Smart Energy Management

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Abstract- The world is powered by technology. People are surrounded by automated instruments. Hence to empower the instruments electricity is required. But nowadays humans are wasting electric source knowingly or unknowingly. Electricity wastage is the main problem in India. India stands third in power consumption in the world. The objective of the project is to reduce the electricity wastage in restrooms especially in night time. People often forget to switch off the light after using restrooms. Here, by using infrared sensor, the movement of person can be detected when he/she enters the restroom. When human motion is detected, the lights are switched ON and it should be ON until the person returns. Also when person leaves the restroom, the lights are made to OFF by detection of motion using IR sensor. So energy can be saved at night time. By this, energy wastage and electricity bills can be reduced. Saving electricity is not about switching off the appliances but it is about using energy efficient appliance models. With several electrical appliances, the one using less energy is preferred to save electricity.

Keywords- Electricity, Human Motion, Infrared Sensor, Reduced Bills, Relay

I. INTRODUCTION

Electricity is a critical element that plays a vital and positive role in the socio-economic development and human welfare of any country. The utility electricity sector in India has one National Grid with an installed capacity of 344.69 GW. Renewable power plants constitute 33.60% of total installed capacity. During the fiscal year 2017-18, the gross electricity generated by utilities In India was 1,303.49 TWh and the total electricity generation (utilities and non-utilities) in the country was 1,486.5 TWh. The gross electricity consumption was 1,149 kWh per capita in the year 2017-18. India is the world's third largest producer and third largest consumer of electricity. As referred in reference 1, people movement will be detected using IR sensor.

India has surplus power generation capacity but lacks adequate infrastructure for supplying electricity to all needy people. In order to address the lack of adequate electricity supply to all the people in the country by March 2019, the Government of India launched a scheme called "Power for All". This scheme will ensure continuous and uninterrupted electricity supply to all households, industries and commercial establishments by creating and improving necessary infrastructure.

India's electricity sector faces many issues. Some are inadequate last mile connectivity, demand build up measures, no access to electricity, average transmission, distribution and consumer-level losses.

Power wastage is becoming a big problem; however, there are several areas that have been identified, first within learning institutions, students forget to turn off the lights and fans before leaving. Teachers often forget to turn off the lights or equipment after using them, some students turn on air conditioners even during cold climates. In most business premises people waste electricity, where the lights glow in the unoccupied building. During the day, most offices still looks brighter with lights being turned on.

II. LITERATURE REVIEW

Existing Method

The use of Passive Infrared Sensor (PIR) in restrooms detects the human movement through thermal variation. This sensor makes the lights to turn ON or OFF by its detection. The disadvantage of this sensor is it cannot sense the human movement properly due to blockages in restrooms, also it cannot sense multiple persons entering there stroom at a time and it goes OFF when there is a person inside. The working of PIR sensor is shown in Fig 1.

Fig. 1 Working of PIR Sensor

Disadvantages of Existing Method

❖ Inaccuracy
❖ Less efficient
❖ Limited angle coverage(120 degree)

Proposed Prototype

Infrared sensor is used to detect the human motion based on infrared rays. It is placed at the entrance so that it can count the number of persons entering the restroom and it will help to turn ON the light until the last person leaves. It can detect multiple persons entering the restroom at a time. Coding is dumped into arduino controller and the lights are switched ON / OFF based on the human presence.

Advantages of Proposed Methodology

- Accurate sensing
- Detects multiple human presence

III. PRINCIPLE OF IR SENSOR

Infrared sensor is an electronic device that emits in order to sense some aspect of the surrounding transmitting and receiving sections. When human interrupts the sensor, it can measure the heat and also motion of the human body.

Infrared Obstacle Sensor Module has builtin IR transmitter and IR receiver that sends out IR energy and looks for reflected IR energy to detect presence of any obstacle in front of the sensor module. The sensor has very good and stable response even in ambient light or in complete darkness. Usually in the infrared spectrum, all the objects radiate some form of thermal radiations. It is invisible to human eyes, but people can feel it as heat.

Any electrically conductive material will block IR rays. If the conductivity is greater, then the blocking of rays will be greater. The working of IR sensor is shown in Fig 2
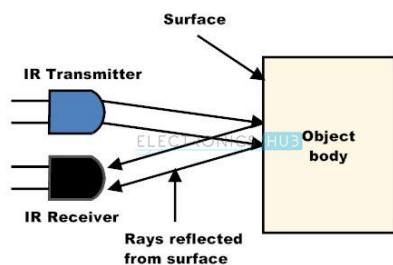

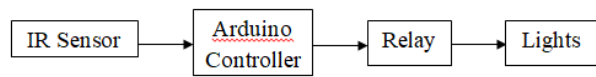**Fig 2 Working of IR sensor.**
IV. BLOCK DIAGRAM

Fig 3 Smart Energy Management

The block diagram of smart energy management is shown in Fig 3. This includes IR sensor, arduino controller, limit switch and lights. IR sensor senses the human motion when a person enters the restroom and gives its output to arduino controller. The controller using relay, switches the lights ON. When the same person leaves the restroom, IR sensor detects the motion and give its output again to controller. Now the lights are switched OFF with the help of relay switches activated by the controller output.

V. HARDWARE DESCRIPTION

IR SENSOR

An Infrared Sensor is shown in Fig 4, it is used as obstacle detector. This transmits an infrared signal. This infrared signal bounces from the surface of an object and the signal is received at the infrared receiver.

There are five basic elements used in a typical infrared detection system: an infrared source, a transmission medium, optical component, infrared detectors or receivers and signal processing. Infrared lasers and infrared LED's of specific wavelength can be used as infrared sources. The three main types of media used for infrared transmission are vacuum, atmosphere and optical fibers. Optical components are used to focus the infrared radiation or to limit the spectral response.
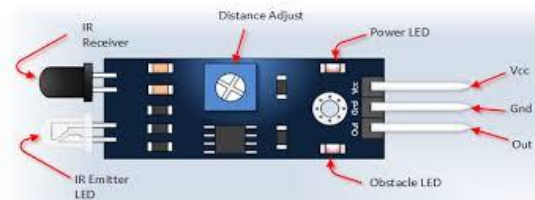

Fig 4 IR sensor

The principle of an IR sensor working as an Object Detection Sensor consists of an IR LED and an IR Photodiode; together they are called as Photo – Coupler or Opto – Coupler. When the IR transmitter emits radiation, it reaches the object and some of the radiation reflects back to the IR receiver. Based on the intensity of the reception by the IR receiver, the output of the sensor is defined.

ARDUINO CONTROLLER

Arduino controller is shown in Figure 5 Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs and light on a sensor, a finger on a button, or a twitter message and turn it into an output, activating a motor, turning on an LED, publishing something online. All arduino boards are completely open-source, empowering users to build them independently and eventually adapt it to particular needs.

Fig 5Arduino controller

RELAY

Relay shown in Fig6 are switches, the terminology applied to switches is also applied to relays. A relay switches one or more poles, each of whose contacts can be thrown by coil. They exists in solid state and mechanical state. Normally open (NO) contacts connect the circuit when the relay is activated; the circuit is disconnected when the relay is inactive. Normally closed (NC) contacts disconnect the circuit when the relay is activated; the circuit is connected when the relay is inactive. All of the contact forms involve combinations of NO and NC connections. The various types of relay are coaxial relay, force guided contact relay, latching relay, machine tool relay, mercury relay, mercury wetted relay, multi voltage relay, etc. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

Fig 6 Relay

WORKING

IR sensor is used for human detection. The working voltage of IR sensor is 3-5v DC and detection distance is upto 30cm. The output of IR sensor is digital output switching between 0 and 1. The IR sensor consists of two LED's-power LED and obstacle LED.IR emitter transfers IR rays and it is received by IR receiver. When there is a human movement, there is variation in the receiving signal. Potentiometer is used

for setting reference voltage at comparator's one terminal and IR sensors sense the object or person and provide a change in voltage at comparator's second terminal. Then comparator compares both voltages and generates a digital signal output. Two IR sensors are placed at the entrance of the room and another two sensors inside the room on the ceiling. First sensor detects human entry movement and counts one while the second IR sensor remains uncounted. The signal is passed to the arduino controller. The arduino controller consists of 3five analog pins and fourteen digital pins.

The Vcc pin of IR sensor is connected to the 5V pin of arduino controller. The output from IR sensor is given to digital pins of arduino controller. Arduino read the digital signals and send commands to relay driver circuit to drive the relay for light bulb controlling .When there is a need to connect AC appliance in embedded circuits, relay is used. Relay pin is made high to make the relay module ON and relay pin is made low to turn OFF the relay module. Using 5V relay, the light gets turn ON. It remains in ON state until the human exits.

TIME	PERSON ENTERS/LEAVES	IR SENSORS I1,I2,I3,I4	COUNT (A=0)	LIGHT CONDITION (ON/OFF)
8.00PM	1ᵗʰPERSON ENTERS	I1=ON THEN I2=ON	A=A+1	ON
8.15PM	1ᵗʰPERSON LEAVES	I2=ON THEN I1=ON	A=A-1	OFF
8.30 PM	2 PERSONS ENTER	I1,I3=ON THEN I2,I4=ON	A=A+2	ON
8.35 PM	1ᵗʰPERSON LEAVES	I2=ON THEN I1=ON	A=A-1	ON
8.45 PM	2ⁿᵈPERSON LEAVES	I4=ON THENI3=ON	A=A-1(i.e A=0)	OFF

Table 1Energy comparison

As shown in table 1, when the person leaves the restroom, the second IR sensor counts one and the light goes to OFF state. When two persons enter the restroom at a time ,count increments by two and it is decreased to one when one person leaves the restroom and another one remains in the restroom. The count decrements to zero when another person also leaves the restroom. The programming is done using arduino controller. The count is incremented or decremented according to the human entry.

The lights are switched ON or OFF according to the sensor input and with the help of programming done in arduino controller. The arduino controller actuates the relay of 5V and when count is increased, the lights are switched ON

and when the count is equal to zero the lights are switched OFF.

VI. RESULT

The human movement is sensed by the sensors. The signal is given to the controller. Then the relay gets energized and hence the light gets ON. When there is no human present the lights will be in OFF state.The following table 1 shows the difference in power consumption between conventional and proposed methodology. According to the reference 5, power consumption gets reduced.

DAY	METHOD	WORKING HOURS	ENERGY CONSUMED (kWh)	ENERGY SAVED(kWh)
1	Conventional method	9	0.36	-
2	Proposed method	3	0.12	0.24
3	Proposed method	2	0.08	0.28
4	Proposed method	3.5	0.014	0.346
5	Proposed method	4	0.016	0.344

Table 2Intrusion Detection

As mentioned in table 2, in proposed method 33% of energy has been saved compared to conventional method on Day 2. Similarly, 22% of energy has been saved on Day 3. On Day 4, 3% of energy is saved.

VII. CONCLUSION

The lights are switched ON when there is a human motion and switched OFF when there is no human inside the restroom by using IR sensor and is controlled using arduino controller. Efficient use of electrical energy at night time is achieved. The electrical energy is saved and electricity bills are reduced.

VIII. FUTURE SCOPE

It can be extended to large buildings, home appliances, hospitals, schools etc.

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