

Design and Fabrication of IoT Based Night Security System

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Abstract—This paper presents an Arduino Based night security system designed to provide an energy efficient, autonomous surveillance solution. The system integrates an LDR(Light Dependent Resistor) to detect nighttime conditions, activating security measures only during low light hours, which conserves during the day. A PIR (Passive Infrared) sensor is employed to detect motion within the surveillance area, triggering an alarm/or activating relay connected light system upon unauthorized entry. The entire system is powered by the sustainable energy source comprising a solar panel and a rechargeable battery , ensuring continuous operation during power outages. This project demonstrates an affordable , scalable solution for residential and small scale security applications, emphasizing renewable energy integration and low power consumptions.

Keywords- IOT, PIR Sensor, Arduino, LDR, Security

INTRODUCTION

An Arduino-based night security system offers an innovative, cost-effective solution for enhancing property safety, utilizing microcontrollers to automate surveillance and response. By integrating sensors like motion detectors, light sensors, and alarm modules, this system can efficiently monitor activity in low-light conditions and respond to potential threats. The flexibility and affordability of Arduino make it an ideal choice for building customizable, user-friendly security systems. With options for expansion, such as SMS alerts or camera integration, this project showcases the practical application of embedded systems and IoT technology in creating a smart, accessible night security solution. The Arduino-based night security system is designed with integrity and simplicity, making it easily accessible for users of all experience levels. The system is simply composed of an Arduino microcontroller, motion sensors, light sensors, and an alarm module. The entire setup is compact and requires basic wiring, making it easy to install without specialized tools. The Arduino code is pre-written in optimized, allowing users to quickly upload it using the Arduino IDE. Additionally, the system's specification includes low power consumption, high sensitivity in detecting motion, and reliable performance in low-light conditions, ensuring consistent security coverage. The straightforward nature of this system reduces the complexity of operation. Once it is completely installed, the sensors automatically starts to monitor the environment around it, and any detection of anomalies it triggers the alarm without needing manual interference. The visual indicators, such as

LED bulb, help users easily understand the current state of the system. There is no need for a complicated interface or continuous monitoring by the user, as the system efficiently can handle these tasks on its own, programmed setup by the user.

LITERATURE SURVEY

In this paper we propose to security that could be provided in a real time situation at a given range area. There are lots of several papers also proposed different approaches for the given problem [1] “IoT Based Night patrolling Robot” describes the design and implementation of an IoT based patrolling robot. It shows that how IoT technologies can enhance security and surveillance operation, with providing a real time data and remote monitoring abilities.[2]” Systematic survey on smart home safety and Security System” offers a comprehensive review of smart home systems, focusing on latest technologies and methodologies. It addresses key aspects of intrusion detection, fire safety and remote monitoring using IoT devices. [3]” IoT based weather prototype using Wemos” emphasizes the real time data collection and remote accessibility, marking it valuable for agriculture and environmental applications.[4]” Smart Agriculture System using IoT” explores various sensors and automation techniques to improve crop monitoring, irrigation management and overall firm productivity.[5]” Implementation of Low Power and Area Efficient IoT devices” discusses the development of IoT devices optimized for low power consumption and minimal physical footprint It covers component selection of potential applications in smart home and wearable techniques.

METHODOLOGY

An Arduino-based night security system is compatible with a wide range of different sensors and tools or devices, making it a versatile and saturated solution for different security needs. Arduino’s open-source nature allows for easy integration with motion detectors or motion sensors, cameras, alarms, and other components, ensuring that the system can be tailored to the specific requirements of any difficult security environment. Additionally, the system is compatible with various communication technologies, such as Wi-Fi or Bluetooth, enabling remote monitoring and control. Since Arduino also supports multiple programming languages and provides different libraries, it offers flexibility in adapting to both simple and complex security setups. Its small form factor and low power consumption further enhance compatibility with compact or off-grid installations,

providing manageability for domestic or commercial purpose. The credibility of this Arduino-based security system is high due to the relatively low cost and wide range in availability of components. Arduino boards are affordable, and the required sensors—such as infrared motion detectors, cameras, and light sensors—are cost-effective and easy to access. The system can be built and deployed without significant technical expertise, as there are numerous tutorials and community resources available for troubleshooting and development. Additionally, Arduino's extensive documentation and support make it feasible for both generalists and technical professionals to implement. However, there are might some of the challenges such as ensuring reliable power supply, handling data storage for camera feeds, and addressing potential security vulnerabilities must be considered for larger or more critical installations. Nonetheless, for small to medium-scale applications, the system is both a practical and affordable solution.

a. Software Implementations

The software implementation of the Arduino Based security system integrates with various sensors and devices. The microcontroller detects motion triggering the specific actions. Arduino IDE code is written to monitor sensor, which detects motion, are programmed to identify changes in the environment, and if detected, send alerts to mobile phone of the user. This system can also be set to monitor ambient light levels using a light sensor, ensuring that the alarm is activated or deactivated at pre-determined hours.

b. Software Features and Integration

To enhance the functionality, advanced software features can be introduced. For instances WIFI modules such as ESP8266 can be added to the Arduino to communicate with a smartphone or web interface for live updates, allowing users to arm or disarm the system remotely. This software can also integrate with cloud services to store lots of sensor data, providing a more robust security solution. Machine learning algorithms can be introduced for anomaly detection, improving the system's ability to differentiate between normal and suspicious activities. Additionally ,the system can be designed with specific time schedule , triggering alerts to mobile phones is activated or deactivated at pre determined times.

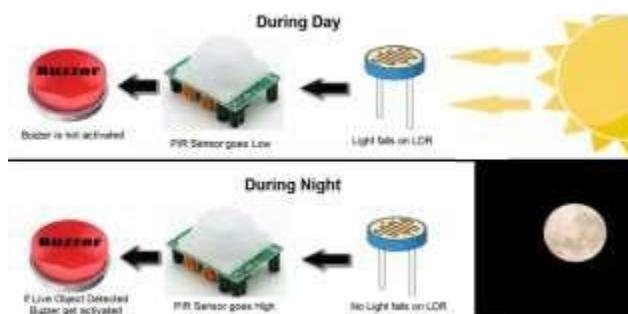


Fig:-1 During the day or in the presence of any external light the LDR detects the presence of light transfer a signal to PIR motion sensor to its static or deactivation status and in the absence of light thus the motion sensor activates itself to detect any movements.

Source:- <https://how2electronics.com/security-alarmusing-pir-sensor-arduino/>

c. System Design

The system of Arduino Based security system is versatile and highly adaptable. At the core of the system is the microcontroller, which processes inputs from various sensors and controls the output devices. Typically an Arduino board such as the Arduino UNO or mega is chosen based on the project's complexity and requirements. Sensors used in the system can include infrared motion detectors ,cameras and other specialized sensors depending on the specific needs of the security system. Output devices range from alarms and lights to automated locks and notification system. For wireless communication, modules like ESP8266 or ESP32 are often integrated enabling remote and monitoring and control. Communication protocols like Bluetooth and WIFI connect the system to a network or directly to user's mobile phone. The system can automate security protocols and provides real time alerts to user. Additionally, the system can be enhanced with features such as data login, cloud storage ,integration with other smart home devices , offering a comprehensive and reliable security solution.

d. Hardware Descriptions

Arduino UNO is a microcontroller board based on ATmega328P. It has 14 digital input output pins of which 6 can be used as PWM outputs.6 analog inputs with a 16 MHz ceramic resonator(CSTCE16MOV5-RO),a USB connection and power jack, an ICSP reset and a header button. A Light Dependent Resistor is a simple divide that can be used detect light levels and respond to light. When there is more light its resistance goes down ,and in the presence of less light its resistance goes up. A passive infrared sensor that measures infrared light radiating from objects in its field of view. It has three pins attached to it that are vcc input , ground and output pin. The 16x2 Liquid crystal display basic module that commonly used in DIYs in circuits .The 16x2 translates a display of 16 characters per line in 2 lines. A relay is electromagnetic switch operated by a relatively small current that can control much larger current. In the 2 channel relay make switch and connection easier and act as indicator to show weather the connection is power is switched on / off. A buzzer is a mechanical audio signaling device which proposes sounds by indicating a the presence any unauthorized user. The 9V battery is an electric battery supplies a nominal voltage up to 9V.The actual capacity which measures the voltages is between 7.2 to 9.3V. The Light Emitting Diode is a semiconductor device that emits light when an electric current passed through. In this associate it works as a indicator as a status of current conductivity throughout the system. A resistor is a passive electrical component which has two terminals that are used regulating or limiting the flow of current in any electrical or electronic circuits.

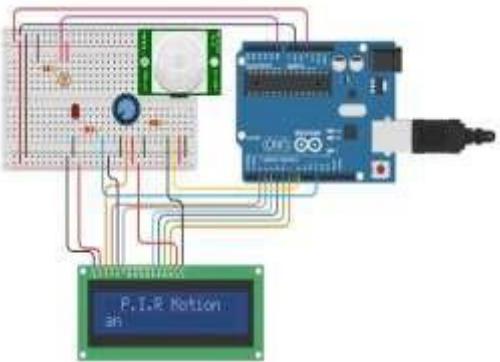


Fig:-2 Wiring Diagram of the system from the microcontroller with its respective components.

Source: <https://www.tinkercad.com/things/6rZgjjiTHgj-arduino-home-security-with-pir-sensor-andlcd-display>

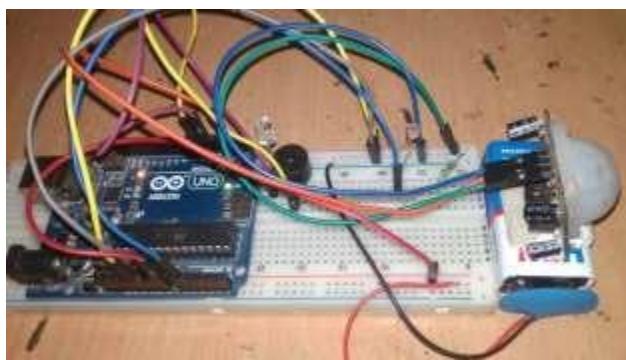


Fig ;-3 Image shows an Arduino UNO microcontroller connected to a breadboard with various components and sensors.

Source: <https://how2electronics.com/security-alarmusing-pir-sensor-arduino/>

RESULTS AND OBSERVATION

We have read the sunlight intensity value. The LDR sensor read the sunlight intensity value in an analog waveform. This experiment is carried out for more than 30 days and using PIR sensor no of motions detected.

| Time: | Sunlight Intensity | LED Intensity | No.Of Motion Detected(In thousands) |
|--------------------|--------------------|---------------|--------------------------------------|
| 12:00am to 5:00am | 0% | 100% | 75 |
| 05:00am to 12:00pm | 65% | 45% | 300 |
| 12:00pm to 5:00pm | 49% | 75% | 410 |

| | | | |
|---------------------|----|------|-----|
| 5:00 pm to 11:59 pm | 0% | 100% | 185 |
|---------------------|----|------|-----|

Table 1: Input data From Sensors

- **Low Motion Periods:** From **12:00am to 5:00am** and **5:00pm to 11:59pm**, where motion detection is lower (75,000 and 185,000, respectively), reduce LED intensity dynamically. For example, instead of 100% brightness, set LEDs to 50–70% in areas with no or minimal motion. We can use motion-triggered LEDs to only illuminate active areas.
- **High Motion Periods:** During **12:00pm to 5:00pm**, where motion detection is highest (410,000), keep LED brightness adaptive but explore zoned lighting (Described in Table 1).

CONCLUSION

The proposed Arduino Based night security system combines renewable energy with advance sensor technology to create a reliable and sustainable solutions. It addresses the growing need for automated and eco-friendly systems, offering an effective alternative to traditional security measures. Future enhancements may include GSM modules for remote alerts and IOT integration for real time monitoring Ensuring a continues and reliable power supply is a significant challenge, especially for the system deployed on the outdoor, or off grid location. Arduino Boards and sensor requires and stable power, also if using wireless communication modules like WIFI or Bluetooth increases power consumption. Solutions such as Battery Backups or solar power might be needed, but these come with their own challenges, such as ensuring enough battery life and managing power efficiently. Sensors like motion detectors or light sensors might not be 100% accurate. False triggered by pets or environmental factors like wind can lead to unnecessary alerts, while failing to detect an intruder can compromise security. Fine-tuning the sensitivity of the sensors and implementing algorithms to reduce false alarms by using multiple sensors or integrating data from cameras can mitigate this issue but increases system's complexity.

REFERENCES

- [1].P.Anbumani,K.Feloomi,B.Dharsana -They published a paper titled as “IOT BASED SMART NIGHT PATROLLING ROBOT”In the international journal of creative research thoughts(IJCRT)..
- [2].Sujal Sharma , Nilesh Kumar , Aryan Kumar ,Imran Ansari , Avinabh Anand , Chandan Dubey , Gurwinder Kaur and Neha Sharma –They contributed to a chapter”Development of Arduino Based Surveillance Drone for Enhanced Security” in a Springer Publication.

[3].Qussay.I.Sarhan – He authored a paper titled “Systemetic Survey on Smart Home Safety and Security System” publishe in IEEE Access.

[4].R.Alam , R.Islam”Autometric Night Light Control by Using Arduino UNO” Sept 2021.pp.1-6,dol:10.1109/IEEECONF51389.20219416096

[5].K kutubuddin(2023).IOT-Based weather prototype using weMos , journal of control and Instrumental Engineering,9(1) <https://matjournals.co.in/Index.php/JCIE/article/view/1623>

[6].A Devanand Wale , D Raghunath Rakore , S Baliram Adsul and K S Kazi(2019).Smart Agriculture System Using IoT , International Journal of Innovative Research in Technology,5(10),439-497

https://ijirt.org/master/publishedpaper/IJIRT147761_PAPE_R.pdf

[7].P R Hotkar, V kulkarni , P Y Kamble and K S Kazi(2019).Implementation of low power and area efficient carry select adder,International Journal Of Research in Engineering Science and Management,2(4), 183-184

https://www.ijresm.com/Vol_2_2019/Vol2_Iss4_April19/IJRESM_V2_I4_50.pdf

[7].Arduino documentations .

www.arduino.cc

[8].PIR Motion sensor Datasheet.

www.datasheets.com

[9].LDR Characteristics and Applications

Available:-www.electronics-tutorials.ws