A New Approach to Improve Power   Quality and Energy Saving Scheme by Dimming of Light Intensity

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Abstract⸻ Energy flow in the world is unidirectional, not cyclic. So huge uncontrolled consumption of conventional energy may cause least avail ability of itself. We should preserve it, reduce its consumption, and try to be interested about non conventional energy consumption. But in practice replacement is not economic rather controlling and modification of system to reduce energy consumption. Through this paper an approach of dimming street lights in municipality/ corporation and its controlling is stated. Improvement of dimming control, detecting, hooking, tapping is discussed. In our locality we see that street lights are glowing for12 hour in a constant intensity. So the consumption of power is fixed for a particular municipal/corporation area. But in actual practice street light very much useful at pick-traffic hours. That is in India(West Bengal) 5 p.m. to 9 p.m. A normal traffic period 10 p.m. to 12 p.m. and other period, 1a.m to 5a.m is an off-traffic. So glowing of street lights in off pick-traffic period is like a wastage of energy.[Fig 1] So by applying diming concept we can save huge energy. Besides it the centralized streets lightning very helpful for data logging. Detecting of tapping, hooking, and fault detection are operated quickly.

Figure 1: street light at off-pick traffic [11]

Index Terms⸻ **Dimmer, Automation. PWM, GSM modem, VFD,PLC, VPN**

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I. INTRODUCTION

The today's power network is very complex system where load demands are much more increasing day by day compare than generations. So for maintain power supply the reliable and uninterrupted in the load areas are very much difficult because much of our distributed power has been wasted due to street lighting. The Street lights of municipal and corporation area or high ways powers are supply uninterruptedly because if load shedding is occurs that sections then many accidents will occure.So we have to supply uninterrupted power supply to the street lights but if we supply uninterrupted power there ,much of powers are wasted due to off pick traffic in midnight time. In the mid night time traffic s are less compare than peak hours(6 P.M to 11 P.M).So it is not require that all the street lights are glow in that time because our costly energy are wasted without any fruitful use. So for improving our power system reliability, we should prevent this misuse of energy. It is our aim that we should save our energy as possible because our fossil fuels are limited. If we misuse the energy, the next generation will not get power. So in this paper we have done a little work in hardware and software that how we can save our costly energy by dimming controls of street lights. So in municipal or corporation area huge amount street lights has to be introduced. The glowing from dusk to dawn of fluorescent light with choke ,sodium vapor lamp with choke consume huge electricity but it was observed that after a certain period full intensity of light is not required. So in this case dimming of street light caused saving of energy. It was shown that 30% of total energy consumption may reduced by Venus Electronics in Kolkata Corporation . They had projected it at Chaplin Park , Kolkata , India. They projected the dimming of street light and control it via GSM based modem and GSM mobile phone. [fig.2] .Through this paper a modern approach on dimming control, data acquisition, hooking and tapping detection is discussed. It is a centralized scheme, controlled by PLC, operated by SCADA HMI.

In research area is not new but in our paper we have analysis Centralize control which gives more accurate result compare Than other research
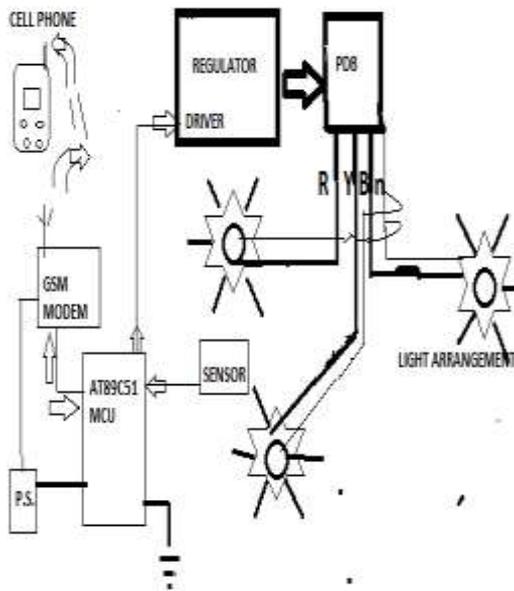
Figure 2: **wireless diming scheme**

I. DIMMER

In early days dimming was done by reducing applied voltage. At that time rheostat was used, but it consumed more power. After that variable transformer was introduced for this purpose,. But it was bulky, costly.
then phase-controlled leading edge TRIAC is come to application.[fig3]

Figure 3: Leading **Edge Dimmer [11]**

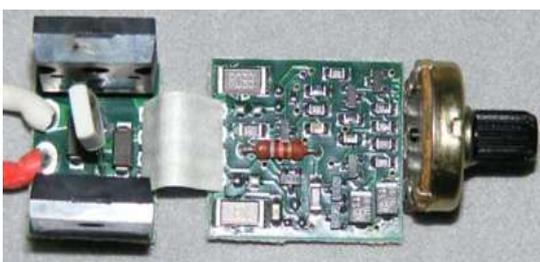Trailing Edge Dimmers consisted of MOSFET/IGBT is used .[fig4]

Figure 4 : Trailing Edge Dimmer [11]

Now ,by upgrading TRIAC circuit, and adding Thruster, **drives** come to practice.
In practice dimming is done successfully. But a human effort is still required to control it. The data login of On time and OFF time

is done manually. Hooking in line, was not detected automatically

II. AUTOMATION

Automation is away, to make control, scan, data logging, alarm etc with a computerized scheme. In automation human operation is almost least, rather master controller acts as a human brain according to programming. An automation unit is consisted with PLC/DCS, as mail controller, ladder logic/ F.D.B. as a programming, SCADA /HMI for human machine interface software.

III. PWM

1) Pulse Width Modulation

Since varying the forward drive current to achieve LED dimming may prove problematic, an alternative method is required. Pulse width modulation, or PWM, can effectively control the pulse width and duty cycle causing the LED light to vary its intensity. This works by turning the light emitting diode off for a very short period. To produce an increased dimming effect, the LED will remain off even longer. The human eye does not interpret a flicker or strobe when utilizing the proper frequency. Instead, the eye essentially will detect the LED as a continuous light stream, but the light appears dimmer due to the short periods during discontinued operation. To produce the appropriate frequency and pulse width, the LED drive circuitry requires some form of programmable timer. Many older PWM LED dimming circuits utilized the 555 timer, and controlled the output pulse width using a simple variable resistor. This method works sufficiently. However, recent advanced in microcontrollers have created new opportunities for PWM LED dimming circuits. The microcontroller is custom programmable, and provides greater application flexibility when compared with traditional 555 circuits. In addition, many new microcontrollers actually require fewer external components than the 555 integrated circuit .

2) Dimming LEDs with PWM

PWM dimming switches the LED on and off at a high rate. The effective IF becomes the time-based average of IF when the LED is on and when it is off. When using the PWM method of LED dimming, the on/off frequency must be faster than the human eye can detect to avoid visible flicker. PWM frequencies of 200 Hz or greater usually avoid flicker problems. Many current PWM LED drivers feature a specialized PWM dimming pin that accepts a wide range of PWM frequencies and amplitudes, allowing a simple interface to external control logic. Often, these LED-dimming driver chips provide several ways to dim an LED.

For example, National Semiconductor's LM3409 LED driver provides several ways to modulate an LED's IF using PWM techniques. Many vendors, including Allegro Microsystems, Analog Devices, Linear Technology, and National Semiconductor offer PWN LED drivers.[14]

IV. G.S.M. MODEM

A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like

a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone.

When a GSM modem is connected to a computer, this allows the computer to use the GSM modem to communicate over the mobile network. While these GSM modems are most frequently used to provide mobile internet connectivity, many of them can also

be used for sending and receiving SMS and MMS messages.[15]

1) GSM Converter

GSM converter will be an add-on device to be attached between a terminal which wants data transfer and the GSM modem. This GSM converter will take care of call establishment where the embedded device cannot make a call. The converter will remain transparent through-out the call once call is established. The GSM converter will be a very small piece of hardware possibly embedded inside the cable itself.

VI V.F.D.

A drive is the power electronics board which is used to control the speed of a motor. Drives may use various techniques to control speed

Variable Frequency Drives are widely used throughout the industry the industry to provide reliable and adjustable current and frequency. The modern variations become very simple to install. In construction a VFD [fig5]is quite complex, containing a myriad of advanced hardware and software. It is consisted of mainly three section 1..rectifier section, 2 DC. Bus storage, 3 Inverter section..

1 Rectifier section- In this section ac. line voltage is rectified to dc. Line voltage.. The rectifier bridge. Is consisted of SCRs.

2. The dc. Bus section is comprised of capacitors that store power by the converter.

3.The inverter section is comprised of IGBTs that create sinusoidal output current using pulsed dc bus voltage, or pulse wide modulation. VFDs are sometimes called inverters, as the presence of an inverter section is the primary difference between VFDs and dc drives.

A moderately low-cost form of drive for controlling DC motors makes use of one of several types of power transistors. These transistors are switched rapidly on and off in a technique known as Pulse Width Modulation (PWM). Hence the term PWM drive.
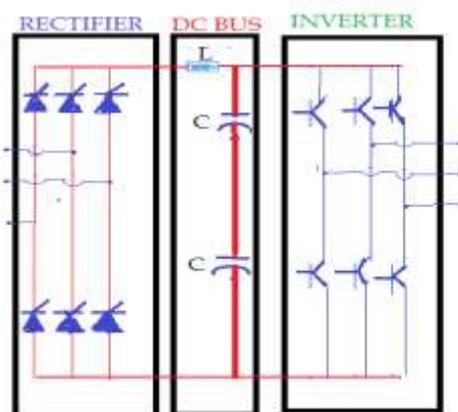

FIGURE 5: VFD configuration

1) Advantages for using VFD

1 Stable and reliable performance
2 Saves energy and therefore reduces energy costs
3 Isolated control signal provided by fibre optics between Power cell and Controller
4 Voltage resource VFD, direct input of 3, 3.3, 4.16, 6, 6.6 and 10 kV, direct output of 3, 4.16, 6, 6.6 and 10 kV, no output transformer necessary. High input power factor, low harmonic current, no power factor correction capacitors and harmonic filters required.
5 Sinusoidal multi-level PWM output waveform, no output filter required. Can be directly connected to standard induction motor, without damage to the insulation of the cable or the motor, low harmonics of the motor, reduction of vibration of the shafts or the vanes. Maximum length of output cable 1000 m.
6 Modular design of the power circuits for simpler maintenance routines.
7 Complete fault monitor circuit for accurate fault alarm and protection.
8 Integrated cooling.
9 The control logic can be easily changed with the help of the integrated PLC
10 Support for standard industrial communication protocols (Mod-bus, Profi-bus, Device Net, TCP/ IP etc.)
11 Analog input 0 ~ 10V / 4 ~ 20 mA for frequency setting.
12 Open or closed loop control with the integrated PID regulator.
13 Complete system setup via parameter settings
14 Easy installation
15 The VFD can self-diagnose and record faults. For trips, an alarm message is displayed in main interface; for serious trips, the trip window and the fault location is automatically displayed. The trip log can be viewed from the trip window.[17]

V. PLC

Before the advent of solid-state logic circuits, logical control systems were designed and built exclusively around electromechanical relays. Relays are far from obsolete in modern design, but have been replaced in many of their former roles as logic-level control devices, relegated most often to those applications demanding high current and/or high voltage switching. The purpose of a PLC was to directly replace electromechanical relays as logic elements, substituting instead a solid-state digital computer with a stored program, able to emulate the interconnection of many relays to perform certain logical tasks.

1) L ADDER DIAGRAM

Ladder diagrams are specialized schematics commonly used to document industrial control logic systems. They are called "ladder" diagrams [fiG6,7] because they resemble a ladder, with two vertical rails (supply power) and as many "rungs" (horizontal lines) as there are control circuits to represent. If we wanted to draw a simple ladder diagram showing a lamp that is controlled by a hand switch, it would look like this:[fig6,7]
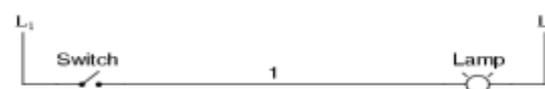

FIGURE 6 : ladder Logic explanation1[12]

The "L1" and "L2" designations refer to the two poles of a 120 VAC supply, unless otherwise noted. L1 is the "hot" conductor, and L2 is the grounded ("neutral") conductor [fig7]. These designations have nothing to do with inductors, just to make things confusing. The actual transformer or generator supplying power to this circuit is omitted for simplicity. In reality, the circuit looks something like this:
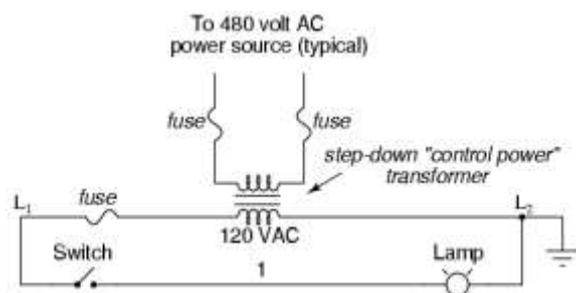

FIGURE 7 : Ladder Logic Explanation 2[12]

VI.   V.P.N

A virtual private network (VPN) is the extension of a private network that encompasses links across shared or public networks like the Internet. A VPN [fig8] enables you to send data between two computers across a shared or public inter network in a manner that emulates the properties of a point-to-point private link. The act of configuring and creating a virtual private network is known as virtual private networking. To emulate a point-to-point link, data is encapsulated, or wrapped, with a header that provides routing information allowing it to traverse the shared or public transit inter network to reach its endpoint. To emulate a private link, the sent data being is encrypted for confidentiality. Packets that are intercepted **on** the shared or public network are indecipherable without the encryption keys. The portion of the connection in which the private data is encapsulated is known as the tunnel. The portion of the connection in which the private data is encrypted
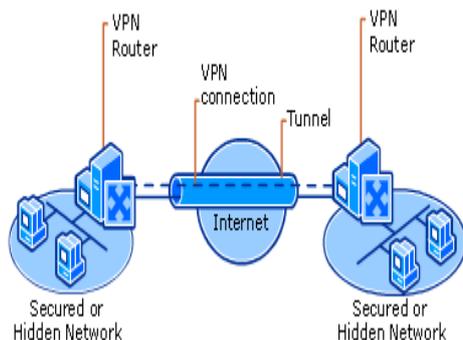

Figure 8: **VPN configuration[16]**

VII   OBJECTIVE

Full intensity of light not required all the time. So by dimming we can reduce intensity of light and also reduce the power consumption. By applying automation we an automatic control could be done. In past control of dimming was done by GSM

mobile. [fig.5] In this approach automatic control also added. Besides it a data acquisition system for on time and off time also could introduced. Detection of hooking and protection against over rating current, short circuit   current flow etc. are introduced.

VIII   LITERATURE REVEW

1 Dimmin,intensity,ctc various papers by Google search,
2 GSM modem, Electronics for you gadgets .practical assessment. Etc.
3 Dimming Technology © 2008-2009 Astra lightning ltd.
4 Dimming technolgy© 2010 Aucom Electronics Ltd.
5 Light and dimming© D.R. Wulfinghoff
6 Dimmer Elliott Sound Products

IX PROBLEM ANALYSYS:

In early days dimming was done by reducing applied voltage. At that time rheostat was used, but it consumed more power. After that variable transformer was introduced for this purpose,. But it was bulky, costly. In practice dimming is done successfully. But a human effort is still required to control it. The data login of On time and OFF time is done manually. Hooking in line was not detected automatically. As the PWM drive is used, power quality is high, distortion is less, transient stability is improved.

X. OPERATION DECRIPTION:

In this operation automation unit consist of PLC. Or may SCADA/ DCS be included. The main purpose of automation unit is to control driver to produce different current as per requirement for dimming. It can be programmed as to detect the difference between set value of CT, PT and present value of it. If any difference detected then it will create an alarm against hooking, or tapping through cell phone. The signal from CT, PT can be sent to PLC by transmitter and receiver arrangement.   The GSM based modem arrangement is comprise of AT89C51MCU micro controller. The GSM modem is specialized types which accept a SIM300. A GSM MODEM [fig5] comes with a serial interface through which the modem can be controlled using AT command. The basic segregation of working of modem are 1. Voice calling, 2 SMS, 3. GSM data calls,4 GPRS SIM 300 is a tri band GSM/GPRS engine that works on EGSM900 MHz, DCS1800MHZ, and PCS1900MHz frequencies. GSM modem is RS232 logic level compatible. The software program is written in 'C' language and compiled using Keil software.
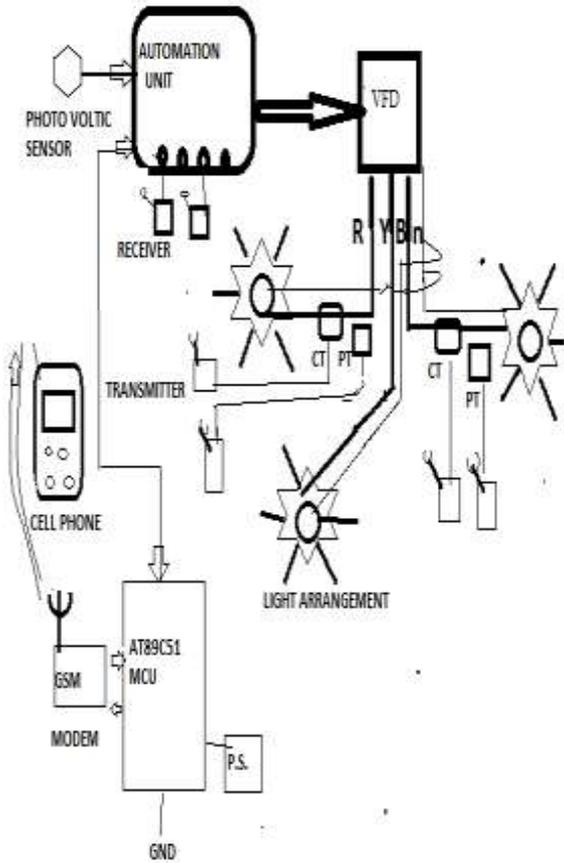
FIGURE 9: centralized scheme for diming, data acquisition

XI. EXPERIMENT

We made an experiment by an Incandescent Lamp of 100wat. (PHILIPS)220v.[fig13]
1.The reflector was whit board.
2 height 6fit vertically from base
3. distance from base point was 10 fit.
4.lux meter METRAVI 1330[fig14]
5. Millimeter UNITY the weather was clear, no fog, no smog condition, temperature 20 deg. C

FIGURE 11: Incandescent lamp

FIGURE 12: lux meter METRAVI 1330

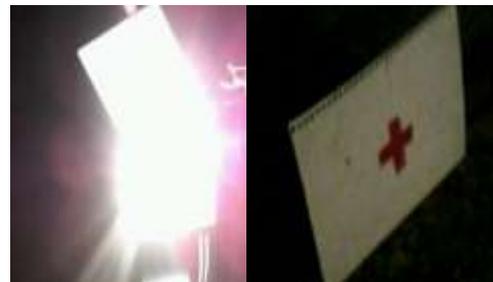*1) Result*

The intensity is high.

FIGURE 13: light intensity and object 1st case
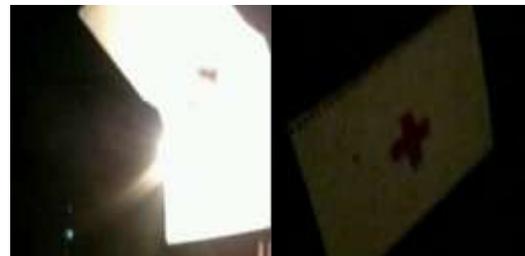
The intensity is medium.

FIGURE 14 : LIGHT INTENSITY AND OBJECT

The intensity is LOW

FIGURE 15: LIGHT INTENSITY AND OBJECT

Current (amp)	Voltage (volt)	Watt (watt)	lux
0.57	210	101.74	160
0.43	210	76.75	122
0.28	210	49.98	82.5

Assume P.F. is 0.85

1. So if the light glow for 12 hour and 30 days. In full intensity it will consume: 36.62 Kilo Watt Hour.
2. but if we dimming
Then;
   a. 5 hour, 30 days with full intensity (101.74 watt) : power consumption 15.261 KWHr
   b. 3 hour 30 days with medium intensity (76.75 watt) : power consumption 6.907 KWHr.
   c. 4 hour 30 days with low intensity(49.98 watt), power consumption 5.997 KWHr.

   So the total consumption for 12 hour, 30 days after dimming is 28.16 KWhr.
   So the energy will save 30.04%

XII IMPLEMENTATION

This project could be implemented is street light diming, data logging, fault detecting, detecting of tapping, detecting of hooking etc. It may be the most fruitful application for energy saving in our corporation street light expense. In practice 7000 of high presser sodium vapor [fig17]lamps and florescence lamps[fig16] are glowing in every day in KOLKATA CORPORATION (WEST BENGAL , INDIA)area.[4] But in off-pick traffic (2a.m. to 5a.m. in INDIA) high intensity lightning may useless. But in case of fog and smog the light should be glow in high intensity.

Figure 16 : Forescence lamp at street

Fig17 : Hgh Presser sodium vapor lamp at street

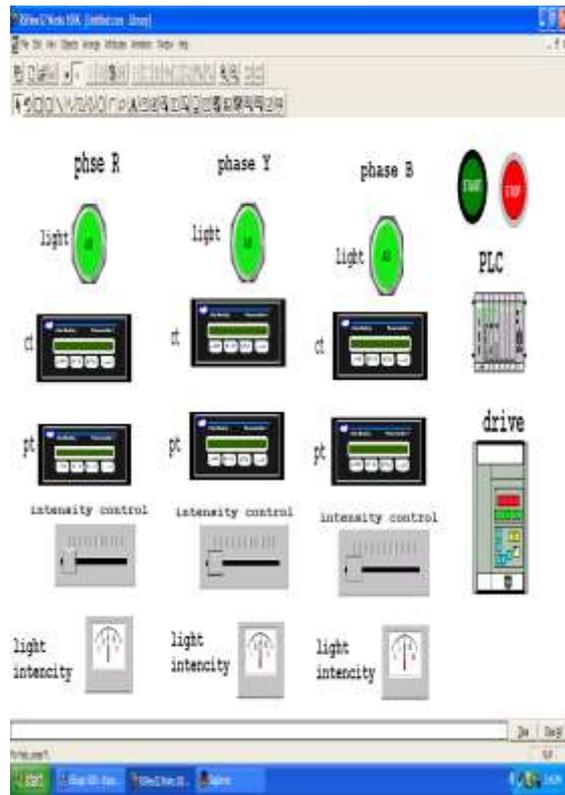| Florescent Lamp-91.7 lux,40 WATT	Sodium vapor lamp-111.8 lux, 400 WATT	Both are 20 degC, NO FOG, NO SMOG CONDITION,hight: 50 fit.(1500 cm)

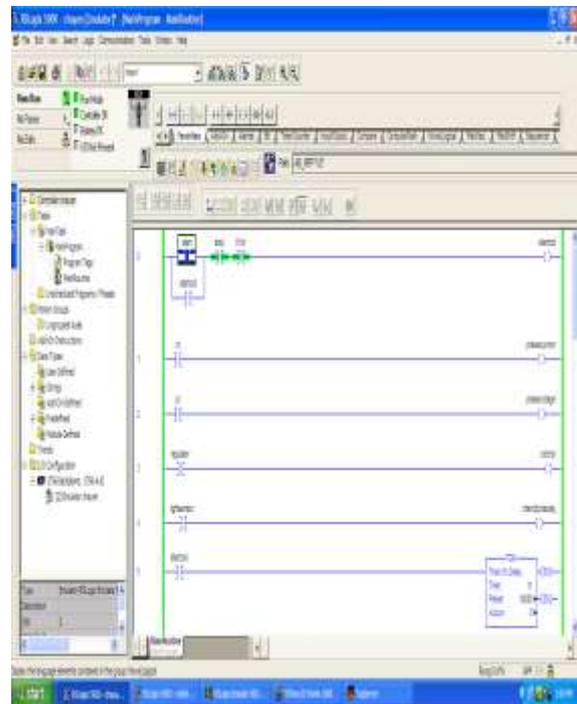**FIGURE 18: SCADA MONITOR FOR DIMMING OPERATION**

FIGURE 19 PLC LADDER LOGIC PROGRAMM

CONCLUSION

Through this paper, an approach to energy savings is stated. The dimming control arrangement is done by electronics and electrical arrangement.[fig9] The PLC[fig19] ,SCADA [fig18]operation is

much reliable, economic and time span reducing ,and safety effort. The action likes, dimming control, alarm and data acquisition could be performed. Through this paper a fundamental and practical knowledge about energy saving in regular operation is stated. Successful application of this type of project will serves in many energy savings aspects, which could not be overcome by human effort. The paper will help how to save the energy.

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,
[4]Guidance of VENUS ELECTRONICS,KOLKATA
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