ISSN No:-2456-2165

Automatic Security Light and Alarm Using Arduino and PIR Sensor

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Abstract:- Now a day's Security is the main aspect in our day to day life and based on the realm of Arduino and PIR (Passive Infrared) sensor we developed a project to create an intelligent lighting system with alarm. This combination of Arduino and PIR sensor leads to an automatic room lighting solution. The setup allows lights to seamlessly respond to human presence, enhancing both convenience and energy efficiency in our living space. Let's explore how this innovative combination transforms a traditional room into a smart and responsive environment.

Keywords:- *Arduino UNO, PIR Sensor, LED.*

I. INTRODUCTION

In an era where security is paramount, leveraging technological advancements to fortify our surroundings has become imperative. One such innovative solution is the integration of automatic security lights using Arduino and PIR (Passive Infrared) sensors [1]. This amalgamation of electronics and sensing technology serves as a robust foundation for enhancing security measures in both residential and commercial spaces. The core components of this system include Arduino, a versatile microcontroller, and PIR sensors designed to detect infrared radiation emitted by moving objects. The synergy between these elements empowers the creation of an intelligent security lighting system that responds dynamically to the presence of potential intruders.

The fundamental principle revolves around the PIR sensor's ability to sense changes in infrared radiation within its field of view. When motion is detected, the Arduino microcontroller orchestrates the activation of security lights, flooding the area with illumination and serving as a visual deterrent. This immediate response not only alerts occupants but also discourages unauthorized access.

Beyond its fundamental functionality, the system offers a spectrum of advantages. It promotes energy efficiency by activating lights only when needed, cutting down on unnecessary consumption. The cost-effectiveness and versatility of the Arduino platform enable customization, allowing users to tailor the system to their specific requirements. Moreover, the potential for integration with additional features, such as alarms, remote monitoring, and connectivity to other smart devices, propels this security solution into the realm of smart home and IoT applications.

In essence, the automatic security lights using Arduino and PIR sensor represent a convergence of technology and security needs. By seamlessly combining detection, response, and adaptability, this system provides a proactive and intelligent layer of protection for our living and working spaces in an ever-evolving security landscape.

A. Problem Statement

Now a day's automatic systems plays a vital role in human life in each and every aspect. This automatic system majorly useful to the physically handicapped people where they cannot dependent on others. In this regard we came across one application on automatic system is Automatic Room Security Light System. This project is designed by main components Arduino UNO and PIR sensor. Based on human motion the lights can switch ON/OFF. The same concept was implemented like hand dryers, toilet flush valves etc.

B. Necessity of Project

Automatic security lights and alarms using Arduino and PIR (Passive Infrared) sensors serve several important purposes. They enhance security by:

- Intruder Detection
- Quick Response
- Energy Efficiency
- Cost-Effectiveness
- Customization
- Deterrence Factor
- Remote Monitoring
- Versatility

In summary, the necessity of automatic security lights and alarms using Arduino and PIR sensors lies in their ability to provide effective, efficient, and customizable security solutions for various applications, ranging from homes to businesses.

ISSN No:-2456-2165

II. COMPONENTS DESCRIPTION

➢ *The Major Components Required to Design this Project are:*

A. Arduino UNO
B. PIR Sensor
C. LED
D. Jumpers

A. Arduino UNO

Arduino UNO is open source platform where hardware components are required and also software program is needed. An Arduino board can be purchased preassembled or, because the hardware design is open source, built by hand is shown in "Fig.1". A pre-assembled Arduino board includes a microcontroller, which is programmed using Arduino programming language and the Arduino development environment. Arduino programming language is a simplified from of C/C++ programming language based on what Arduino calls "sketches," which use basic programming structures, variables and functions. These are then converted into a C++ program[2].

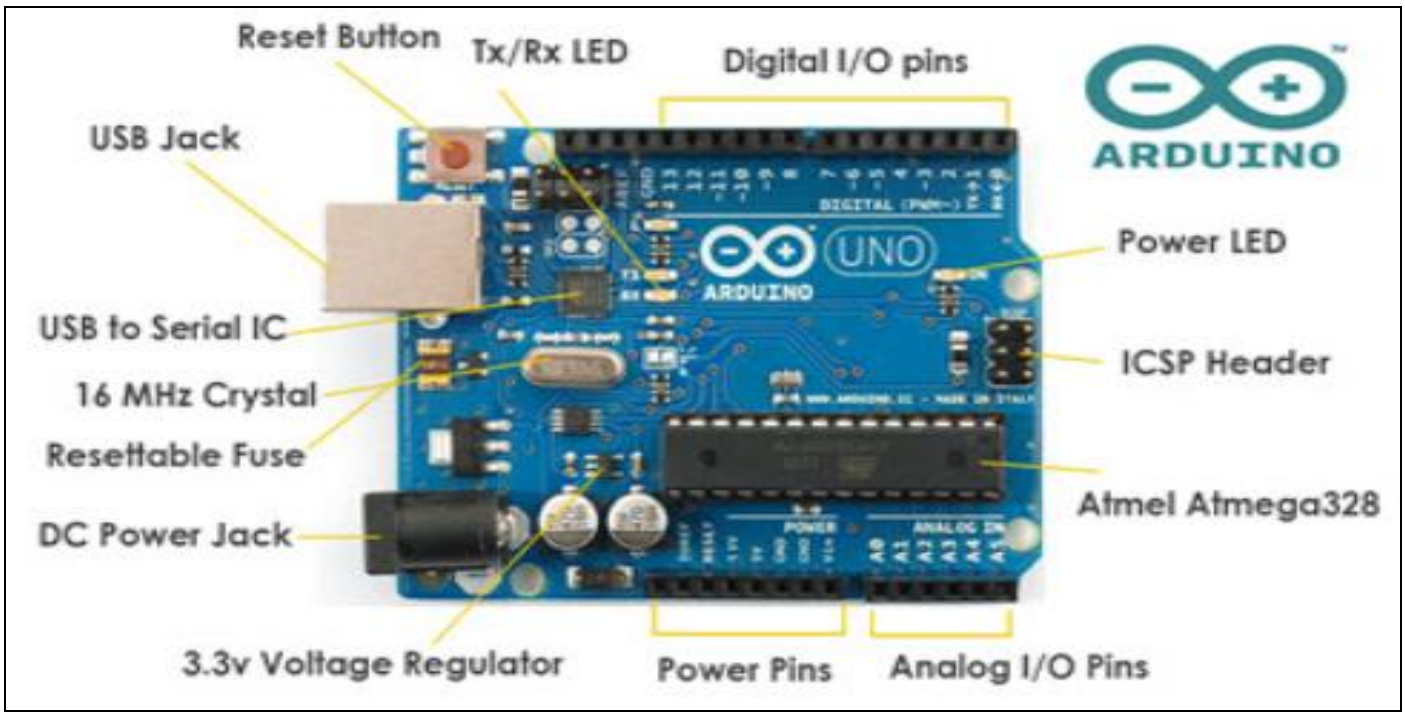

Fig 1: Arduino

Arduino board is an open-source based on ATmega328P microcontroller IC. It consisted of 14 digital input and output pins (of which 6 can be used as PWM outputs), 6 analog inputs. The feature of Arduino Uno is shown in Table I.

Table 1: Features of Arduino UNO

Microcontroller	**ATmega328**
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40mA
DC Current for 3.3V Pin	50mA
Flash Memory	32 KB of which 0.5 KB used by boot loader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz

The "fig 2" represents the pin diagram of Microcontroller IC present in the Arduino UNO. The microcontroller IC Atmega328p consists of 28 pins.

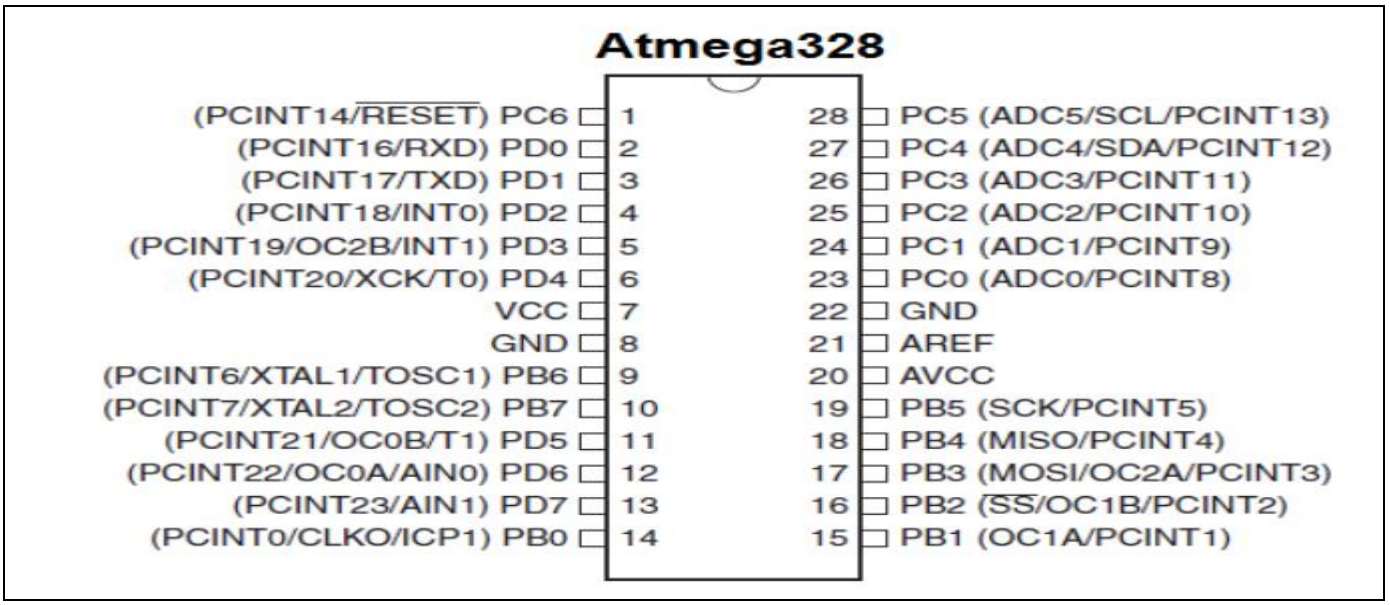

Fig 2: Pin Diagram

B. PIR Sensor

A PIR (Passive Infrared) sensor detects changes in infrared radiation, commonly used in motion detection applications. It's passive because it doesn't emit energy but detects variations in heat [3]. When motion occurs, the sensor detects the change in heat signatures, triggering a response. PIR sensors are widely used in security systems, lighting control, and smart home devices. Adjusting sensitivity and placement are crucial for optimal performance. The basic PIR sensor is shown in "fig 3".

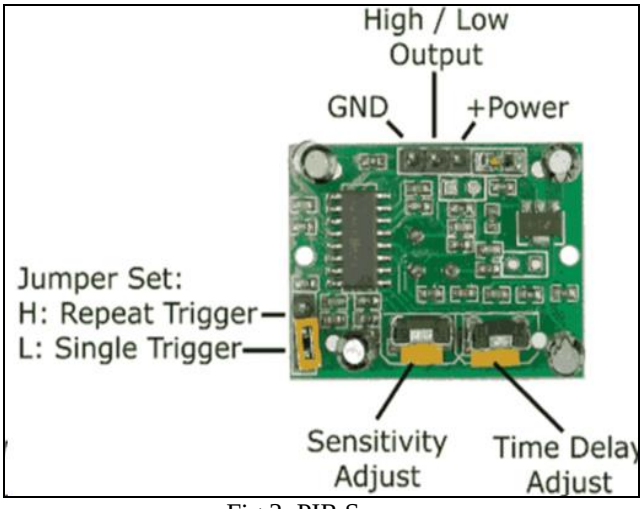

Fig 3: PIR Sensor

➢ *PIR*

The sensor in the figure above has two built-in potentiometers to adjust the delay time (the potentiometer at the left) and the sensitivity (the potentiometer at the right).

➢ *Pinout*

Wiring the PIR motion sensor to an Arduino is pretty straightforward – the sensor has only 3 pins.

- GND – connect to ground
- OUT – connect to an Arduino digital pin
- 5V – connect to 5V
- Detection distance range of PIR Sensor is 25cm to 20

C. LED

Light-emitting diode (LED) is a widely used standard source of light in electrical equipment. The "fig 4 (a)" represents the LED and "fig 4 (b)" represents the symbol of LED [4]. It has a wide range of applications ranging from your mobile phone to large advertising billboards. They mostly find applications in devices that show the time and display different types of data. Light-emitting diodes (LEDs) are promising lighting sources for general lighting applications with the promise of being more than ten times as efficient as incandescent lighting. Such characteristic combined with their long operating life and reliability has made them becoming a potential choice for next generation of lighting systems including automotive, emergency, backlight, indoor, and outdoor.

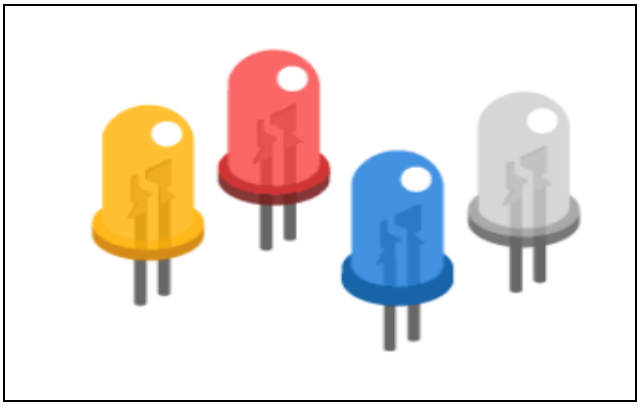

Fig 4(a): LED

ISSN No:-2456-2165

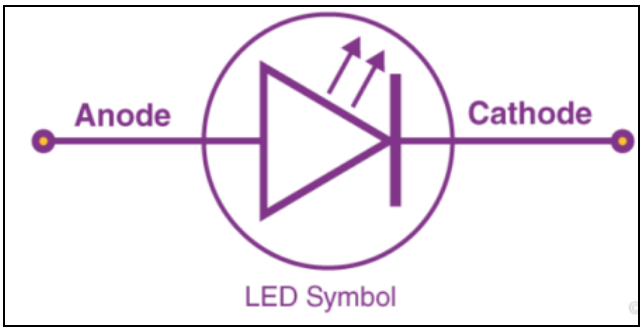

Fig 4(b): LED Symbol

To ensure proper operation and to control the light intensity, LEDs need an efficient driver, normally implemented by power electronics-based conversion stages, to match the LED characteristics with the AC grid voltage and to generate a controllable, high quality light. The following Table II shows the LED voltage ratings.

Table 2: Led Voltage Ratings

LED color	Forward voltage
Red	1.8 V
Yellow	2.1V
Green	2.2 V
Blue	3.2 V
White	3.2 V

III. IMPLEMENTATION

A. Circuit Diagram

Implementing security lights and alarm system using arduino and PIR (Passive Infrared) sensor involves detecting motion and triggering corresponding actions. Based on using the major components the circuit is designed as shown in "fig 5".

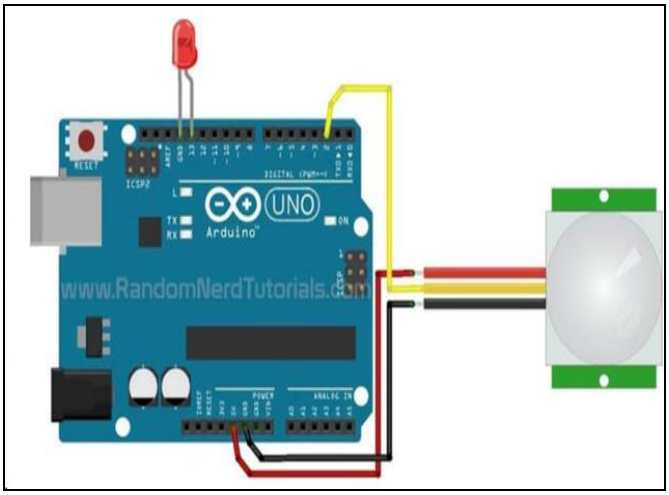

Fig 5: Circuit Diagram

The basic steps of circuit comprises into three steps firstly connect the PIR sensor to arduino. Based on the terminals existed in PIR connect the:

- V_{cc} (supply voltage) to 5v in Arduino
- GND to GND in arduino
- Out to a digital pin in arduino (D2).

Next secondly connect the next component LED to arduino by connecting the positive terminal of LED to arduino pin (D13) and negative terminal of LED to arduino GND pin and finally the power supply of the arduino by using DC 9v battery.

B. Software Description

➢ *Arduino IDE*

Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board. The programming language used first, the Arduino compiler/IDE accepts C and C++ as-is. In fact many of the libraries are written in C++. And there are steps explained in getting started to Arduino as shown in "fig 6".

- Open arduino 1.8.5
- Go to file menu and select new page.
- Write program.
- Compile
- Upload program to Arduino.

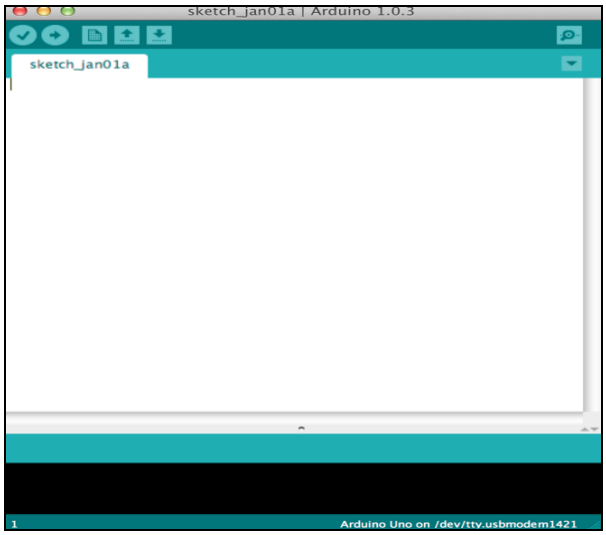

Fig 6: Arduino IDE

C. Advantages

- Energy Efficiency Automatic room lights help conserve energy by turning off lights when there is no movement detected, reducing unnecessary usage.
- Cost Savings As a result of energy efficiency, there can be cost savings on electricity bills, making it an economically beneficial solution in the long run.

- Convenience Users don't need to manually turn lights on or off, providing convenience and a hands-free experience as the lights respond to movement.
- Increased Lifespan of Bulbs by minimizing the time lights are switched on, the overall lifespan of the bulbs can be extended, reducing the frequency of replacements.
- Enhanced Security PIR sensors can be part of a security system, triggering lights when movement is detected. This can deter potential intruders by creating the illusion of an occupied space.
- Customization Arduino-based systems allow for customization of the automation process. Users can adjust sensitivity, duration, and other parameters according to their preferences
- Adaptability the system can adapt to different environments and usage patterns, providing a flexible solution for various spaces and user needs.

D. Applications

- Garage lights
- Bathroom lights
- Hand Dyers
- Toilet Flushers

IV. RESULTS

The working model of the proposed security lights and alarm system using PIR sensor was successfully designed and implemented. The circuit was able to measure distance upto 2000cm.The circuit was also able detect the motion of human movements. By using PIR sensor we were able to reduce cost and increase efficiency. The “fig 7” represents the input image.

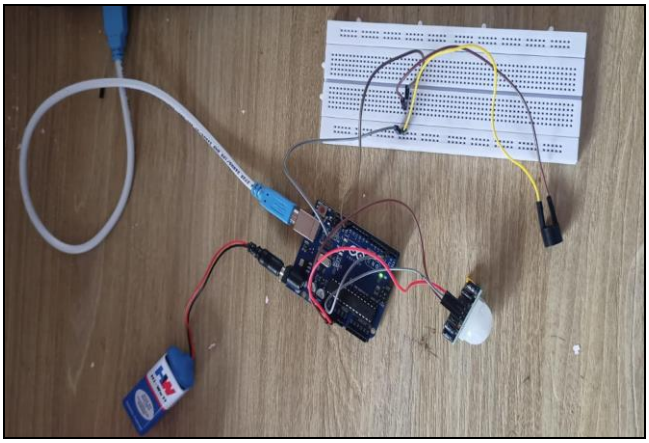

Fig 7: Project Image

When the power supply is connected and program is compiled by using Arduino UNO the output displayed as seen in “fig 1.8”

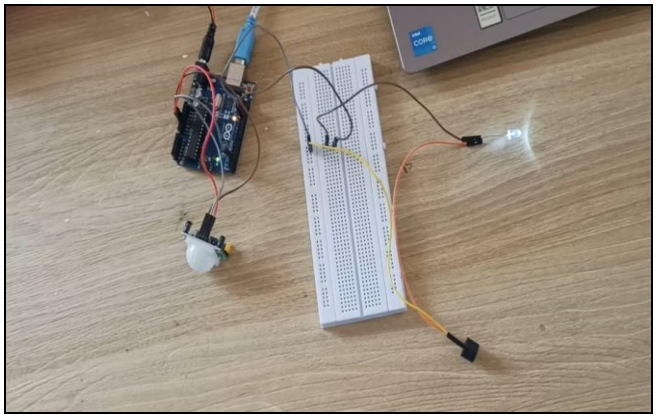

Fig 8: Output of Project

V. CONCLUSION

With automated home lighting systems you can ensure we are getting the right amount of light as and when we needed it and this project helps to reduce energy usage resulting in lower electricity bills. As nowadays enormous amount of energy wasted in daily life ,with the help of this system the energy wastage can be prevented and can be contribute to large amount of power saving in which the total effective of system is more reliable.

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