while the switch is physically actuated. An automatic mechanism (ie a spring) returns the switch to its default position immediately afterwards, restoring the initial circuit condition. There are two types:

4.1 PUSH TO MAKE

A push to make switch allows electricity to flow between its two contacts when held in. When the button is released, the circuit is broken.

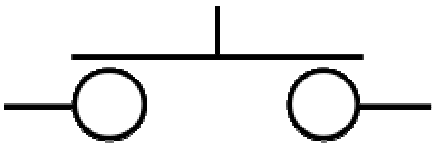

Figure 9: Push-to-make switch electronic symbol

4.2: PUSH TO BREAK

A push to break switch does the opposite, i.e when the button is not pressed, electricity can flow, but when it is pressed the circuit is broken.

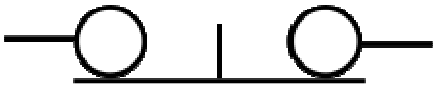

Figure 10: Push-to-break switch electronic symbol

5. ADVANTAGES AND DISADVANTAGES

5.1 Advantages:

- Saves energy upto 70% used by lighting during night hours.
- Helps in maintaining atmosphere.
- Cost cutting on electric bills.
- All lamps can be used whenever required being adaptive in nature.

5.2 Disadvantage:

- Increase cost of lighting hardware setup.

6. FURTHER MODIFICATIONS

This project can be further modified in reference with following points:

1. Sensors can be switched from simple mechanical two point contact switches to advanced infrared based beam cutting sensors.
2. Time duration of lighting can also be made adaptive in nature.
3. Number of lamp thus controlled can be further increased by implementing advanced technologies.

7. CONCLUSION

In huge city, lighting the street is a pricey precaution. Pedestrians are no doubt safer when street lamps not just car headlights illuminate roadways and sidewalks but street lamps are expensive and inefficient to run. This is a prototype system turns the light ON and OFF depending on traffic and could save money while preserving safety.

The project work thus fabricated exhibits the expected work results. The problem statement in the beginning of the work is successfully executed.

Keeping in mind some modifications suggested in the future modification and overcoming the limitations, this project could be worked in Indian cities.

The overall future of this project seems promising.

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