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Arduino Based Automated Light Control in Domestic Applications for Energy Conservation

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Abstract: ***In this age of growing energy demand there is a need to conserve energy that is being produced. It is known that each watt saved is 4 watts of power stopped from generation. In this era, it is impossible for monitor the unnecessary power wastage hence there is a need for automating these processes. This paper discussed about a brief idea about automation of lights using PIR sensor for domestic applications. It is good initiative in the field of Energy conservation.***

Keywords: Arduino, Automation, Energy Conservation, Domestic application

I. INTRODUCTION

Commercial Buildings currently implement the automation using IR sensor and PIR Sensor. [1] The below gives a brief explanation about the different components that are used for the setup and what each of the different components do to this setup that makes it easy to make and use [2]. The BEE (Bureau of Energy Efficiency) has instructed the upcoming buildings to be star rated for their efficiency [2]. The Energy Efficiency Index is Used to Know the present standard of a building [3]. The PIR Sensor detects human movement and triggers the Arduino to give a HIGH signal to the relay [4]. The relay allows the supply current to enter the light source that switches on the light; the light continues to glow as long as there is human presence [5]. This project controls the light using an Arduino Uno and a PIR sensor. [6]. The light then stops glowing after there is no human presence in the room. PIR has a large range for detection of Movement [7]. Arduino is an easily available module for which many sensors can be fixed to give a desired output. [8]. The PIR Sensor can be replaced by temperature sensor for automatic cut off of heating devices when specific temperature is achieved. [9].

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IOT plays a crucial role in the upcoming days where we can monitor the output of sensors. [10] The energy demand has been increasing for the past decade and we can expect it to double within 5 years [11].PIR Sensors can replace the the need for manual switching and reduces the energy loss[12]

II. EXISTING SYSTEM

At present the logic for automated light control is implemented with the help of PIR sensors, where the program logic differs. Initially the PIR sensor senses the movement and after a while the value reset's itself. Hence it is not effective.

III. PROPOSED SYSTEM

Our Proposed system has a continuous working of PIR sensor as it detects the movement every 50 ms. It ensures the human detection for every predefined interval of time which ensure there is no automatic turning off of the light even though when the human is present inside the room.

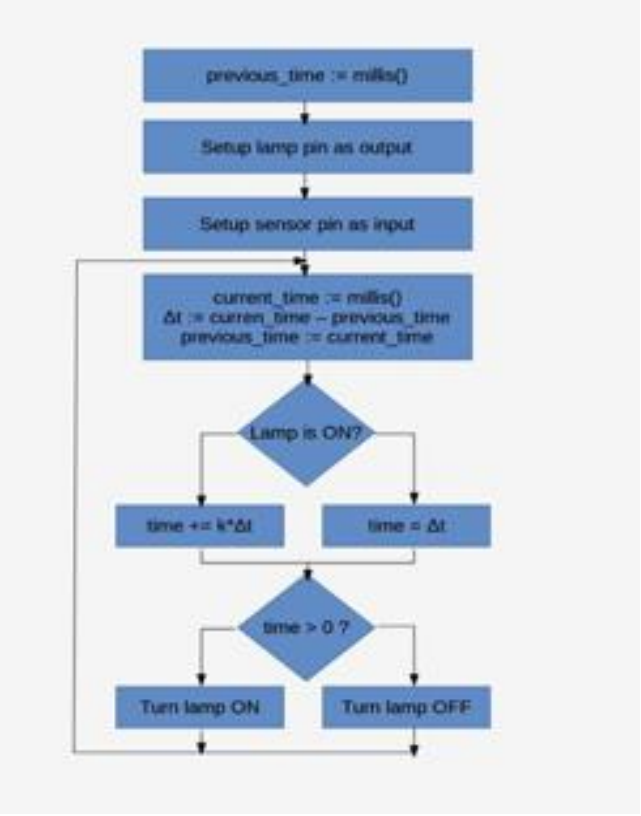

Fig. 1. Program Logic

IV. PROGRAM CODE

The code given below is used to control the relay by adjusting the signal given as digital signal to the common of the relay.

The program first sets the 8th pin as the output pin for the relay and the 4th pin as the input pin to get the status of the PIR sensor. It also sets up various variables for monitoring time namely previous time, time, timespan and current time.

The code then checks the status of the PIR sensor as whether digital HIGH or LOW and activates the relay pin by triggering it with a digital HIGH.

The various time variables each have a different but similar purpose viz., to get the time and overcome the problem of the lamp getting off even if people are still present in the room. The previous time variable gets the time taken till that line of code is executed and acts as the base value that is used to control the ON time of the lamp. The current time variable again gets the time take till that line of code is executed and uses the time difference between the current time and gives the difference between the variables to time which acts as the base value to increase or decrease the lamp time ON. When the PIR sensor is digital low it doesn't do any change to the lamp ON time lets it decrease on its own. When the PIR sensor is digital HIGH the time value increases by a small constant that can be set by the user according the amount time that is needed for the lamp to stay on even when human presence is not available. [10] The time value is also controlled to not get to infinity by using a simple if statement. The given project can be extended with the help of IOT [8].

V. HARDWARE IMPLEMENTATION

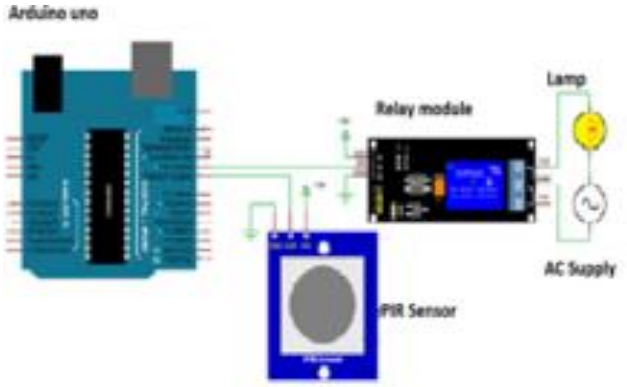

Fig. 2.Proposed Circuit Design

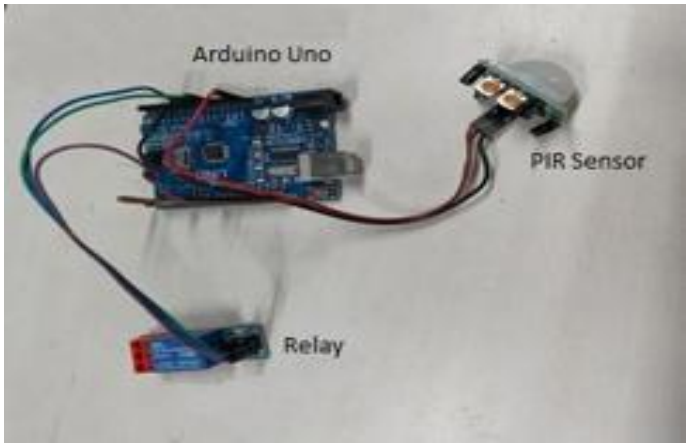

Fig. 3.Hardware Implementation

Fig. 4.When the PIR sensor is digital HIGH and lamp is ON

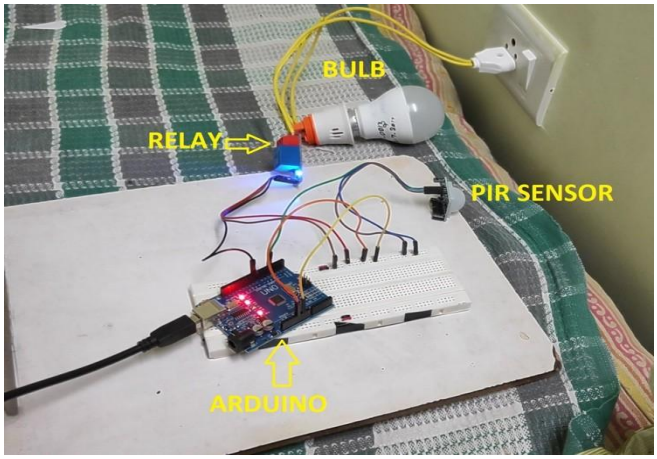

Fig. 5.When the PIR sensor is digital HIGH and lamp is OFF

VI. WORKING SYSTEM

ARDUINO:

Arduino is most commercially viable and versatile microcontroller platform available in the market as of today. Arduino is used as the platform, as cost effectiveness is the main goal of the project.

Fig. 6.Pin Setup of Arduino Uno

PIN 8: It is connected to the relay, for controlling the light using the it.

Pin 8 sends out a digital HIGH signal to the relay to switch ON the light and a digital LOW to switch OFF the light

PIN 4: It is connected to the PIR sensor and acts as the INPUT to the Arduino which acts as the triggering mechanism for the relay.

+5V: It acts the base power supply for both the relay and the PIR sensor. There are totally two +5V pins in the board. It constantly gives out a digital HIGH signal as the output

GND: It acts as the common port for all the connections. There are totally three GND pins in the board. It constantly gives out a digital LOW

RELAY MODULE:

Relay module is the main reason that the project can be scaled up very easily. Relay acts as a switch that is controlled electromagnetically through signal given by the Arduino.

Fig. 7.Relay Module

There are basically 6 connections given to the relay 3 from the Arduino side and 3 from the EB side. The connections are:

Normally Close (NC): We connect nothing to this port so that when a digital LOW signal is given to the relay the light stays OFF

Normally Open: We connect the bulb's phase to this port so that when a digital HIGH signal is given to the signal port the light is ON

Common: We connect the phase of the EB supply to this port so that the relay can switch ON and OFF according to the signal from the Arduino

Input/Signal: The pin 8 output from the Arduino is connected to this port. It receives the digital HIGH or LOW signal from the pin 8 and helps in controlling the light

Ground: The GND pin of the Arduino is connected to this port. This gets a constant digital LOW.

+5V: The +5v of the Arduino is connected to this port.it gets a constant digital HIGH to this port.

The number of relay modules increases according to the size of the relay board. This makes it very convenient to increase the scale at which the program can work.as all the relay modules have the configurations for the input it is very easy increase the number of outlets very easily and efficiently.

PIR SENSOR:

It is one of the main components for this project, through which the light is controlled from the signal given by it to the Arduino [7]. The PIR (Passive infrared sensor) senses the movement of the body with change in infrared radiation emitted by the body. The PIR senor can detect the movement of the body between (5-12 meters) upto an angle of 270 degree.

Fig. 8.Top View of PIR Sensor

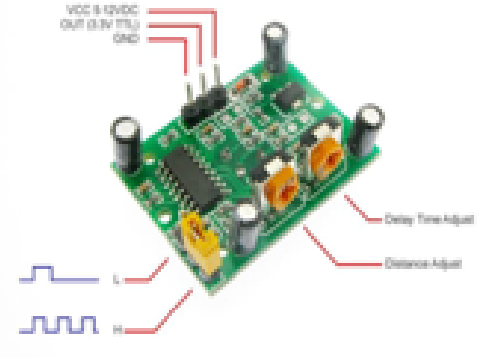

Fig. 9.Bottom View of PIR Sensor

There are basically 3 connections given to the PIR sensor,using the following ports:

+5V: The +5V of the Arduino is given to this pin. This constantly gives digital HIGH to the +5V of Arduino.

OUT: The output of this is given to pin 4 of Arduino. This is the input for the Arduino. It sends digital HIGH when a motion is detected by the PIR sensor and digital LOW when there is no motion detected.

GND: The GND pin of the Arduino is connected to this port. This gives a constant digital LOW to the Arduino.

The PIR Sensor can be replaced by temperature sensor for automatic cut off of heating devices when specific temperature is achieved. [9]

VII. MODEL CALCULATION - ANALYSIS

SCENARIO: CLASS ROOM

No of fans: 6
No of tube light: 9
Power rating of fan: 75 W
Power rating of tube light:18W
Power consumed by all the fans = 75*6
= 450 W
Power consumed by all the tube light = 18*9

= 162 W

Total power consumed by both = 450W+162W
= 612W

The power consumed in a class in 1hr = 612W IN 8hrs the power consumed = 612*8
= 4896W

For the same room in 8hrs effective run time is about 6hrs in 6hrs the power consumed = 612*6
=3672W

Therefore, the power saved in the class with PIR sensor
= 4896W-3672W
= 1224W

Hence one unit of power each day in a single room can be saved.

The percentage of power saved is

=1224W/3672W *100

=25% of the total energy per day

VIII. RESULT ANALYSIS

SL.NO	DEVICE	RATING	QUANTITY	POWER UTILISED WITHOUT PIR	POWER UTILISED WITH PIR
1	FAN	75	6	3600	2700
2	TUBE LIGHT	18	9	1296	972
			TOTAL POWER	4896	3672

Fig. 10. Result Analysis

SL.NO	ROOM	POWER UTILISED WITHOUT PIR	POWER UTILISED WITH PIR
1	101	4896	3672

Fig. 11. Energy Utilized in a Room

SL.NO	DURATION	WITHOUT PIR (KW)	WITH PIR (KW)
1	1 DAY	4.896	3.672
2	1 MONTH	97.92	73.44
3	1 YEAR	1175.04	881.28

Fig. 12. Forecast Energy Readings

SL.NO	DURATION	WITHOUT PIR (KW)	COST
1	1 DAY	4.896	24.48
2	1 MONTH	97.92	489.6
3	1 YEAR	1175.04	5875.2

Fig. 13. Cost Analysis Without PIR

SL.NO	DURATION	WITH PIR (KW)	COST
1	1 DAY	3.672	18.36
2	1 MONTH	73.44	367.2
3	1 YEAR	881.28	4406.4

Fig. 14. Cost Analysis With PIR

Fig. 15. Energy Utilized without PIR

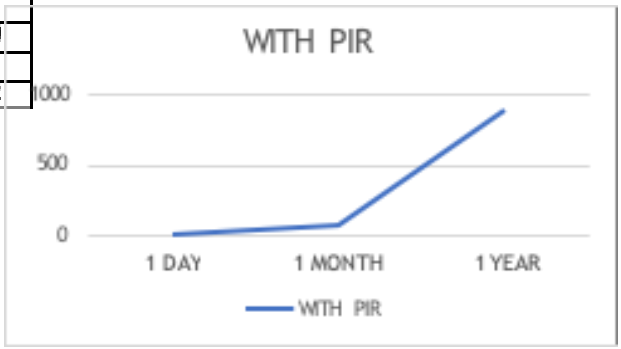

Fig. 16. Energy Utilized with PIR

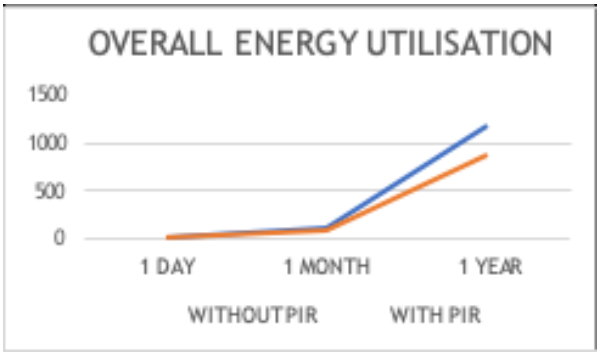

Fig. 17. Overall Energy Utilized

Fig. 18. Cost Analysis

IX. CONCLUSION

Automation of lights using PIR sensor for domestic purpose has proved to be saving the amount of energy spent. More energy can be saved by extended this logic to various conditions with the help of different sensors. With the help of PIR sensor we can save nearly 1224 watt of energy per day for a single room which infers that we are saving nearly 4800 watts from production.

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