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Design and Implementation on Industrial Automation with the help of Renewable Energy Sources

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Abstract: ***In the quest for a sustainable future, we've identified that traditional street lighting consumes more electricity than necessary. To address this, we've conceptualized an energy-efficient street lighting system. Our prototype leverages a Light Detecting Resistor (LDR) to optimize power usage, paving the way for an eco-friendly world. Fire alarms are crucial for timely fire detection, safeguarding lives and property. Our simplified circuit design enhances reliability, forming an integral part of a comprehensive security system that relies on sensor technology for prompt fire detection. The demand for automation is surging in both industrial and domestic spheres. This paper aims to minimize manual intervention by introducing self-operating systems powered by renewable energy sources. We're integrating solar technology and piezoelectric sensors to harness electricity. This approach not only fuels industrial automation but also contributes to the global shift from finite conventional energy to renewable sources. By employing sensors, we ensure safety and efficiency in industrial zones while generating clean energy.***
Keywords: Diode, Arduino UNO, ALARM, Sensor, Controller

I. INTRODUCTION

Our initiative focuses on designing an industrial automation system that harnesses renewable energy sources. By integrating solar panels and piezoelectric plates, we're at the forefront of applying cutting-edge technology across various applications. Our paper centers on generating electricity, which is then utilized to power industrial operations. The innovative use of piezoelectric modules captures energy from footsteps, showcasing the diverse potential of piezoelectric power generation. Additionally, solar energy plays a pivotal role in our electricity production strategy.

This electricity is instrumental in monitoring key industrial parameters, including flame presence, motion detection, temperature levels, and ambient light. Our energy conservation efforts are further enhanced by employing light sensors that adapt to day and night conditions. Motion sensors add another layer of efficiency, brightening street lights when human presence is detected at night and dimming them otherwise. Safety is also a top priority, with flame and temperature sensors activating buzzers for immediate alerts.

This paper tackles the prevalent issue of fire hazards in industrial settings, often caused by high temperatures or continuous operation. To enhance energy efficiency, we've incorporated motion sensors to detect human activity within street light zones. Temperature monitoring is achieved through digital humidity and temperature sensors, which trigger a buzzer once a certain threshold is reached, serving as an alert mechanism. The integration of these diverse sensors effectively mitigates the risks mentioned, ensuring a safer and more energy-conscious industrial environment.

II. LITERATURE REVIEW

Ali M. Eltamaly, Majed A. Alotaibi, Abdulrahman I. Alolah & Mohamed A. Ahmed elaborated in the *"IoT-Based Hybrid Renewable Energy System for Smart Campus"* that the shift towards renewable energy systems is gaining momentum as the limitations of fossil fuels become increasingly apparent. Integrating these systems into the existing grid, however, presents complex challenges that affect the operation, stability, reliability, and quality of power. Small Hybrid Renewable Energy Systems (HRES) offer a solution as compact power networks that combine various energy sources and storage mechanisms. These systems are designed to efficiently manage and optimize both energy production and consumption. The key to their success lies in real-time monitoring, which provides critical data that allows operators to assess performance and swiftly pinpoint any irregularities.[1]

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In the *"Design and Implementation of a Real-Time Smart Home Management System Considering Energy Saving"* by Mahmoud H. Elkholy, Tomonobu Senjyu, Mohammed Elsayed Lotfy, Abdelrahman Elgarhy, Nehad S. Ali and Tamer S. Gaafar explained that navigating the complexities of smart microgrid operations is a formidable task, particularly when it comes to devising an optimal home energy management system that balances multiple, often competing, objectives. The rise of homes outfitted with renewable energy sources (RESs) adds another layer of complexity. These systems enable homeowners to finely tune the balance between energy consumption and generation, leading to significant cost savings and reduced peak demand. This study presents a design for a solar-powered smart home that prioritizes both cost-effectiveness and security. It empowers homeowners with the ability to manage their energy resources remotely or on-site through smartphones and computers.[2]

In the *"Renewable energy-based home automation using IOT"*, the incorporation of a variety of technical devices, including a sensor-based network, significantly reduces the incidence of random and human errors during the validation process. This system is adept at detecting common hazards such as gas leaks, fire outbreaks, and unauthorized access with high levels of accuracy, thereby preventing potential disasters. Modern automation systems are equipped with specialized parametric sensors that analyse performance and structural integrity, utilizing historical data from components to inform and execute actions based on sensor analysis.[3]

III. METHODOLOGY

In industrial automation to generate electricity by using solar plate and piezo plate and this electricity is used to store energy and also for monitoring the various parameters like temperature sensor, flame sensor, light sensor and motion sensor.

1) Identify the system and components that will be used for industrial automation.
2) Making Circuit diagrams are very important before starting work, from circuit diagrams can find out the flow in the circuit so that there are no errors in the work.
3) To generate electricity by using two plates such as solar plate and piezo plate. For monitoring and control purpose various sensors are used such as temperature sensor, flame sensor, motion sensor and light sensor.
4) The tool is functioning (running) If all the circuits are correct and working properly then the tool has functioned, but if an error occurs in the tool circuit it will not work, then the circuit must be checked again.

IV. WORKING PRINCIPLE

In "Design and implementation of industrial automation with the help of renewable energy sources" paper we are going to make the industrial or any other sector is automatic thus to reduce the human effort we are kept the different sensors for the indication and protection purpose. By using renewable energy sources such as solar plate and piezo plate, these are used for the generation of electricity. This generated electricity is given to the charge controller through the diode whereas the diode is unidirectional device i.e. to conduct current in only one direction and it is also used for the reverse protection. The charge controller is used to regulates the value of voltage or current. In this project we use the lithium-ion battery because of their several advantages and battery is used to store the energy. The different sensors such as DHT11 sensor, flame sensor, motion sensor and light sensor. For indication purpose we use the buzzer and LED.

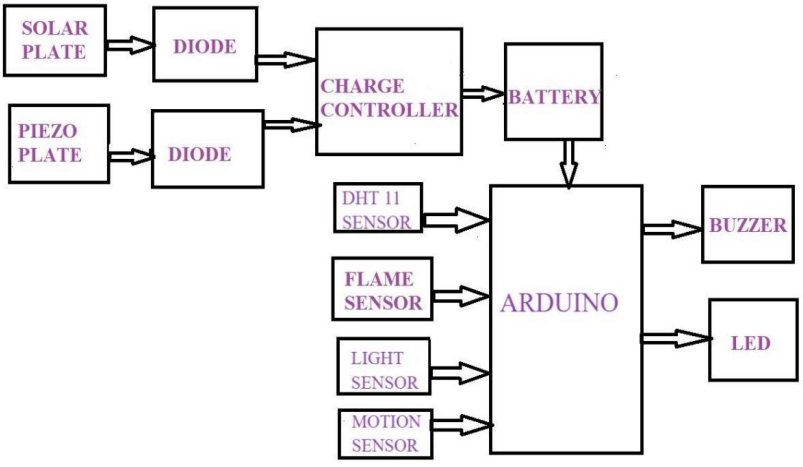

Fig. 1 Block Diagram

Fig. 1 shows the block diagram of the prototype we are presented in this paper. The Solar Plate captures solar energy and converts it to electrical power and Piezo Plate generates electricity from mechanical stress or vibrations. Both plates are connected to diodes that prevent reverse current flow, ensuring energy is only directed towards the charge controller. The battery stores the electrical energy generated by the solar and piezo plates. Arduino Microcontroller acts as the brain of the system, processing input from sensors and controlling outputs. The DHT 11 Sensor measures temperature and humidity and Flame Sensor detects the presence of fire or high temperatures whereas the Light Sensor measures light intensity.

The Motion Sensor detects movement within its range. The Buzzer and LED emits an audible alarm when triggered by the sensors and provides a visual indication or status light. The Charge Controller manages the flow of electricity to the battery, ensuring it is charged efficiently and safely.

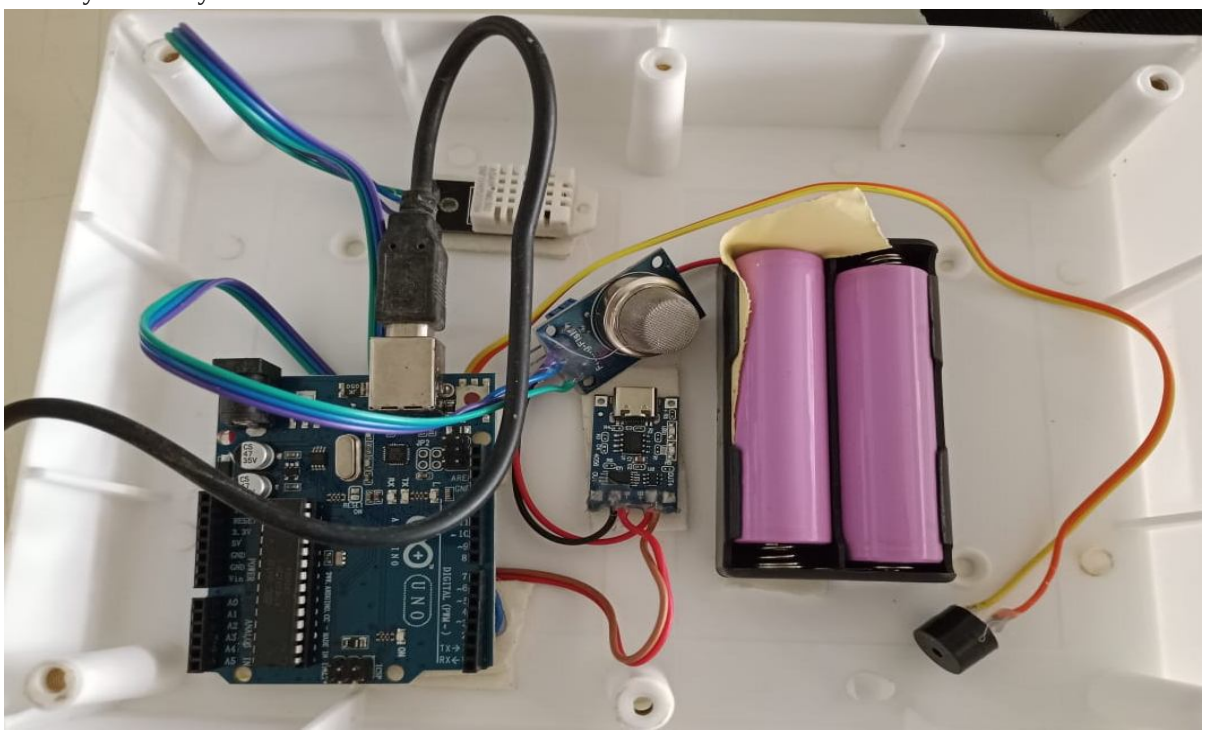

Fig. 2 Prototype

V. ADVANTAGES & APPLICATIONS

A. *Advantages*

1) Reduced Carbon Footprint: Automation systems powered by renewable energy significantly lower greenhouse gas emissions.
2) Cost Savings: Over time, the use of renewable energy can lead to reduced operational costs.
3) Energy Independence: Industries can reduce their reliance on fossil fuels and become more self-sufficient.
4) Improved System Reliability: Renewable energy sources can provide a more stable and reliable power supply.
5) Enhanced Safety: Automation reduces the need for human intervention in hazardous areas.

B. *Applications*

1) Manufacturing: Automated manufacturing processes can be powered by solar or wind energy to increase efficiency and reduce waste.
2) Agriculture: Renewable energy can power automated irrigation and crop monitoring systems.
3) Mining and Metals: Automation combined with renewable energy can improve safety and reduce environmental impact in mining operations.
4) Energy Sector: Automation can improve energy storage and collection processes, especially for solar and wind farms.
5) Utilities: Energy and utility companies can automate processes to meet the increasing demand for green energy while reducing costs.

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VI. CONCLUSIONS

The design and implementation of industrial automation with the aid of renewable energy sources is a pivotal step towards creating a sustainable and efficient industrial sector. This approach not only aligns with global environmental objectives but also offers a resilient and cost-effective solution to the energy needs of modern industry. By integrating renewable energy systems, industries can reduce their carbon footprint, decrease energy costs, and improve system reliability.

The successful integration of these systems requires careful planning, robust design, and strategic implementation. It involves the adoption of smart technologies, such as automation and real-time monitoring, to ensure optimal performance and energy management. As renewable energy technologies continue to advance, they present an ever-growing opportunity for industries to innovate and evolve in their energy practices.

Embracing renewable energy in industrial automation not only benefits the environment but also enhances the competitiveness of businesses by reducing operational costs and ensuring a stable energy supply. The future of industrial automation is intrinsically linked to the utilization of clean energy sources, marking a significant shift from traditional energy systems to more sustainable practices.

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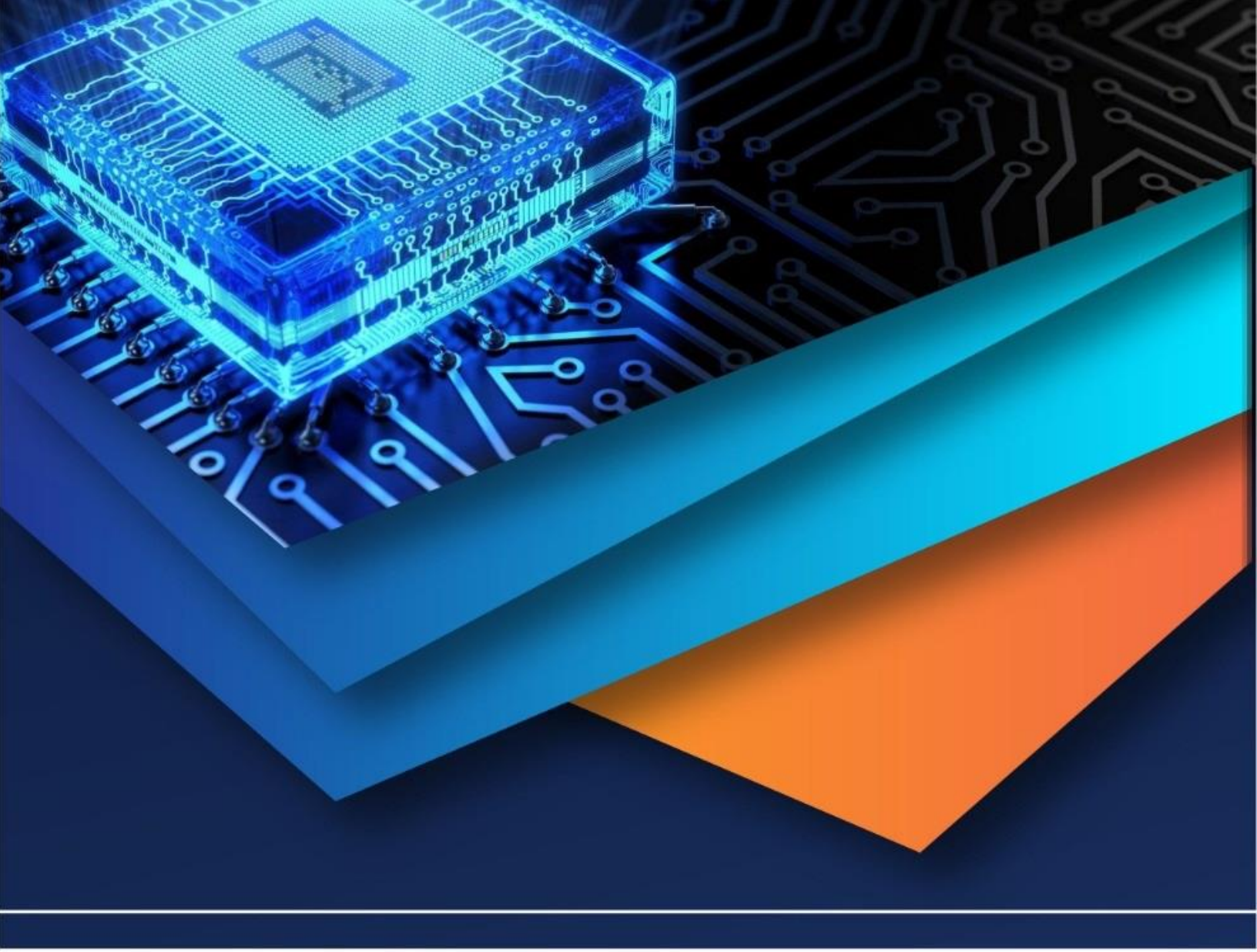

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