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AUTOMATIC SOLAR PANEL CLEANING ROBOT USING ARDUINO

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ABSTRACT

This paper presents the design and implementation of an automatic solar panel cleaning robot utilizing Arduino microcontroller technology. The proposed system aims to address the efficiency degradation of solar panels caused by dust accumulation, particularly in harsh environmental conditions. The robot employs a combination of sensors for environmental monitoring, including dust density sensors and temperature sensors, to determine the optimal cleaning intervals. Utilizing a motorized cleaning mechanism, the robot autonomously traverses the solar panel array, detecting and removing debris using brushes or wipers. The control system integrates feedback from sensors to adapt cleaning patterns based on real-time environmental conditions, maximizing cleaning efficiency while minimizing energy consumption. Experimental results demonstrate the effectiveness of the proposed system in maintaining the performance of solar. The solar PV modules are generally employed in dusty environments. The dust gets accumulated on the front surface of the module and blocks the incident light from the sun.

The power output reduces as much as by 50% if the module is not cleaned for a month. In order to regularly clean the dust, a automatic cleaning system has been designed, which senses the dust on the solar panel and also cleans the module automatically.

This automated system is ARUINO UNO controller which controls. This mechanism consists of a sensor (LDR).

I. INTRODUCTION

Solar panel production has increased globally in response to the growing demand for solar energy. This has been the result of an increased awareness of the damage to the environment that using fossil fuel sources has had over the years. There are many factors that affects PV power efficiency, such as shadow, snow, high, temperature, dust and dirt. The main factor that affects PV panels efficiency is dust, which can reduce its efficiency by up to 50%, depending on the environment. The best way to eliminate the effect of accumulated dust on the solar panel is to clean the solar panel. Cleaning of solar panel by washing is expensive in terms of labor involved and time.

Photovoltaic array installations are becoming more prevalent around the world. Each of these solar parks has an expected lifetime of 20-25 years, and it is vital to maximize the power generating potential during daily service. The energy generated by solar photovoltaic modules is related with the sun's available intensity and spectral content, as well as other factors like environmental, climatic, component performance and inherent system. The accumulation of dust particles and debris on the surface of photovoltaic (PV) panels negatively affects the performance. Cleaning dust accumulated panels with commercial detergents can required more time , costly, hazardous to be environment, or even corrode the solar panel frame. Ideally solar panels should be cleaned every few weeks to maintain peak efficiency, which is especially hard to do for large solar panel arrays. There is a need for an automated cleaning solution to this problem which can service large ground based solar array up to an operating park of 22,000 panels (20,000 Square meters).

II. METHODOLOGY

In Solar panel cleaning robot using Arduino involves a series of steps and processes to design, develop, and deploy the system effectively.

- Project Planning and
- Requirements Analysis
- Hardware and Sensor Selection
- Integration and Testing

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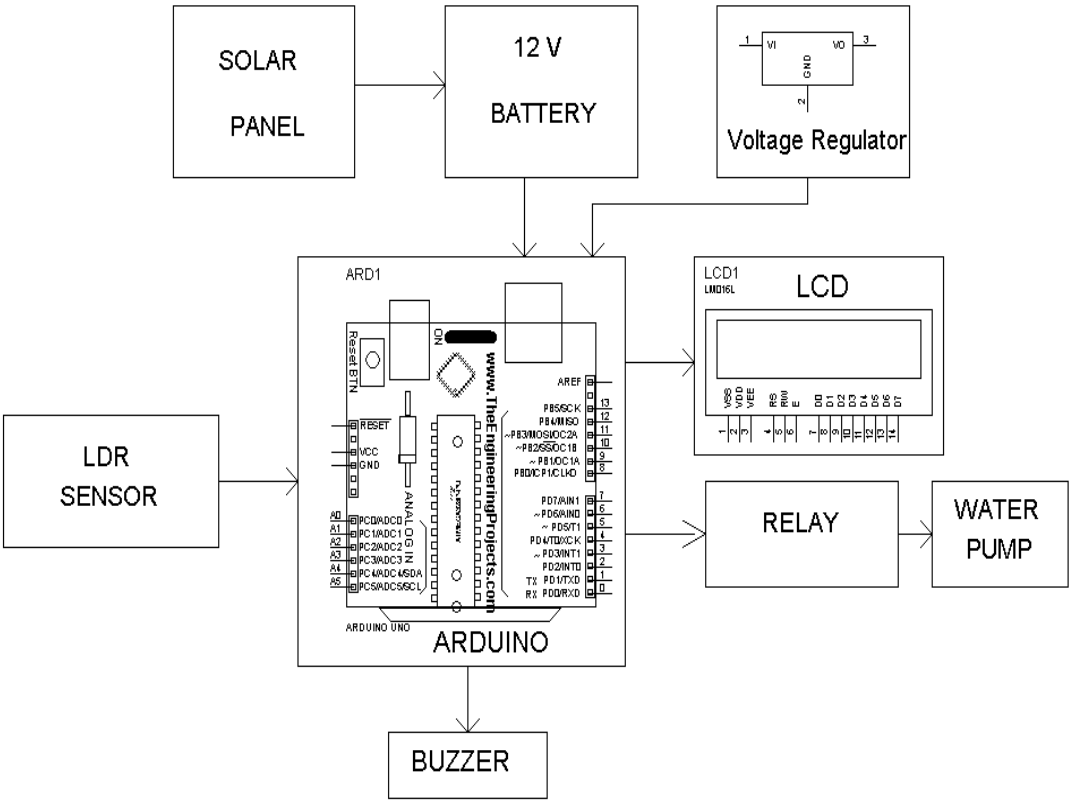
- Safety Measures
- Data Collection and Analysis
- Training and Operator Education
- Deployment and Scaling
- Maintenance and Ongoing Optimization
- Monitoring and Reporting
- Feedback and Iteration

Block diagram:



III. MODELING AND ANALYSIS

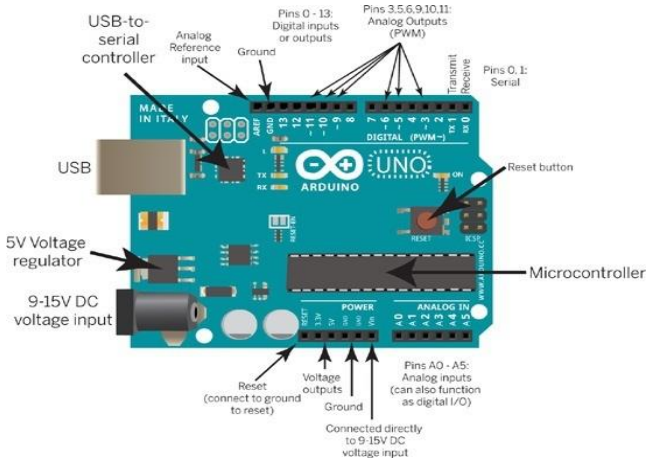


Figure 1: Arduino

The Uno is one of the more popular boards in the Arduino family and a great choice for beginners. We'll talk about what's on it and what it can do later in the tutorial. Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new

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needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments. All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular needs.

IV. RESULTS AND DISCUSSION

Following are the outputs that we get from the robot on our mobile screen through the mail when the sensor detects:

Regular cleaning of solar panels can significantly improve their efficiency by ensuring maximum sunlight absorption.

Cleaner solar panels contribute to increased renewable energy generation, thus reducing reliance on fossil fuels.

V. CONCLUSION

This project provides information about how energy efficiency of solar photovoltaic panel is increased by using cheap and less energy consumption products. It will provide brief information about using a dual axis Sun tracking solar panel with automatic dust cleaning system. Many researchers provides cleaning system for solar panel but they provide costly and high energy consumption and low efficiency methods. But when we use this method on large scale to increase efficiency, it becomes very cheap and less energy consumption methods to increase efficiency more than that of normal. The increase efficiency shown in case 5 More than that of normal efficiency and increasing this amount of efficiency on large scale is very useful & production of energy units is increased in less amount of infrastructure costs.In this project, a water spray based sanitation system prototype has been presented further work uniform water spray distribution, prototype improvements required to optimize wiper sweep time's iteration, and its potential autonomous operation using an Arduino controller.

However, the development of the cleaning system can solve those problems. The overall performance of the PV system of the Automatic dust cleaner will overcome its demerits & will bring revolution in today's condition where each & every country is facing the challenge of energy crises. During night there is also presence of dust but, LDR turn off the dust clean process and save energy in the absence of solar rays.

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