# STUDY CASE ON LIGHTING SYSTEM AT FACULTY OF ELECTRICAL ENGINEERING IN UiTM SHAH ALAM

**Mohd Hafiz Bin Taib**
Faculty of Electrical Engineering
Universiti Teknologi MARA (UiTM)
40450 Shah Alam

Abstract - **It is important to note that lighting systems consume most of electrical energy supplied in a building in Malaysia. In UiTM Shah Alam, most of the fluorescent lamps always turn on 24 hour per day at the corridor site. Even though the corridor site is bright on the day light, the fluorescent lamps still turn on. These contribute to energy wastage. Other than that, some of the places use too much fluorescent lamps to light up the places and these make the places become too bright and this will contribute energy wastage because this contribute more than enough energy to light up the places. There are two ways the wastage energy can be reduced. Firstly is by estimating the number of fluorescent lights that are suitable with the places. Secondly is by using a system that can control the lighting system while maintaining a comfort and safe environment in the building. This paper will presents about a lighting system focus on fluorescent lamps at Electrical Faculty in UiTM Shah Alam especially at electrical machine lab. Also reported in this paper is a control system that can control the lighting system in UiTM Shah Alam that will be proposed.**

Keyword - **Lighting System, energy wastage**

## 1.0 Introduction

Lighting plays a significant part in many of our day to day activities and there is a considerable range of lamp available to suit the various activities taking place. Selecting the correct type of lamp is therefore important if it is to meet the need of a particular activity. The efficiency of the lighting systems is also a major consideration. [6]

The low pressure of mercury vapour lamp is better known as fluorescent lamp and they use the effect of phosphorescence to produce light. Two cathode filaments coated with electron emissive material are sealed into a glass tube which contain gases such as argon and crypton with small quantity of liquid mercury, creating a low pressure region. The inside wall of the lamp is phosphor coated to produce the desired colour such as white, warm white and cool white. Figure 1.0 shows the fluorescent light and the data of fluorescent lamp is shown below:

- Efficacy range between 38 and 104 lumen per watt.
- Average life 12 000 hours.
- Wide range of color option available.
- Low operating temperature.
- Wide range of application in domestic, commercial and industrial premises.
- Dimming controls available.
- Lamp designation - MCF. [6]

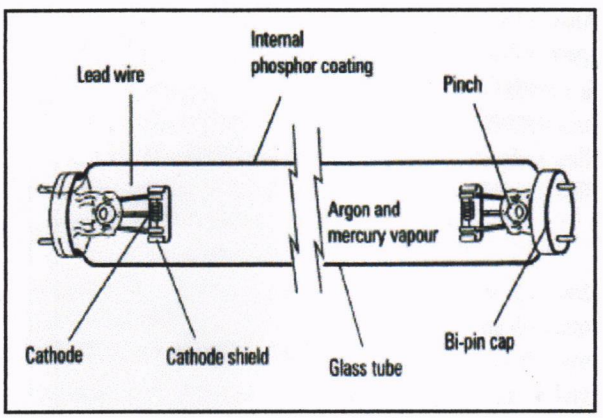
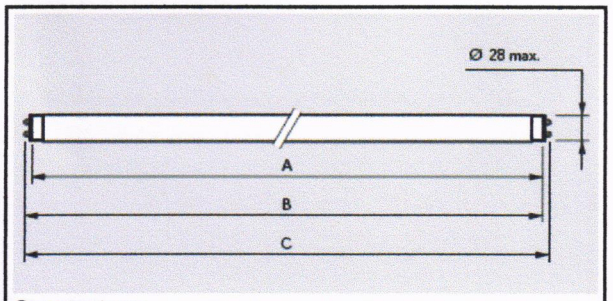



**Figure 1.0**: Fluorescent Light

Most of the fluorescent light that had been used at Faculty of Electrical in UiTM Shah Alam's building are TL-D 36W/54 and TL-D 18W/54 that are produced by Philip lighting. Table 1.1 shows the dimension of fluorescent light and Table 1.2 shows the datasheet of fluorescent light that used at Faculty of Electrical in UiTM Shah Alam.[8]

**Table 1.0**: Dimension of fluorescent light




*Dimensions in mm*

| Type | A max. | B min. | B max. | C max. |
|---|---|---|---|---|
| TL-D 14W | 361.2 | 365.9 | 368.3 | 375.4 |
| TL-D 15W | 437.4 | 442.1 | 444.5 | 451.6 |
| TL-D 16W | 720.0 | 724.7 | 727.1 | 734.2 |
| TL-D 18W | 589.8 | 594.5 | 596.9 | 604.0 |
| TL-D 23W/36W-1 | 970.0 | 974.7 | 977.1 | 984.2 |
| TL-D 30W | 894.6 | 899.3 | 901.7 | 908.8 |
| TL-D 36W | 1199.4 | 1204.1 | 1206.5 | 1213.6 |
| TL-D 38W | 1047.0 | 1051.7 | 1054.1 | 1061.2 |
| TL-D 58W | 1500.0 | 1504.7 | 1507.1 | 1514.2 |
| TL-D 70W | 1763.8 | 1768.5 | 1770.9 | 1778.0 |

**Table 1.1**: Datasheet of fluorescent light

| Commercial name | Type | Cap/ base | Lamp voltage[1] V | Lamp current[1] A | Colour designation | Correlated colour temperature K | Lumen output[2] lm | Average luminance[3] cd/m² | Nett weight g | EOC |
|---|---|---|---|---|---|---|---|---|---|---|
| /33 | | | | | | | | | | |
| TL-D | TL-D 14W /33 | G13 | 45 | 0.38 | COOL WHITE | 4100 | 730 | 0.95 | 66 | 721754 |
| TL-D | TL-D 15W /33 | G13 | 51 | 0.34 | COOL WHITE | 4100 | 960 | 0.95 | 76 | 702777 |
| TL-D | TL-D 18W /33 | G13 | 59 | 0.36 | COOL WHITE | 4100 | 1200 | 0.85 | 100 | 702661 |
| TL-D | TL-D 23W /33 | G13 | 95 | 0.30 | COOL WHITE | 4100 | 1900 | 0.90 | 161 | 726384 |
| TL-D | TL-D 30W /33 | G13 | 98 | 0.36 | COOL WHITE | 4100 | 2100 | 1.05 | 145 | 702821 |
| TL-D | TL-D 36W /33 | G13 | 103 | 0.44 | COOL WHITE | 4100 | 2650 | 1.05 | 186 | 702708 |
| TL-D | TL-D 36W/1 /33 | G13 | 80 | 0.56 | COOL WHITE | 4100 | 2800 | 1.20 | 161 | 702880 |
| TL-D | TL-D 38W /33 | G13 | 104 | 0.43 | COOL WHITE | 4100 | 3100 | 1.20 | 162 | 726698 |
| TL-D | TL-D 58W /33 | G13 | 111 | 0.67 | COOL WHITE | 4100 | 4600 | 1.35 | 233 | 702746 |
| TL-D | TL-D 70W /33 | G13 | 122 | 0.69 | COOL WHITE | 4100 | 5350 | 1.30 | 272 | 618375 |
| /35 | | | | | | | | | | |
| TL-D | TL-D 15W /35 | G13 | 51 | 0.34 | WHITE | 3500 | 960 | 0.95 | 76 | 618634 |
| TL-D | TL-D 18W /35 | G13 | 59 | 0.36 | WHITE | 3500 | 1150 | 0.85 | 100 | 729002 |
| TL-D | TL-D 30W /35 | G13 | 98 | 0.36 | WHITE | 3500 | 2300 | 1.05 | 145 | 618603 |
| TL-D | TL-D 36W /35 | G13 | 103 | 0.44 | WHITE | 3500 | 3000 | 1.10 | 186 | 704980 |
| TL-D | TL-D 58W /35 | G13 | 111 | 0.67 | WHITE | 3500 | 4600 | 1.35 | 233 | 700704 |
| TL-D | TL-D 70W /35 | G13 | 122 | 0.69 | WHITE | 3500 | 5400 | 1.35 | 272 | 615962 |
| /54 | | | | | | | | | | |
| TL-D | TL-D 14W /54 | G13 | 45 | 0.38 | COOL DAYLIGHT | 6200 | 660 | 0.85 | 66 | 721785 |
| TL-D | TL-D 15W /54 | G13 | 51 | 0.34 | COOL DAYLIGHT | 6200 | 850 | 0.85 | 76 | 722218 |
| TL-D | TL-D 18W /54 | G13 | 59 | 0.36 | COOL DAYLIGHT | 6200 | 1050 | 0.75 | 100 | 702678 |
| TL-D | TL-D 23W /54 | G13 | 95 | 0.30 | COOL DAYLIGHT | 6200 | 1550 | 0.70 | 161 | 726414 |
| TL-D | TL-D 30W /54 | G13 | 98 | 0.36 | COOL DAYLIGHT | 6200 | 1825 | 0.90 | 145 | 722638 |
| TL-D | TL-D 36W /54 | G13 | 103 | 0.44 | COOL DAYLIGHT | 6200 | 2500 | 0.95 | 186 | 702715 |
| TL-D | TL-D 36W/1 /54 | G13 | 80 | 0.56 | COOL DAYLIGHT | 6200 | 2350 | 1.00 | 161 | 726599 |
| TL-D | TL-D 58W /54 | G13 | 111 | 0.67 | COOL DAYLIGHT | 6200 | 4000 | 1.15 | 233 | 702753 |

This project is concern on how to reduce the energy consumption of lighting system by reducing the number of fluorescent light but still producing the suitable illumination at the places. At the same time by using Managed Lighting System (MLS), the energy wastage also can be reduced.

## 2.0 Methodology

### 2.1 Problem Analysis at Faculty of Electrical Engineering in UiTM Shah Alam.

From the observation for three months at Faculty of Electrical in UiTM Shah Alam, there are several problems of lighting system that had been detected. One of the problem that has been detected is the lighting system along the corridor is turn on 24 hour per day without switch off even though the corridor is bright on the day light. This will contribute the energy wastage and at the same time life span of fluorescent light also has been wasted. As information, the life span for TL-D Philips fluorescent is 15000 hours [8]. Figure 2.1 below shows the lighting system along the corridor at the UiTM Shah Alam.

Figure 2.1: The lighting system at the corridor daytime

Other than that, for the lighting system used at the 4th floor of PTAR 3 is not suitable. The type of fluorescent have been used is TL- 18W/54 [8]. Even though the power consumption of this type of fluorescent is low but it is not following the standard of lighting system. Figure 2.2 below shows the type of lamp that use in PTAR 3.

Figure 2.2: Type of lamp that use at PTAR 3

The arrangement of lighting system also can contribute a problem. If the arrangement is not proper, the illumination of the places can become too bright or too dim. The illumination also can be unbalance if the lighting system arrangement is not suitable. By following the standard of illumination, the illumination of the places must be at least 70% uniform [6]. Most of the lecture room and laboratories have these problems. Below shows the arrangement of lighting system at the lecture room.

Figure 2.3: Arrangement of lighting system at lecture room

Human factor also play a role in energy wastage. From the observation, most of the lighting system at the lecture room is not been turn off after had been used. A lot of energy can be saved if this attitude is change.

## 2.2 Analysis of Lighting System at the Electrical Machine Laboratories

Electrical Machine laboratory is one of the laboratories at the Faculty of Electrical. From the observation that had been made, several problems had been detected. One of the problems is the number of fluorescent light is more than enough to light up the laboratory.

The second problem is the arrangement of the lighting system is not proper. From the observation, the patent of lighting system arrangement is too close and this will produce a higher illumination that will contribute energy wastage. Other than that, the illumination at the laboratory also is not uniform. Less than 70% of the illumination is uniform in the laboratory. Figure 2.4 and 2.5 below show the lighting system arrangement and the illumination at the laboratory.

Figure 2.4: Lighting system arrangement at laboratory

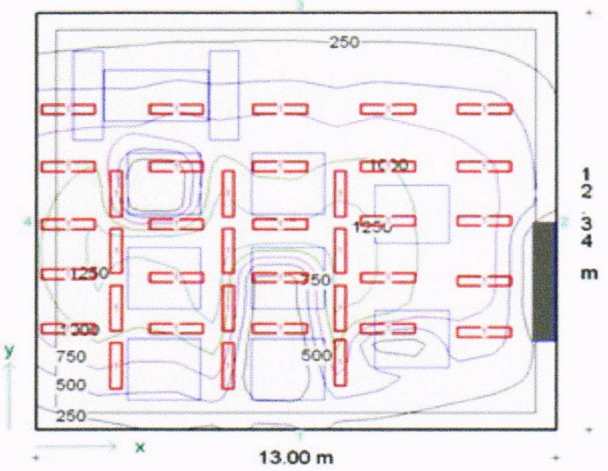



Figure 2.5: The illumination at the laboratory

Finally the last problem that had been detected is glare. Glare can happen when bright object (such as luminaries) are excessively bright in relation with general surroundings [6]. The illumination that had been produced by the lighting is too bright. Glare can make working condition very unpleasant, giving rise to headaches, general fatigue and reduction in output from individuals. This is known as 'discomfort glare' [6].

From the problems detected, the data of the laboratory have been taken to upgrade the performance of lighting system in the laboratory such as measuring the room dimension, measuring the illumination at certain places using lux meter and measuring the distance from the light source to the working plan. All data will be entered into lighting software. The real design is compared with modified design. Figure 2.6 shows the lux meter.

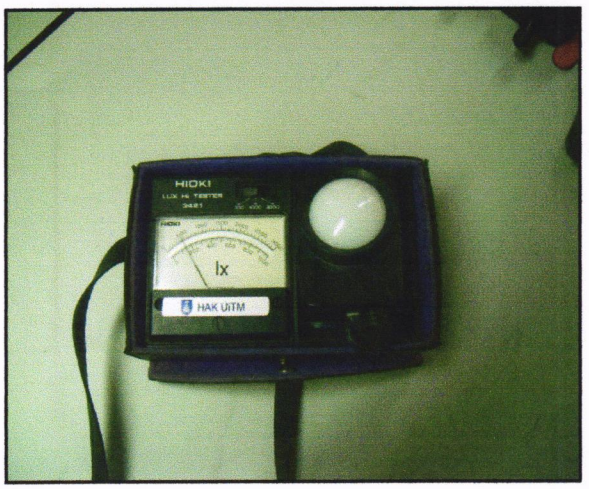



Figure 2.6: Lux Meter

## 2.3 Managed Lighting System

In this study case, Manage Lighting System will be proposed to manage the consumption of lighting system at the Faculty of Electrical. This lighting control system will provide full occupancy control of luminaire output based on the amount of light present in the area.

This system also will be fully networked and communicating system providing automatic synchronous switching of area based on easily programmable parameters [7]. All the lighting at the area will be control by movement. It is possible to configure each luminaire controller into one of three zones that are group zone, common zone, and building zone.

A group zone will cover the working area that may consist of one, two or more work stations situated closely together. Anybody who enters this area, the entire zone will be held on. A group zone can also be assigned to lecture room, lecture hall, meeting room or any other small area.

A common zone will cover multiple user area such as corridor or exit route. Lighting in a common zone area shall be ON whenever anybody is present within the common zone any group zone.

A building zone will refer to a building with wide common area such as stairwell or lift lobby. Lighting in a building zone will be held on whenever somebody is present in the building zone.

The components that will involve in this system are such as below:

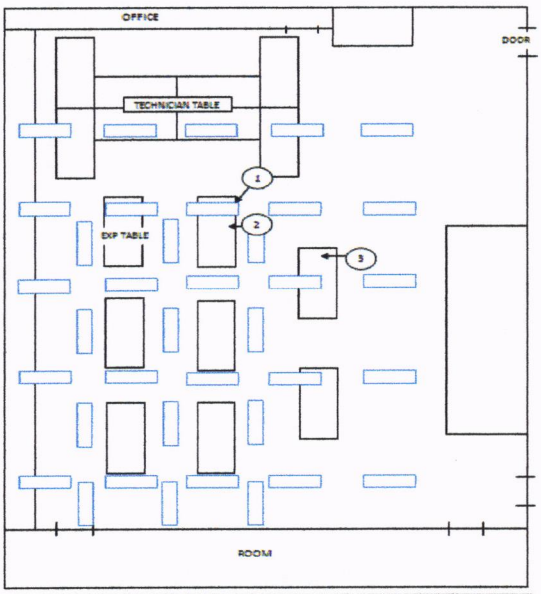
- MLS2000 Luminaire Controllers
- RB2000 Bus Power Supply
- UBT2000 Universal Bus Transceiver
- MLS2000 Emergency Test Module
- HP2000 Hand Held Infrared Programmer
- MLS2000SSP Scene Select Panel
- MLSLCP Local Control Plate

For this study case, the system will be proposed to be place at the Electrical Machine lab. A few components of the system will be proposed to be use in this system because the lab is small and not connected with other lab. The duration time of student will use the lab have been taken and the benefit by using this system will be determined.

## 3.0 Result and Discussion

### 3.1 Result

From Figure 3.1 below the plan at electrical machine lab is shown. The dimensions of the lab have been taken and the size of the experiment table also has been measured at Figure 3.2.




| Room Dimensions | |
|---|---|
| length | 13.00 m |
| width | 12.34 m |
| height | 3.46 m |
| height of luminaire plane | 2.48 m |

Figure 3.1: Dimension at Electrical Machine lab

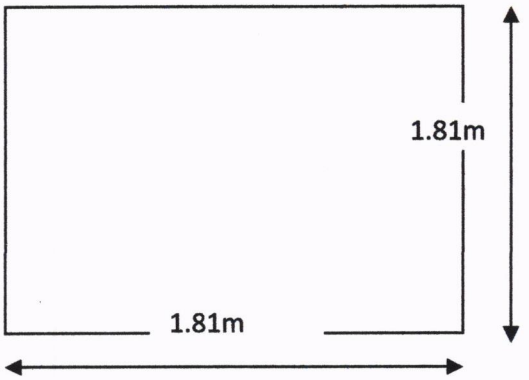



Figure 3.2: Experiment Table

Below show two of design that had been made that is the real design and the new design.

### 3.1.1 Real Design

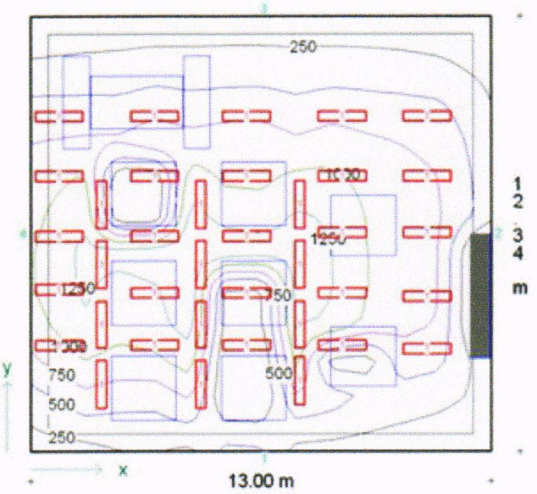



Figure 3.3: lighting system layout for real design

#### 3.1.1.1 Average Reflectances

1. Ceiling 0.70
2. Wall 1 0.06
3. Wall 2 0.70
4. Wall 3 0.50
5. Wall 4 0.50
6. Floor 0.50

#### 3.1.1.2 Design Data

1. Maintenance Factor 0.80
2. Maintained Illuminance 500lx
3. Number of calculation Points in direction (x/y/z) 13/12/8

#### 3.1.1.3 Selected Luminaires

| Type | Number | Luminaire Name | Setting |
|---|---|---|---|
| 1 | 37 | Fitting for fluorescent lamp 2 pin | 2 X L 36W/54 |

### 3.1.1.4 Calculation Results

Average illuminance utilisation **662 lx**
Plane (h= 0.78)

| | Task Area | Surrounding area |
|---|---|---|
| | $E_{av}$/lx | $E_{av}$/lx |
| **Task Area 1** | 795 | 308 |

Average Luminances

| | |
|---|---|
| **Ceiling** | 52.5 cd/m$^2$ |
| **Wall 1** | 5.0 cd/m$^2$ |
| **Wall 2** | 38.2 cd/m$^2$ |
| **Wall 3** | 4.0 cd/m$^2$ |
| **Wall 4** | 61.8 cd/m$^2$ |
| **Floor** | 85.9 cd/m$^2$ |

Max. UGR-value in direction wall 1, 2, 3, 4

| | | | |
|---|---|---|---|
| 23.8 | 23.2 | 23.8 | 22.9 |

Wattage **2.66kW**

### 3.1.2 New Design

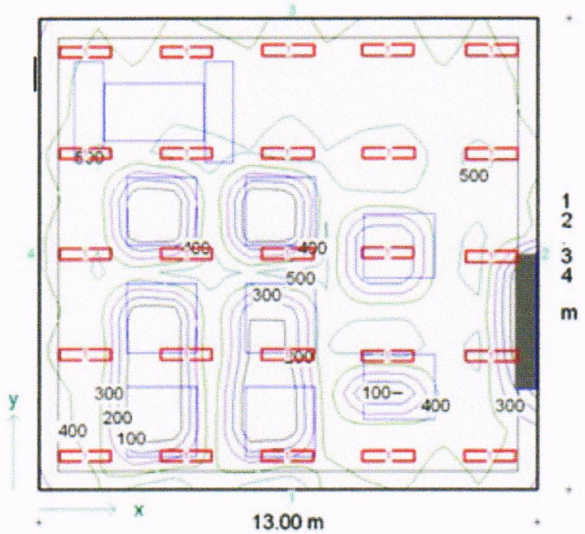



Figure 3.4: lighting system layout for new design

### 3.1.2.1 Average Reflectances

1. Ceiling 0.70
2. Wall 1 0.06
3. Wall 2 0.70
4. Wall 3 0.50
5. Wall 4 0.50
6. Floor 0.50

### 3.1.2.2 Design Data

1. Maintenance Factor 0.80
2. Maintained Illuminance 500lx
3. Number of calculation Points in direction (x/y/z) 13/12/8

### 3.1.2.3 Selected Luminaires

| Type | Number | Luminaire Name | Setting |
|---|---|---|---|
| 1 | 25 | Fitting for fluorescent lamp 2 pin | 2 X L 36W/54 |

### 3.1.2.4 Calculation Results

Average illuminance utilisation **373 lx**
Plane (h= 0.78)

| | Task Area | Surrounding area |
|---|---|---|
| | $E_{av}$/lx | $E_{av}$/lx |
| **Task Area 1** | 474 | 321 |

Average Luminances

| | |
|---|---|
| **Ceiling** | 31.3cd/m$^2$ |
| **Wall 1** | 4.7 cd/m$^2$ |
| **Wall 2** | 35.9 cd/m$^2$ |
| **Wall 3** | 4.9 cd/m$^2$ |
| **Wall 4** | 32.9 cd/m$^2$ |
| **Floor** | 57.9 cd/m$^2$ |

Max. UGR-value in direction wall 1, 2, 3, 4

| | | | |
|---|---|---|---|
| 23.0 | 22.1 | 23.1 | 21.9 |

Wattage **1.80kW**

### 3.2 Discussion

1. From the result, we can see that the number of fitting for fluorecent light had been reduced from 37 to 25. By following the standard of lighting system below, the number of fitting light can be reduce and at the same time the arrangement of lighting system become more proper than before [6].

$$\frac{Spacing}{height} = \frac{3}{2}$$

2. Other than that, the average illumunation utilisation have been reduce from 662 lux to 373 lux. By looking at Figure 3.3 and 3.4, we can see that the lux at the real design have been reduce from 1250 lux to 500 lux. Moreover, the illumination in the laboratory become more uniform than before and achive more than 70% from the maximum [6]. From this, the glare in the laboratory can be reduced.

3. The energy consumption have been reduce from 2.66kW to 1.80kW. This because the no of fitting light from real design has been reduced from 37 to 25 unit.

4. From the observation, the lighting system at the laboratory always been turn on from 8am to 6pm even though there are no student use the lab. To maximize the energy consumption in the laboratory, the lighting control system has been proposed to be install in the laboratory.

## 4.0 Conclusion and Recommondation

### 4.1 Conclusion

The objective of reducing the number of lamps and the number of lux in the laboratory is following the standard of illumination is not succeed. Refer to BSI standard, the illumination inside the laboratory must reach 500 lux and by referring JKR and IEC standard, the illumination must reach 600 lux and 700 lux. This may be because some of the data not include in the calculation.

By reducing the number of fluorescent lamp, the energy consumption will be reduced and the energy wastage can be avoided. Other than that, to maximize the energy consumption in the laboratory, lighting control system had been proposed to be install in the laboratory. By placing this system in laboratory, energy consumption can be optimized.

### 4.2 Recommendation

For the future, continues this project by installing the lighting control system at the corridor, classroom, laboratory, or at all places at the Faculty of Electrical engineering. These because by using this system, the energy consumption at faculty can be optimized and the wastage can be avoided. In the system, it have two types of detector that are motion detector and photo detector. For motion detector, it will detect a motion within 7m diameter from the detector. For photo detector, it will detect a illumination for certain illuminance that had been setup inside the detector. After installing the system, estimate the value of energy consumption at the faculty and compare it with the old lighting system before installing the lighting control system.

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