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Design of energy efficient lighting loads in EEE block at GCE, Salem

Prof.R.Sharmil Suganya[1], Ravichandran P[2], Sasirani R[3], Sridhar R[4], Vajayakumar R[5] , Vinoth Kannan M[6]

Assistant Professor (Bio Engg), EEE, Government College of Engineering, Salem, India[1]

Students, EEE, Government College of Engineering, Salem, India [2,3,4,5,6]

Abstract: Energy efficiency is using technology that requires less energy to perform the same function. There are many motivations to improve energy efficiency. Decreasing energy use reduces energy costs and may result in a financial cost saving to the institution if the energy savings offset any additional costs of implementing an energy-efficient technology. Reducing energy use is also seen as a solution to the problem of minimizing greenhouse gas emissions

The proposed energy efficient technologies are motion sensor, power cut off switch, conversion of old ACs to modern day technology 5 star ACs, Conversion of fans to new energy efficient fans. The main challenge faced during the project is the identification of old type circuits where wiring of a particular device cannot be traced individually as it is of group circuit model

Also formation of energy club in our department for the progress of energy saving motto in future in a planned manner. Slogan posters are posted in many places to create impact about energy efficient programs. Standardization of circuits are taken to support energy efficient future projects. considering water crisis in today's environment automatic float valve control for water conservation is also done which additionally supports electrical energy efficiency project by reduction in pumping time of water

The motivation behind taking this project is to make a detailed analysis of estimation of energy efficient system for lighting loads and also partial implementation of the energy efficient systems to observe the impact on the existing for full conversion.

Keywords: PIR Motion sensor, Energy saving card switch, energy efficiency

I. INTRODUCTION

Energy efficiency simply means using less energy to perform the same task – that is, eliminating energy waste. Energy conservation is the effort made to reduce the consumption of energy by using less of an energy service. This can be achieved either by using energy more efficiently by using less energy for a constant service or by reducing the amount of energy used .

Energy efficiency brings a variety of benefits: reducing greenhouse gas emissions, reducing demand for energy imports, and lowering our costs on a household and economy-wide level. According to the International Energy Agency, improved energy efficiency in buildings, industrial processes and transportation could reduce the world's energy needs in 2050 by one third, and help control global emissions of greenhouse gases.

The National Energy Conservation Day is being celebrated every year on December 14 since 1991.As per the Mission guidelines, 80% of the buildings in the smart cities need to be energy-efficient with a 'green building' design and 10% of the Smart City's energy requirement should come from solar energy.

Every year the National Energy Conservation Day is celebrated using a particular theme and this year the theme for the day is "**Conserve Energy Save the Future".** The day focuses on making people aware of global warming and climate change and promotes efforts towards saving energy resources. ... Thus, every year 'Energy Conservation Day' is celebrated to raise awareness among the general public about the importance of energy conversation and energy efficiency.

The task of powering college campuses with clean energy can be made easier through aggressive steps to improve the energy efficiency of campus buildings. Energy efficiency in campus buildings can save colleges money and accelerate the transition to a clean energy future.

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Universities / colleges can make cost-effective investments to improve building performance, such as widespread adoption of low-energy LED lighting, and undertake building retrofits to improve insulation and upgrade heating and cooling equipment.

Lighting is the basic requirement of any facility and it impacts the day-to-day activities of the people. This accounts a considerable amount of total energy consumption in domestic, commercial and industrial installations. In industries, energy consumption for lighting constitutes only a small component of the total energy consumed, which is nearly 2-5 percent of total energy consumption. It accounts for 50 to 90 per cent in the domestic sector and it may go up to 20-40 percent in case of commercial /building sectors, information technology complexes, and hotels. So it becomes an important area wherein energy to be conserved, especially in the domestic sector. Lighting efficiency solutions therefore play a key role in energy saving opportunities.

One of the most obvious energy-wasting habits is leaving the lights on, and it's also one of the easiest habits to fix. By simply turning off the lights when you leave a room or your home, you will save electricity and help your lightbulbs last longer.

Due to the high energy consumption, traditional incandescent lamps and high discharge lamps have to be substituted with energy efficient lamps. Traditional lamps not only consume large amounts of electric power, but they use much of its consumed energy to produce heat rather than light (for instance 90% of consuming energy in case of incandescent lamps. The energy efficient lighting is necessary to reduce electricity consumption, thereby reduces the electricity bills ,to save electricity rather than wasting in terms of losses, to lower greenhouse emissions because conventional lamps cause CO2 emissions, to achieve peak load reduction.

Thus the main motto behind taking this project is that to make the college campus utilize the electrical energy with higher efficiency and to support college financially by reducing the amount of power it consumes. On a global basis energy efficiency works behind the scenes to improve our energy security, lower our energy bills and move us closer to reaching our climate goals.

II. LITERATURE SURVEY

Like many utilities, Pacific Gas & Electric (PG&E) has achieved a large fraction of its energy and demand savings through lighting programs. These have included a variety of program types, including those targeting residential and non-residential customers; upstream and downstream programs; and programs incentivizing readily available technologies (e.g., through deemed programs) and emerging technologies. For the 2010-2012 program cycle, lighting measures represented more than one third of PG&E's electric portfolio savings claim.

However, the lighting market is quickly evolving as LEDs become more prevalent and efficient, advanced controls become more sophisticated, some (although far from all) of the inefficient base technologies (e.g., incandescent lamps and T12s) have been replaced, and new regulations set higher efficacy requirements for lighting. This evolution of lighting is reflected in many changes in end-user behaviour such as CFL spiral bulbs achieving a saturation level exceeding 50% of sockets in homes in the PG&E service territory in 2012 and the introduction of utility-rebated lamps by online retailers. Utility programs must also evolve if they will continue to provide the level of energy and demand savings delivered in the past.

The purpose of this review is to inform future program design and implementation, so that PG&E's lighting programs can continue to serve the current market, anticipate future needs, provide energy and demand savings, and educate customers and trade allies. This memo also serves a California Public Utility Commission (CPUC) Lighting Action Plan (LAP) initiative. The LAP is a key component of the California Long Term Energy Efficiency Strategic Plan that was adopted by the CPUC in 2008.

III. PIR MOTION SENSOR

PIR sensors are passive electronic devices which detect motion by sensing infrared fluctuations [7]. It has three pins (gate, drain and source). After it has detected IR radiation difference, a high is sent to the signal pin.

A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion detectors. They work entirely by detecting infrared radiation (radiant heat) emitted by or reflected from objects

PIR sensor is made up of crystalline material that generates surface electric charge when exposed to heat in the form offered. This change in radiation striking the crystalline surface gives to change in charge. The sensor elements are sensitive to radiation of wide range but due to the use of filter window that limits the sensitiveness to the range 8 to 14 micrometer which is most suitable to human body radiation [5].

A. PYRO ELECTRICITY

Pyro electricity relates to the generation of an electrical voltage upon heating. Pyro electricity or pyroelectric material is an electric response of polar dielectric with a change in temperature. Pyroelectric Infrared

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Motion Sensors offer a 1.75V to 3.6V supply voltage range, 1µA to 23 µA Supply current, and digital or Analog output.

B. **RANGE OF PIR SENSOR**

The different range of PIR sensor are listed below

- Indoor passive Infrared – Detection distance ranges from 25 cm to 20 cm.
- Indoor Curtain type - The detection distance ranges from 25 cm to 20 cm.
- Outdoor passive Infrared - The detection distance ranges from 10 meters to 150 meters
- Outdoor passive Infrared Curtain detector - The detection distance ranges from 10 meters to 150 meters.

FRONT VIEW BACK VIEW

Fig 1 PIR sensor – image

C. **PRINTED CIRCUIT BOARD OF PIR SENSOR**

The printed circuit board of PIR sensor is shown below which consist of the following parts such as BISS0001 PIR chip, retrigger setting jumper, delay time adjustment pot, sensitivity adjustment pot,3V DC regulator and a protection diode. The IC details are given below

D. **BISS0001-Micro Power PIR Motion Detector IC- Features**

Low power CMOS technology (ideal for battery operated PIR devices)
CMOS high input impedance operational amplifiers
Bi-directional level detector / Excellent noise immunity
Built-in Power up disable & output pulse control logic
Dual mode: retriggerable & non-retriggerable

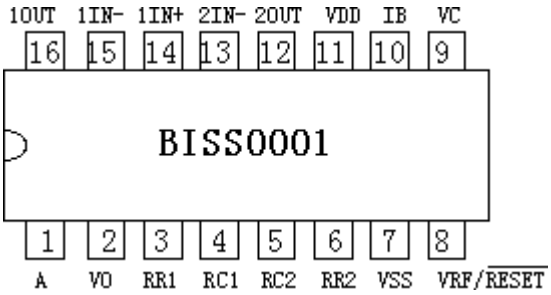

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Fig 2 BISS0001 IC PIN diagram

E. **PIN DESCRIPTION:**

Table 1 BISS0001 IC – Pin details

PIN NUMBER	SYMBOL	DESCRIPTION
1	A	Retriggerable & non-retriggerable mode select (A=1 : re-triggerable)
2	VO	Detector output pin (active high)
3	RR1	Output pulse width control (Tx) * See definition below
4	RC1	Output pulse width control (Tx) *
5	RC2	Trigger inhibit control (Ti)*
6	RR2	Trigger inhibit control (Ti)*
7	Vss	Ground
8	VRF	RESET & voltage reference input (Normally high. Low=reset)
9	VC	Trigger disable input (VC >0.2Vdd=enable; Vc<0.2Vdd =disabled)
10	IB	Op-amp input bias current setting
11	Vdd	Supply voltage
12	2OUT	2nd stage Op-amp output
13	2IN-	2nd stage Op-amp inverting input
14	1IN+	1st stage Op-amp non-inverting input
15	1IN-	1st stage Op-amp inverting input
16	1OUT	1st stage Op-amp output

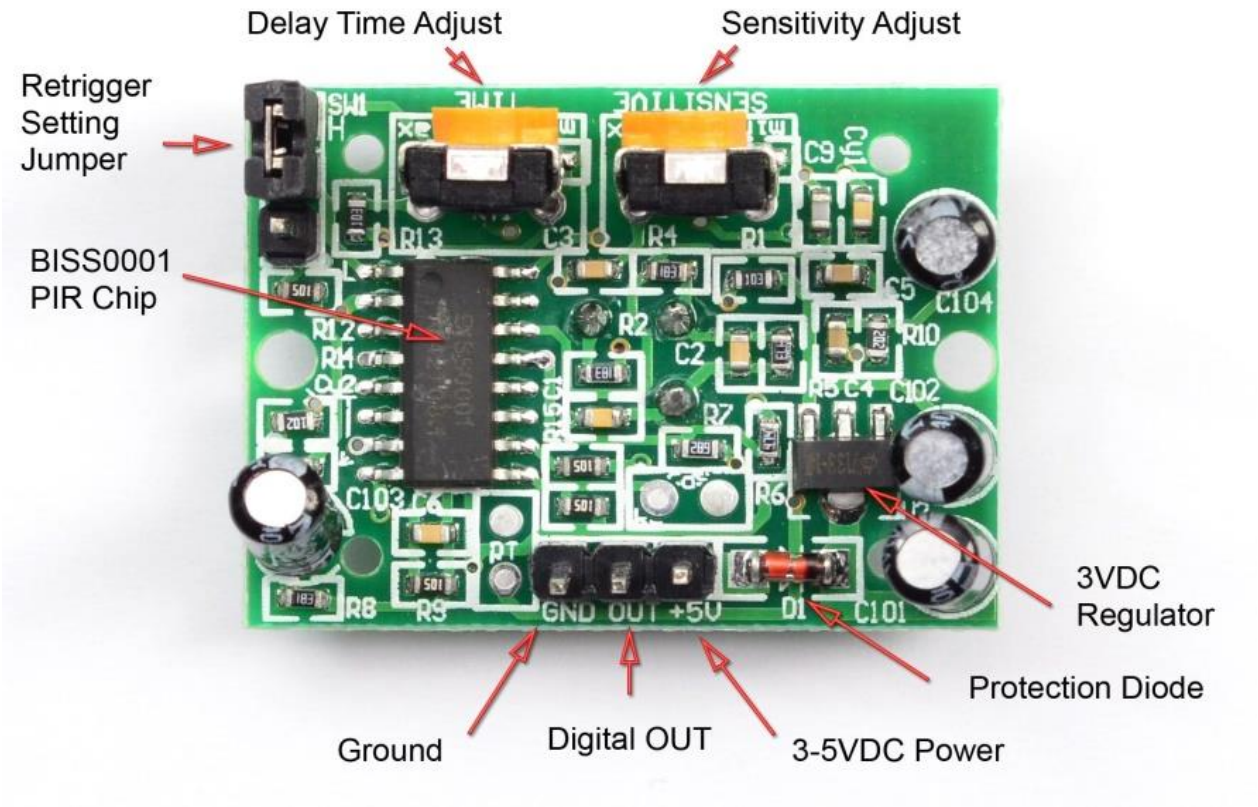

Fig 3 PCB of PIR sensor

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F. **TERMINAL DIAGRAM OF PIR SENSOR:**

The terminal diagram of the PIR sensor is shown which shows the connection details with the load and the supplied voltage

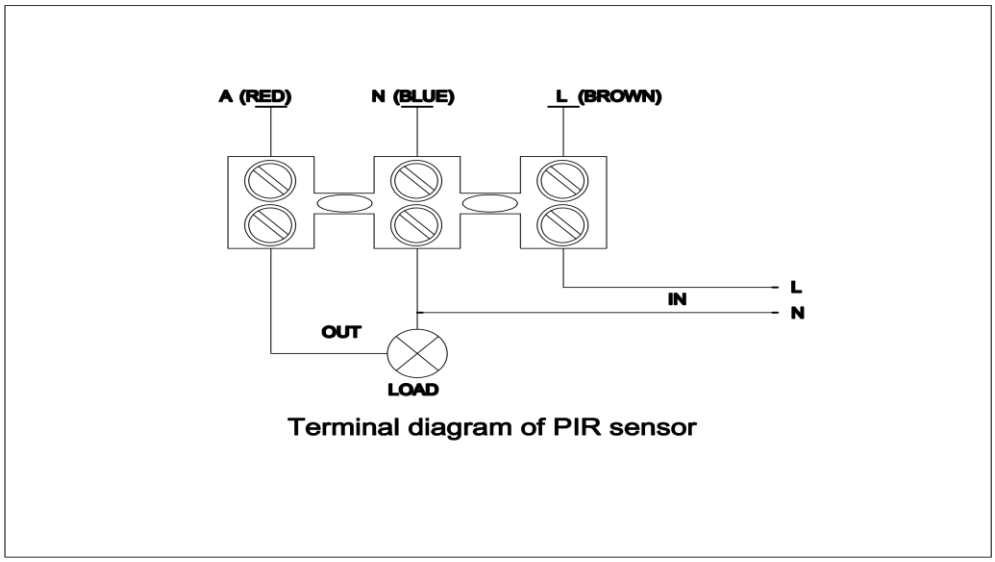

Fig 4 Terminal diagram of PIR sensor

G. **TECHNICAL SPECIFICATON DETAILS:**

The technical specification of the sensor is given below

Manufacturer: Blackt Electrotech (BT)
Serial No: BT31WA
Operating Volt: AC 220 – 250V 50 Hz – 60 Hz.
Load Power: up to 300/1200W Max & Ambient Light:3 – 2000(adj)
Detecting Angle: 180 Degree
Installation Height: 1.8 to 2.5 Mtr
Detection distance: 5-12 Mtr (<24˚)
Load Type: Incandescent lamp, LED light, CLF fans
Motion Detection Speed: 0.6~1M / power Consumption: 0.1 W (Static) and 0.4 Working
Humidity: Less than 93% Relay.

H. **FEATURES OF MOTION SENSOR LIGHT SWITCH**

The features of the sensor light switch are as follows

- Delay Adjustment: 10 seconds – 10 minutes
- Adjustable Lux – Lux can be adjusted
- Day/night mode Selection-Turn on the lights during the Day or Night with mode selection

I. **WORKING OF PIR MOTION SENSOR: -**

BLOCK DIAGRAM OF PIR SENSOR CIRCUIT:

The block diagram of the PIR sensor circuit system is shown below. The different blocks involved in the circuit are a step down transformer to step down the given 230V to required working voltage, rectifier to covert the step down voltage into dc voltage,12v and 5v regulator to reduce the rectified DC voltage to 12v and 5v respectively, relay picks up to transfer the power to the lamp.

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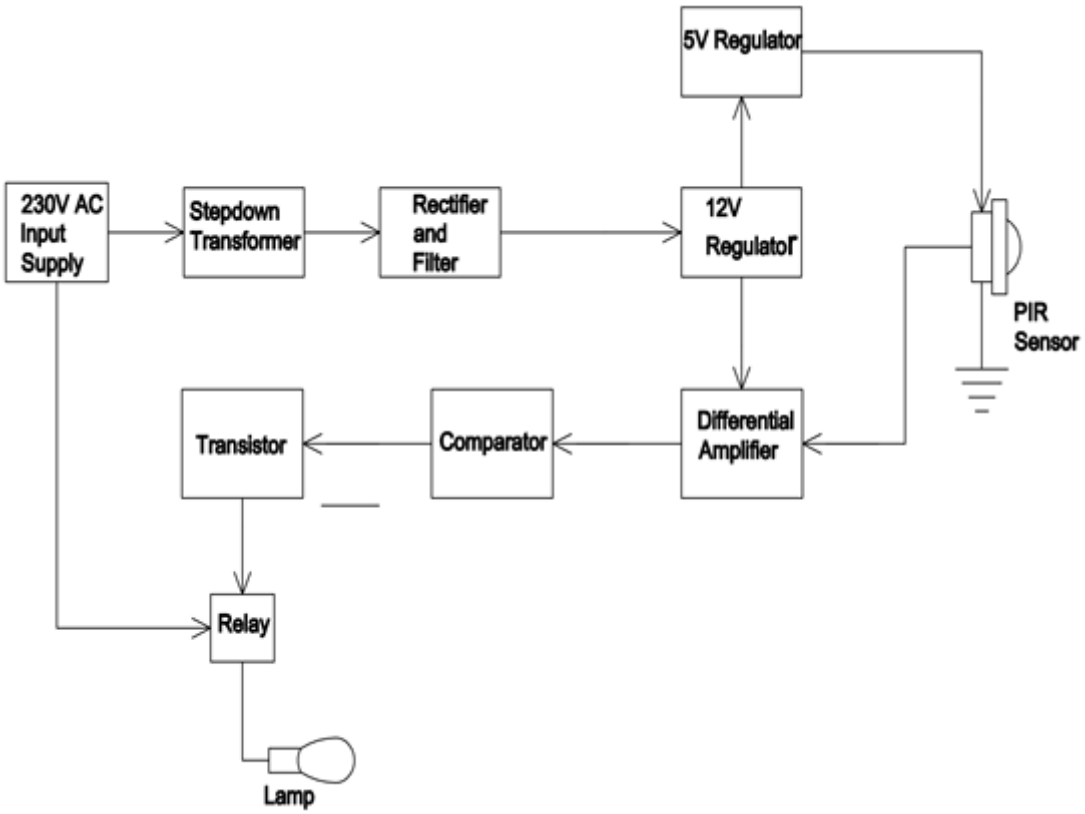

Fig 5 Block diagram – PIR Sensor circuit

IV. POWER SUPPLY - CIRCUIT

The power supply circuit involves the conversion of 230 volts, 50Hz AC into 16 volts DC. This is achieved by using step down 16-0-16 center tapped transformer full wave rectifiers. The AC ripples are eliminated using the passive filter i.e. capacitor. The circuit diagram showing the power supply circuit of 12v and 5v regulator is shown below. The circuit mainly consist of LM7812 IC for the purpose of 12V and 5v voltage regulation.

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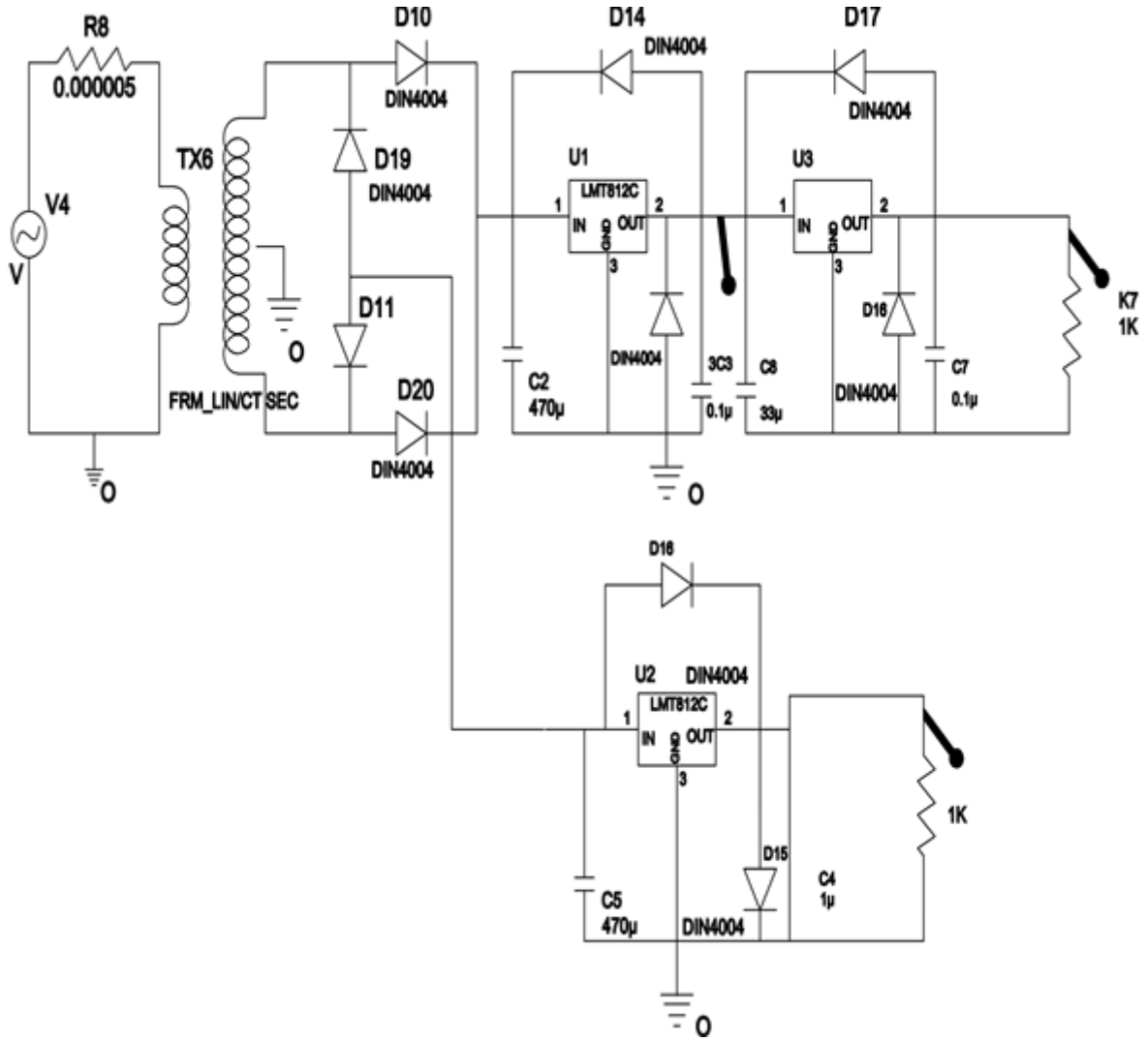

Fig 6 Power supply circuit – PIR sensor

A. CARD KEY MASTER SWITCH

The card key switch is featured by innovative design, convenient and simple operation. The special card identification design facilitates hotel management. Card key switch is super-luxuriously designed with luminous LED indicators, and are made of PC fire resistant, insulating materials with a plurality of optional colors. With rated output current of 16 Ampere, it can completely replace traditional energy-saving switches.

All facilities will get the power once a corresponding card is inserted in its card key switch. When the key card is removed from its slot, the controlled circuits will have power for another10 30 seconds to allow safe egress from the room before power is turned off. If you want to restore the power for the facilities, reinsert the card

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Fig 7 Card key master switch -image

Keycard switches are designed to provide energy savings for the hospitality industry by ensuring that no devices are left on when the room in not in use. These switches control electrical circuits by simply inserting or removing the guest's access card into the device

The room card must also be taken out from the energy-saving switch when turning off all power supplies in the room to ensure safety. The college energy saving switch can ensure all electrical appliances in the class room and save electricity for the hotel.

The wiring diagram of the card key switch is shown.The ratiing of the switch is upto 10 A. Power is given and the given power will be transferred only when the card key is inserted.

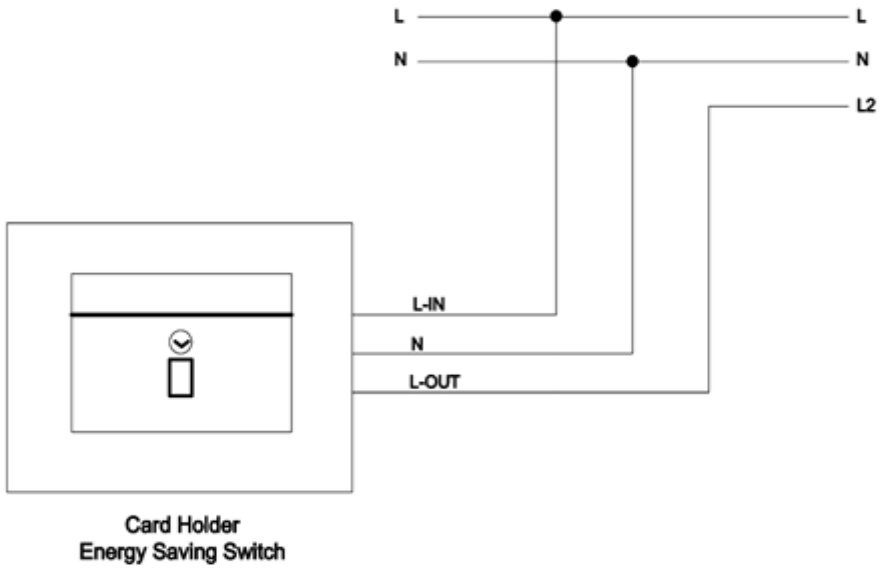

Fig 8 Wiring diagram – card key switch

V. CALCULATION OF ENERGY SAVING BY REDUCTION IN PUMPING WATER

The calculation of energy saving by reduction in pumping of water is done and is shown below

BEFORE

HP in = Q * H * S.G / (3960 * Effp)
KW in = .7457 * HP in /Eff m
Cost energy = Rate * KW in * Hrs. /Eff d

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AFTER

HP in = Q * H * S.G / (3960 * Effp)

KW in = .7457 * HP in /Eff m

Cost energy = Rate * KW in * Hrs. (reduced) /Eff d

The only difference between before and after is the number of operating hours of pumping water which got reduced due to savings of water and by considering Rs 6 per unit

Rating of motor – 15 KW

Energy consumed for 60 minutes – 15 KWH

Cost – 15*6 = Rs 90/ day,

Total savings =Rs 2000/month (22 days)

Where:

HP in = Pump input horsepower –hp, Q= Average pump flow rate –gpm, H = Pump total developed hrad at average flow rate – ft, S.G = specific gravity of liquid being pumped, Effp = Pump efficiency at average flow rate, Eff m = Motor efficiency at actual power draw, Eff d = Drive efficiency at average speed, KW in = Motor input power – KW, Hrs. = Annual operating hours – hr., Rate = Electrical energy cost- S/KW hr., Cost energy = Annual energy cost – S

VI. IMPLEMENTATION DONE FOR WATER CONSERVATION

Fig 9 Automatic float valve fitted in tank

Fig 10 Float valve implementation

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Automatic float valve fitted in the overhead tank of EEE block and found working satisfactorily to cutoff after the required water

VII CONVERSION OF TUBE LIGHT TO LED LIGHT FITTING

A. LED - LIGHT EMITTING DIODE

A diode is an electrical device or component with two electrodes (an anode and a cathode) through which electricity flows - characteristically in only one direction (in through the anode and out through the cathode). Diodes are generally made from semi-conductive materials such as silicon or selenium - solid state substances that conduct electricity in some circumstances and not in others (e.g. at certain voltages, current levels, or light intensities).

LED is highly energy efficient – Less heat, more light, lower cost. Use less electricity for the same light output - 85% less electricity when compared to conventional lighting and around 18% less electricity compared to CFL. ... LED can make a big impact on your energy use.

B. CONVERSION OF NORMAL CEILING FANS TO BLDC FANS

BLDC ceiling fan is one type of ceiling fan which consumes lower electricity compare to normal induction fan. It's also called energy saving fan or brushless dc fan. The full form of BLDC is brushless Direct current. With the use of BLDC motor in ceiling fan we can save 60% electricity in the ceiling fan

Ceiling fan is by default the most used appliance at classrooms. People are not aware of how much power does ceiling fan consume. Ceiling Fan Power Consumption is the draw in watts of the ceiling fan on the highest speed excluding the light fixture. The power consumption of a ceiling fan depends on the size and type of motor used in ceiling fan. An ordinary ceiling fan would consume more power as compared to Energy Efficient Ceiling Fan.
To help people make electricity consumption as deciding factor and reduce their electricity bill, we have listed below selected brands in India based on their power consumption. 1.20 to 32 Watt Ceiling Fans Typically Energy Star, BLDC or DC Motor ceiling fans are going to be found in this category. These fans consume drastically less energy than any other ceiling fans in the market. Low power consumption means more savings in Electricity. Only few have achieved success under this category like ATOMBERG (28 watts, 220.00 CMM), Orient ECOTECH (32 watts, 220.00 CMM). 2.35 to 50 Watt Ceiling Fans 35 to 50 Watt Ceiling Fans exclude a majority of the energy star ceiling fans but include some of the most energy efficient ceiling fans in the industry, based on their motor size ran at the highest speed. Brand which falls under this category are Super fan SUPER A1 (35 watts, 220.00 CMM), Usha TECHNIX (43 watts, 210.00 CMM), Orient ENERGY STAR (48 watts, 210.00 CMM).

3.50 to 65 Watt Ceiling Fans Most 5 star fans, which claim to be consuming lowest wattage falls under this category. Some well-known brands which fall under this category are Havells ES 50 (50 watts, 218.00 CMM), Crompton HS PLUS (53 watts, 218.00 CMM), EESL fans. 4.65 to 80 Watt Ceiling Fans Most of the ceiling fans in India consume around 70-80 watts. As energy efficient ceiling costs more, people prefer cheap fans even though they consume more of energy. Brands under this category are Khaitan, Relaxo, Usha.

5.80 to 95 Watt Ceiling Fans Some of the more common 60″ and greater ceiling fans can be found in this category. Due to the larger sized motors being ran at high speed they will typically draw 80 to 95 watts.

6.95 to 110 Watt Ceiling Fans Not too many ceiling fans in the industry draw this much wattage but the ones that do are truly unique and high-end ceiling fans. It does take power to get some of these truly great ceiling fans up and running. People who do not change their fan for years too fall under this category.

The below table will help you compare wattage consumption of India's most energy efficient ceiling fan with an ordinary fan.

Table 4 Fan wattage consumption

SPEED	ENERGY EFFICIENT CEILING FANS	ORDINARY CEILING FANS
SPEED 1	6 WATTS	16 WATTS
SPEED 2	10 WATTS	27 WATTS
SPEED 3	14 WATTS	45 WATTS
SPEED 4	19 WATTS	55 WATTS
SPEED 5	28 WATTS	75 WATTS

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VIII. OBSERVATIONTABLE -FLUORESCENT LAMP:

Table 5 Observation table- Fluorescent table

S. No	Applied Voltage Increasing			S. No	Applied Voltage Decreasing		
	Striking Voltage(volt)				Extinguishing Voltage(volt)		
	Applied Voltage(volt)	Line Current(A)	Power Input(watt)		Applied Voltage(v)	Line Current(A)	Power Input(watt)
1	180	0.3	40	1	160	0.3	40

The fluorescent lamp gets ignited when the applied voltage as increased up to 180v and gets cut off when it was decreased up to 160v

5.7 OBSERVATIONTABLE –LED LAMP:

Table 6 Observation table- LED

Sl No	Applied Voltage Increasing			Sl No	Applied Voltage Decreasing		
	Striking Voltage(volt)				Extinguishing Voltage(volt)		
	Applied Voltage(v)	Line Current(A)	Power Input(watt)		Applied oltage(volt)	Line Current(A)	Power Input(watt)
1	50	0.03	20	1	50	0.03	20

The LED lamp gets ignited when the applied voltage as increased up to 50v and gets cut off when it was decreased up to 50v. LED lamp gets ignited at the minimum voltage of 50vand also gets OFF only when the voltage reaches minimum value of 50v

IX. FORMATION OF ENERGY CLUB

A. ENERGY CLUB

Energy Club. The Ministry of Non-conventional Energy Sources (MNES) Government of India is promoting Energy Clubs in all Engineering Colleges, with a view to creating awareness among the student community and general public in villages around the college about Environment friendly renewable energy technologies.

Energy Club is purely a voluntary, non-profit group activity of students aimed at practicing energy conservation and environment protection.

B. MAIN OBJECTIVE

The main objective of this Energy Club is to drive home the message of energy conservation and environment protection in the minds of students, by planning and organizing regular activities. Another objective is to increase the contribution of renewable sources of energy in the energy balance

Talks, Seminars, Workshops, Exhibitions and other awareness programs are undertaken by the clubs every year to spread the message of energy conservation and environment protection

C. VISION

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To make our community aware and committed to the cause of energy conservation and environment protection.

D. **MISSION**

"To make the students and staff aware about the need, concept and methodology of energy conservation and environment protection and its benefits to the individual, society and nation as a whole by regularly organizing talks, seminars, workshop, exhibitions, write ups etc"

E. **STEPS TOWARDS FORMATION OF ENERGY CLUB**

Energy club is a 9-step methodology aiming at the achievement of energy and financial savings in a building. It actively involves buildings' users in the process of energy management and teaches them environmentally friendly behavior through practical actions.

X. CONCLUSION

This entire thesis describes the estimation of energy efficient lighting loads in EEE block and hardware implementation of energy efficient lighting loads in EEE block. In the proposed system, it is explained about the advantages of implementing the energy efficient system and the investment required for implementing the project. Payback period calculation is done for the investment done for the proposed system.

The following energy efficient lighting loads are implemented in the proposed work

1. Sensor based lighting
2. Conversion of tube light to LED light fittings
3. Master Switch
4. Automatic float valve for water and electrical energy conservation
5. Slogan posters for creating awareness
6. Circuits standardization for easy implementation of future energy saving projects

PIR sensor is installed in the passage of restroom and its working found satisfactory. The sensor settings are done with cutoff time as 10 minutes with night mode selection.

The different types of lighting systems used are analyzed and tested for better illumination condition, low power consumption and high efficiency. An energy evaluation method has also been carried out. The simulation result and analysis has proved that LED lamps are better suited for domestic applications and are recommended for near future use. Master switch practice implemented in the classroom and found to be used effectively by students.

As part of energy conservation and water conservation auto float valve fixed in overhead tank of EEE block gives satisfactory result of savings in water by cutting of water wastage

Formation of energy club in the department for the participation of students and staff in the future energy saving projects is done. Also posters are created regarding energy efficiency is made and awareness raised regarding the energy efficiency. Standardization of circuits is made first step which will help the energy efficient teams.

The Proposed project gives strong warning to the institution not only in terms of the energy bills also the energy crisis in the near future to all sectors of people and in this project the recommendations reduces the around 15-20% of the energy and 25-30% of cost reduction excluding some issues takes more payback period and some are economically not fit will also be taken in to account in a long run. There is a scope of improvement to include the advanced lighting scheme to reduce further 10% of the cost.

The result of the life cycle analysis reveals that after two years, the selected will bring profit for the investment

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