UNIVERSITY OF ENGINEERING & TECHNOLOGY MARDAN

DEPARTMENT OF ELECTRICAL ENGINEERING

FINAL YEAR PROJECT PROPOSAL

"Solar-powered smart energy management with modified panels cleaning and sun tracking system, for UET Mardan"

(September-2023)

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ABSTRACT:

The increasing electricity demand, coupled with rising energy costs and environmental concerns, necessitates the development of innovative solutions for sustainable energy generation and management. This research project focuses on designing, implementing, and evaluating a solarpowered smart energy management system tailored to the needs of the University of Engineering and Technology (UET) in Mardan, Pakistan. The proposed system incorporates advanced technologies, including solar panels with sun-tracking capabilities and automated cleaning mechanisms, to enhance energy production efficiency and reduce electricity costs.

The solar panels equipped with sun tracking systems are designed to follow the sun's trajectory throughout the day, optimizing energy capture and increasing overall energy yield. An automated cleaning mechanism also ensures that dust and debris are promptly removed from the solar panels' surfaces, further improving their performance and longevity.

The study includes a comprehensive analysis of the system's performance under varying environmental conditions, including solar irradiance and temperature changes. Real-time data monitoring and analysis tools are integrated into the system to provide insights into energy production and consumption patterns. This data-driven approach enables precise energy management and load balancing to minimize electricity costs.

The research demonstrates the economic and environmental benefits of the solar-powered smart energy management system at UET Mardan through simulations and experimental data. The results show a significant reduction in electricity costs. The study's findings provide useful insights for adopting sustainable and cost-effective energy systems in education and commercial settings.

Keywords: Solar energy, Smart energy management, Sun tracking, Cleaning mechanism, Electricity cost reduction,

1.1 INTRODUCTION AND BACKGROUND OF THE STUDY:

Energy is one of the most promising candidates, which plays a major role in the economic growth of the world's nations. Several factors, such as urbanization, modernization, and increasing human population, lead to a sharp increase in the world's energy demand [1]. All countries are now looking for alternate energy sources; among them, solar energy is the one source, and its harnessing is growing worldwide. The total energy that can be intercepted from the sun is 1.8 × 1011 MW [1][2]. Solar energy with a high intensity of solar radiation, durations of sunshine hours, and open land has a gentle topographical feature in most of it[1]. It enjoys the advantages of sustainability, energy independence, and environmental compatibility. Different mechanisms are recommended and used to harvest solar energy, especially in generating electrical power. The photovoltaic (PV) systems directly convert solar energy into electricity. The main advantage of PV systems is size/power flexibility, as they are available in less than 1cm2 size and 1W power. This advantage allows for their application in areas exposed to the sun that are typically unusable, such as building rooftops and parking lots, making them ideal for companies and universities.[3]. The most reliable and tested technology for increasing the performance of solar panels is a solar tracking system, which aligns the panels with the direction of the sun. In recent days, it has become popular worldwide to extract

the maximum power in the most effective way. It was observed that a dual-axis tracker can increase power output by 40 percent to 60 percent over a fixed system. These systems use solar collectors to absorb and convert solar energy into electricity or heat.. The power produced in these applications MPPT method is chosen based on several factors like rapid tracking under varying atmospheric simplicity, cost, situations, small power output locations, etc. MPPT techniques automatically find the voltage or current at the maximum power point of the PV system. It is possible to have multiple local maxima at the same points, so the maximum power point shifts according to it. Most MPPT techniques are automatically responding to vary in both temperature and irradiance. Among these, some techniques are more useful and compare the results with those of others [5]. Solar panels can absorb solar energy to generate electrical output. Unfortunately, the electrical output energy can be influenced and inclined by environmental factors. Dust accumulation is one of the environmental factors that significantly affect the efficiency of the photovoltaic modules. Solar panels are usually set up in series; therefore, a single spot on the surface of the solar panel will affect the production of the entire output. Developing alternative solutions and looking for new cleaning technologies is ongoing. Recently, scholars have focused on new technologies of automatic cleaning systems with better performance than conventional methods, such as wiping and brushing systems[6, 7]. The studies were carried out to evaluate the efficiency of solar panels for dust collected on them for one day, one week, and a month[8].

PROBLEM STATEMENT:

- The current conventional electric system relies on non renewable energy sources, leading to high energy costs and environmental impact.
- Solar energy systems offers a sustainable alternative but face efficiency and maintenance challenges.
- Solar panels typically have a fixed orientation, limiting their exposure to optimal sunlight.
- Accumulation of dust and debris on solar panels reduces their efficiency over time.

OBJECTIVES OF THE PROJECT:

The objectives are as follows;

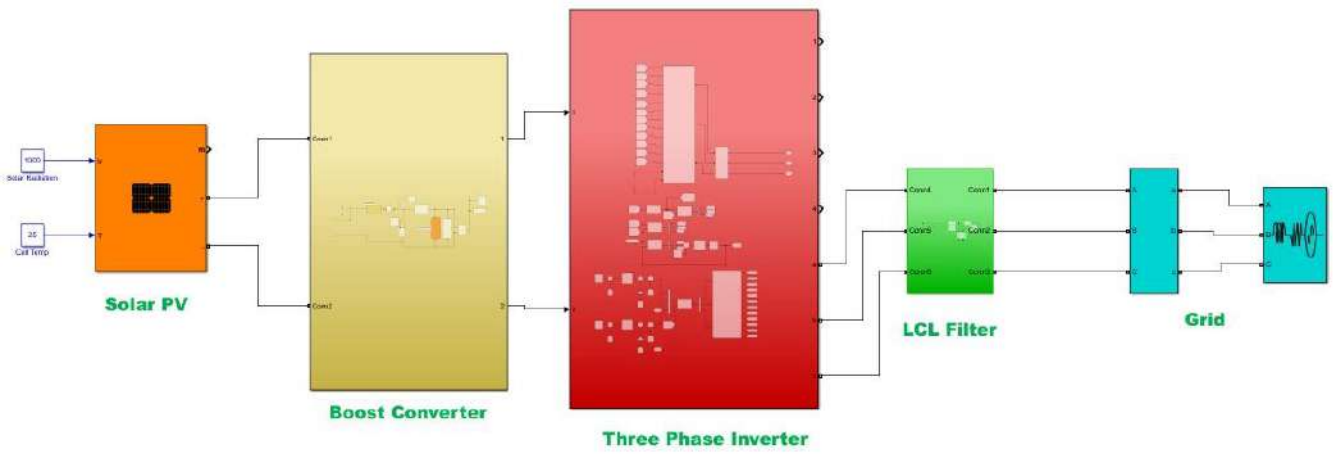
- To Design and Develop a Solar Energy Management System for the Electrification of Academic Blocks of UET Mardan.
- To Develop a sun tracking mechanism to orient solar panels optimally throughout the day for maximum efficiency.
- To Develop a mechanism to autonomously clean solar panels, ensuring maximum efficiency.

LITERATURE REVIEW:

Authors	Title	Date of completion	Finding
Mohammad I. Al-Najideen	Design of a solar photovoltaic system to cover the electricity demand for the faculty of Engineering- Mu'tah University in Jordan	15 April 2017	The faculty building consumes 96 MWh per year with a cost of more than 15,000 JD. On-grid PV system was fully designed with total capacity 56.7 kW for 25 operation years. PV system annual production delivered to the electric grid was 97.02 MWh by using 442 m2 out of the available area which is 657m2.
Ravi Kumara, C.S. Rajoria, Amit Sharma	Design and simulation of standalone solar PV system using PVsyst Software: A case study	30 August 2020	This paper presents the study of required load to run the office in Mechanical department. It is evident that average annual energy requirement in the office of Department of Mechanical Engineering is 1086.24 kWh and the energy available through solar panel is 1143.6 kWh.
Ahmed A., Adel Alblawi	A Feasibility Study of PV Installation: Case Study at Shaqra University	2018	proposed PV installation under varying climate conditions is required. Moreover, proper design is required in order to maximize the harvest electrical power.
K.S. Tamilselvan, T. Rajesh, A. Vijayalakshmi	Design and implementation of an automatic solar tracking system for a monocrystalline silicon material panel using MPPT algorithm	2021	On a typical normal day light condition, fixed panels only have maximum output from 11:00am to 3:00 pm. Automatic tracking system panel offers 61%, 93% and 82% efficiencies at 7:00am, 12 noon and 5:00 pm respectively and offers 16.46% more power output compared to the immovable panel.

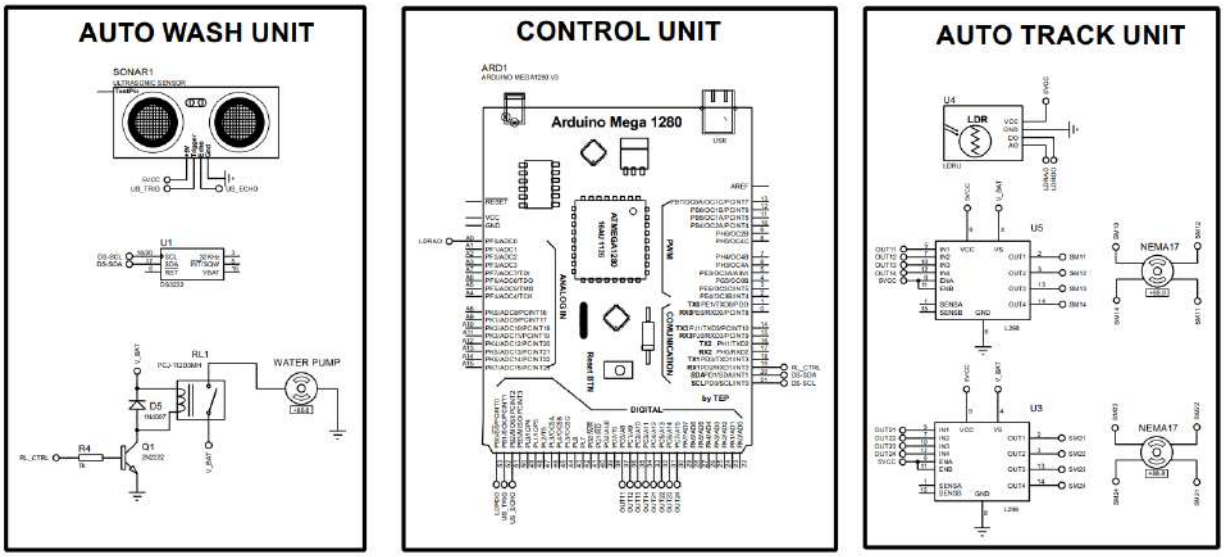
Hemant Patel, Manju Gupta.	Mathematical Modeling and Performance Analysis of MPPT based Solar PV System	2016	Mathematical Modeling of PV and then compare of MPPT and without MPPT. Hence with the use of MPPT, we increase the efficiency and improve the waveform.
Javad Farrokhi Derakhshandeh, Ghanima AlHendi, Dalal AlEid,	A comprehensive review of automatic cleaning systems of solar panels	2021	brushing and heliotex cleaning systems are cost-effective mechanisms, both require a human operator. On the other hand, electrostatic cleaning systems are recommended for regions where water is scarce.

PROPOSED MODEL:



Pv System Model

AUTO WASHABLE and TRACKABLE SOLAR SYSTEM:



METHODOLOGY:

In order design such system we will follow and apply different methods

1. Calculate the load of the university.
2. MATLAB/Simulink software for design.
3. Purchase of the required equipment.
4. Making a prototype of the system

IMPLEMENTATION AND ARRANGEMENT:

The project which we are presenting is a hardware based. We will use that type of components that are easily available in the market and are cheaper means having low cost.

The following major components used in our project:

- Solar panels
- Inverter
- Converter
- Batteries
- MPPT Controller
- Tracking system
- Cleaning materials

Utilization of Project Results

- Solar PV systems, providing a sustainable and renewable source of power for homes, businesses, and communities.
- Homeowners use solar panels to generate electricity, reducing their reliance on the grid and lowering energy bills.
- Solar PV systems are crucial in remote areas where grid electricity is unavailable, providing power for homes, schools, and healthcare facilities.
- Solar charging stations and solar-powered vehicles contribute to sustainable transportation options.

Budget details:

This project will cost approximately **95,000 Pkr**.

PROJECT SCHEDULE PLAN:

Phase	**Schedule**
Collection of Literature	Two Weeks
Study of Literature	Two Months
Analysis of Proposed Scheme	One Month
Preparation of Scheme/Model	One Month
Implementation of Scheme Model	Two Months
Analysis and Simulation, Hardware Testing	One Months
Result Formulation	Two Weeks

Final Write-up & Thesis Submission	Two Weeks

PROJECT PROPOSED TIME SCHEDULE:

Activity	Aug 2023	Sep-Oct 2023		Nov 2023	Dec 2023	Jan 2024	FebMar 2024		April 2024	May 2024
Proposal draft										
Comprehensive Literature review										
Analysis of the proposed scheme										
Preparation of schemes/Model										
Implementation of schemes/Model										
Analysis & simulation										
Result Formulation										

Final Write-up & Thesis Submission										

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UNDERTAKING

This is to certify that to the best of my knowledge; the content of this project proposal is my own work. This proposal has not been submitted for any degree or other purposes. I certify that the intellectual content of this project is the product of my own work and that all the assistance received in preparing this proposal and sources have been acknowledged.

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Signature: _____ **Signature: _____**

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20MDELE145

Signature: _____

PROPOSED SUPERVISOR'S COMMENTS:

Take recommendation of your supervisor for your project work here.

Please note the proposed supervisor may be changed on the recommendation of FYP Committee and final approval of Chairman.

_____

Signature of Supervisor

Dr. Gul Rukh

Comments of FYP Coordinator

Comments of FYP Coordinator in accordance with recommendations of FYP Committee.

Signature of FYP Coordinator: _____ Dated: _____

APPROVAL BY THE CHAIRMAN OF DEPARTMENT

Signature: _____ Dated: _____