ENERGY SAVING IN OFFICE

Using passive infrared sensor technology

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Abstract— The aim of this concept is to save energy in work places like meeting rooms, lift, washroom where energy is wasted on light and air conditioners even when no one is utilizing it, passive infrared sensor senses human radiation and only then controller will command the electronic gadgets to turn on or off, this will save lot of energy.

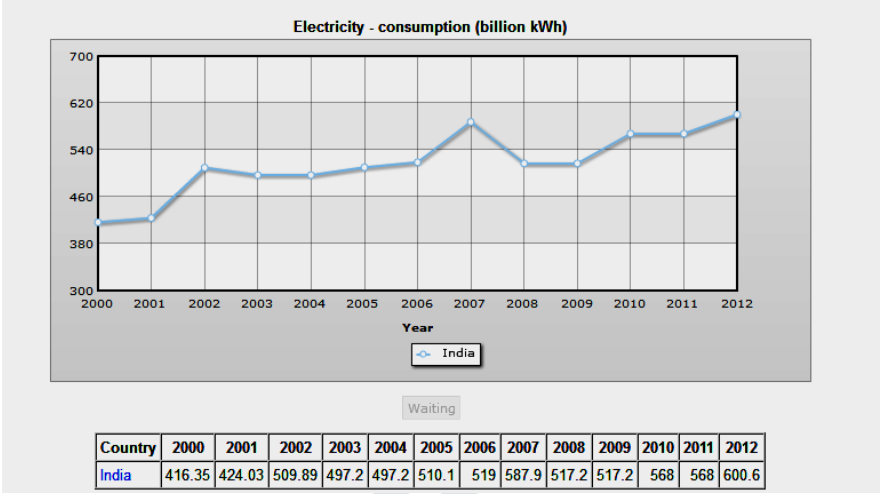
Key word— Embedded systems, AVR ATmega16 micro-controller, passive infrared sensor, relays, air conditioner, light.

I. INTRODUCTION

Natural energy serves as one of precious treasure of our world, it is very important that we utilize it very wisely, in country like India where distribution of electricity is very unfair as in electricity in rural areas are available only for few hours of the day whereas electricity in urban areas are available in overabundant amount that it is wasted even when no one is utilizing it, for example in common work places like meeting rooms, lifts and washrooms electricity is wasted in form of light and AC's even when no one is present at that particular time.

According to current distribution more than 44.20% out of total electricity produce is utilize by industrial sector and according to Central Electricity Authority (CEA)India face outage of more than 30,000MW daily, taking consideration of current scenario it is very important to develop smart products which makes minimum use of electricity.

Taking this into consideration this projects aims to save energy by sensing human radiation i.e. presence of human in work place by using passive infrared sensor, microcontroller decides to switch the devices on and off, this will result in saving of electricity in huge amount.



Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
India	416.35	424.03	509.89	497.2	497.2	510.1	519	587.9	517.2	517.2	568	568	600.6

Fig.1. Shows energy consumption increases every year.

II. MATERIAL

1. **Passive infrared sensor (PIR sensor)**:

All objects above absolute zero temperature emits heat energy in form of radiation in infrared wavelength, this wavelength can be detected by pyro-electric material, pyro-electric material is generally made of gallium nitride (GaN),

Passive infrared sensor usually known as PIR sensor consist of pyro-electric material which generates energy when exposed to heat this energy is converted into appropriate form that is understood by microcontroller using built-in signal conditioning circuit. The size of this sensor is 1/4 inch square and has integrated circuit built-in that covert's the sensor output which is in form of voltage pulses into transistor-transistor logic (TTL) i.e. 1's and 0's which is understood by the micro controller. Source current up to 23mA @5V is applied to PIR sensor, its sensitivity affected by the size and thermal properties of object at distance up to 5 meters, its operating temperature range 0 to 500C or 32 to 1220 F.[1]

2. **Micro-controller:**

A micro-controller is a small controller on single integrated circuit which contains in build central processing unit, memory, input/output programmable pins, arithmetic and logic units, micro-controller can be programmed as per the user requirement.

ATmega16 is an 8-bit high performance microcontroller of Atmel's Mega AVR family, Atmega16 is based on enhanced RISC architecture with 131 powerful instructions. Most of the instructions execute in one machine cycle. Atmega16 can work on a maximum frequency of 16MHz.

Power requirement of this microcontroller varies from 4V-5V and current rating as 1.1V in active mode which operates at 16MHz frequency [2].

3. **Relay**:

Relays are switches that open and close circuits electromechanically or electronically. Relays control one electrical circuit by opening and closing contacts in another circuit. When a relay contact is Normally Closed (NC), there is a closed contact when the relay is not energized.

Relay is used in this project to turn on and off the light and ac connected at one end of relay and it is controlled by controller which is connected to other end of the relay.

Relay normally operate on 12v relay [3]

4. **AVR studio:**

AVR studio is an Integrated Development Environment (IDE) by ATMEL for developing applications based on 16-bit AVR controller, working of this model is tested on virtual environment with tool "proteus", then on hardware

Fig2. Shows Passive infrared sensor

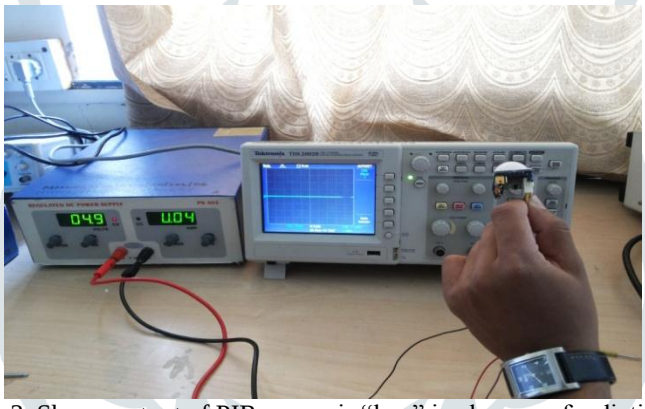


Fig.3. Shows output of PIR sensor is "low" in absence of radiation.

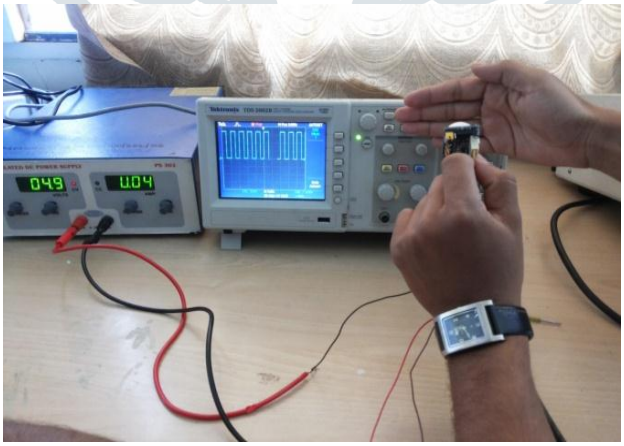


Fig.4. Shows output of PIR sensor is high in presence of radiation

III. IMPLEMENTATION:

As seen in the figure 4. output of passive infrared sensor which are pulses indicating 5V as high and 0V as low are given to AVR microcontroller Atmega16 to its PORTD as input, microcontroller is programmed in a such way that based on input it decides to give the output as high or low to ULN 2003 driver IC, driver IC is used to meet the power requirement of relay switch, based on power up of relay it switches on and off as commanded by controller.

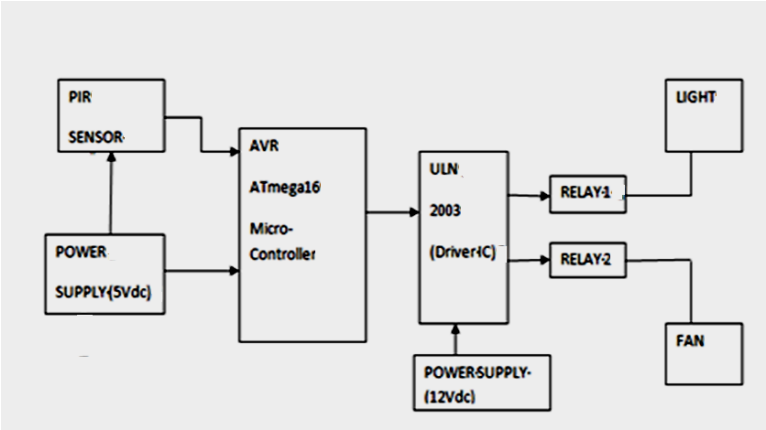


Fig.5. Flow chart

Software part is programmed in embedded c, as per the flow chart seen in figure5. microcontroller is initializes its registers and memory when booted, after that it waits for interrupt from sensors once it gets interrupted it enters interrupt service routine(ISR), ISR is a piece of code which executes on reception of input, so when the sensor detects human radiation it gives pulses at output, microcontroller detects the pulses and enter into ISR, ISR in turn gives output at its port pin to drive the relay on or off. [4]

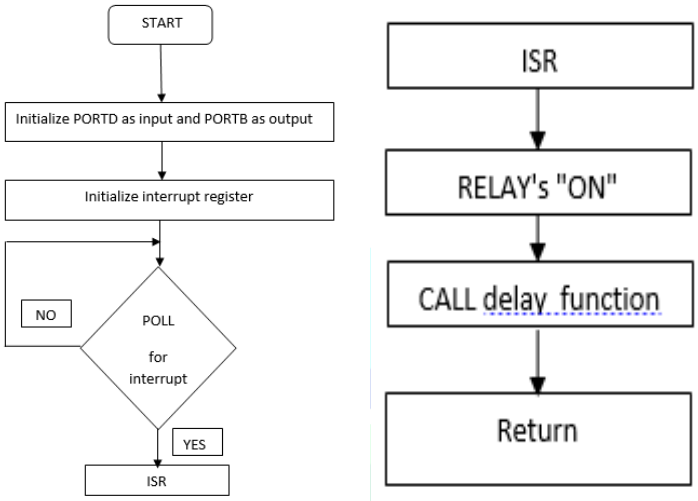


Fig. 6. Software flow chart

IV. DESIGN OF POWER SUPPLY:

As seen in figure6. Aim is to design a power supply that gives fixed output voltage of +5V.

1. Selection of Voltage Regulator

1.1 Parameters for regulator IC.

Output Voltage = 5V
Drop out Voltage = 2V
Ripple Rejection = 62 dB
So we will use 7805 regulators to give +5V fixed positive voltage.

1.2 Design of Filter Capacitor

From datasheet of 78XX dropout voltage is 2V.
V in = V out + V dropout
V in = 7V
Total V in = 7+1 = 8V
V p = Vin X Safety Factor
V p = 8 X 1.1
V p = 8.8V = 9V
V r (p-p) = I dc/ (2*50*C)
1.8=1/100*C
C = 5700 u F.
V c = 13.5 nearly = 16 V
We have to choose 1000uF capacitor.

1.3 Selection of Diode

PIV = V m
V m = 9 + 1.4
V m = 10.4 V.
From above specification diode 1N4007 is selected.
PIV = 100V, I = 1A.

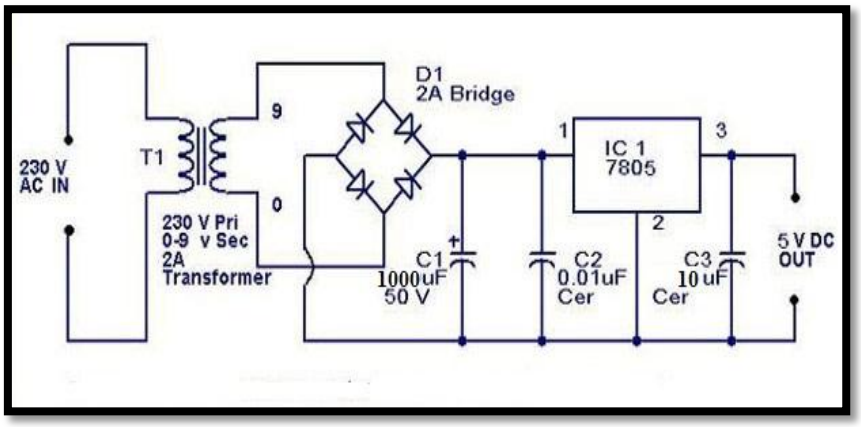


Fig.7. Circuit diagram of power supply

V. CALCULATION AND OUTPUT:

Currently lights and AC in our meeting rooms, lifts and washrooms are on 24 hours a day and 5 days a week, let's consider an example for 1 light of 60W in a meeting room is lit for whole day.

$$E_{(\text{kWh/day})} = P_{(\text{W})} \times t_{(\text{h/day})} / 1000_{(\text{W/kW})} \quad (1)$$

(60 W * 24 H) / 1000 = 1.44 units

Therefore, if a bulb of 60W is lit for 24 hours a day 1.44 units of energy is consumed, now if we use of passive infrared sensor system then the bulb will only lit in presence of human, for example if actual presence of humans in meeting room is total of 14 hours a day, then energy consumed can be calculated as:

$$E_{(\text{kWh/day})} = P_{(\text{W})} \times t_{(\text{h/day})} / 1000_{(\text{W/kW})} \quad (2)$$

(60W * 14 H)/ 1000 =0.84 units

Thus, after implementing this concept energy consumed will drop down to 0.84 units i.e. total of 58.33% of energy will be saved and that is a huge amount.

VI. CONCLUSION:

Energy saving by installing passive infrared sensor in office space was tested and verified practically, as a result of saving energy in huge amount, extension of application of this concept can be used in any public places like stairways, ATMs, changing room where energy is wasted unnecessarily even when no one is using it, this product will not only save precious energy but also protect us from harmful emission of carbon dioxide.

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