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TWO WAY POWER TREE WITH PIC CONTROLLER

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Abstract : In our rapidly advancing world, the demand for electricity has become indispensable, yet the reliance on conventional energy sources poses significant environmental challenges due to their depletion and pollution. Consequently, there is an urgent need to transition towards sustainable and renewable energy alternatives. This research focuses on harnessing the synergy between two renewable energy sources, namely solar energy and vertical axis wind turbines, to establish a robust and eco-friendly energy generation system. By integrating these two energy systems, we aim to create a hybrid energy solution capable of providing uninterrupted power supply while minimizing the ecological footprint.

The core of this hybrid energy system lies in the utilization of solar panels for converting solar radiation into electrical energy and vertical axis wind turbines for harnessing wind power. This combined approach ensures a continuous and reliable power output, allowing for diverse applications across various sectors. Moreover, the integration of advanced microcontroller technology and efficient switching devices facilitates seamless control and management of the energy flow within the system, enhancing its overall performance and reliability. Furthermore the inclusion of energy storage solutions such as batteries and relay systems ensures optimal utilization of generated electricity, enabling efficient load management and distribution. Through meticulous design and implementation, this project endeavors to offer an affordable and sustainable solution for electricity generation, thereby promoting environmental preservation and resource conservation.

Keyword: **Vertical Axis Wind Turbine, Solar Energy, Hybrid Energy System, Microcontroller, Energy Storage, Renewable Energy, Sustainable Development.**

Introduction: In today's world, where the need for sustainable energy is more crucial than ever, we face a challenge: how to reliably meet our energy needs while reducing our environmental impact. Traditional renewable energy sources like solar and wind power are great, but they have a drawback—they're not always available when we need them .To tackle this problem, our project combines the strengths of both solar panels and vertical axis wind turbines (VAWTs) to generate power. By using these together, we aim to make energy production more consistent and reliable .This report dives into how we designed our system, the methods we used, and what we discovered. Our hope is that by sharing our findings, we can help advance the use of renewable energy and move towards a cleaner, more sustainable future for everyone.

1.2 Background and Motivation

In today's world, the need for sustainable energy solutions has become increasingly rapidly. The reliance on fossil fuels for power generation not only contributes to environmental degradation but also results in long-term risks to energy security. Identifying the challenges, our team was motivated to explore alternative sources of energy that are clean, renewable, and accessible The motivation for selecting a hybrid system of solar panels and vertical axis wind turbines (VAWTs) stems from the inherent advantages and synergies offered by these renewable resources. Solar energy, abundant and widely available, provides a clean and reliable source of power. However, solar power generation is subject to variability due to factors such as weather conditions and diurnal cycles. On the other hand, wind energy, harnessed through VAWTs, offers a complementary and consistent energy source that can augment solar power production. By integrating these two renewable resources into a hybrid system, we aim to address the limitations of individual technologies while maximizing energy output and reliability. This approach aligns with the global push towards renewable energy adoption and sustainability, contributing to efforts to mitigate climate change

1.3 Purpose for the Research

The purpose of this research project is to conceptualize, engineer, and validate a novel tree-shaped hybrid power generation system, harmonizing solar photovoltaic (PV) arrays and vertical axis wind turbines (VAWTs). By innovatively configuring renewable energy components in a tree-like structure, our objective is to optimize land use efficiency while maximizing power output. Through rigorous modeling, prototyping, and field testing, this study aims to demonstrate the feasibility and effectiveness of the tree-shaped design in harnessing solar and wind energy synergistically. Ultimately, this research endeavors to offer a sustainable and space-saving solution for decentralized energy generation, addressing environmental challenges and promoting renewable energy adoption in urban and remote areas

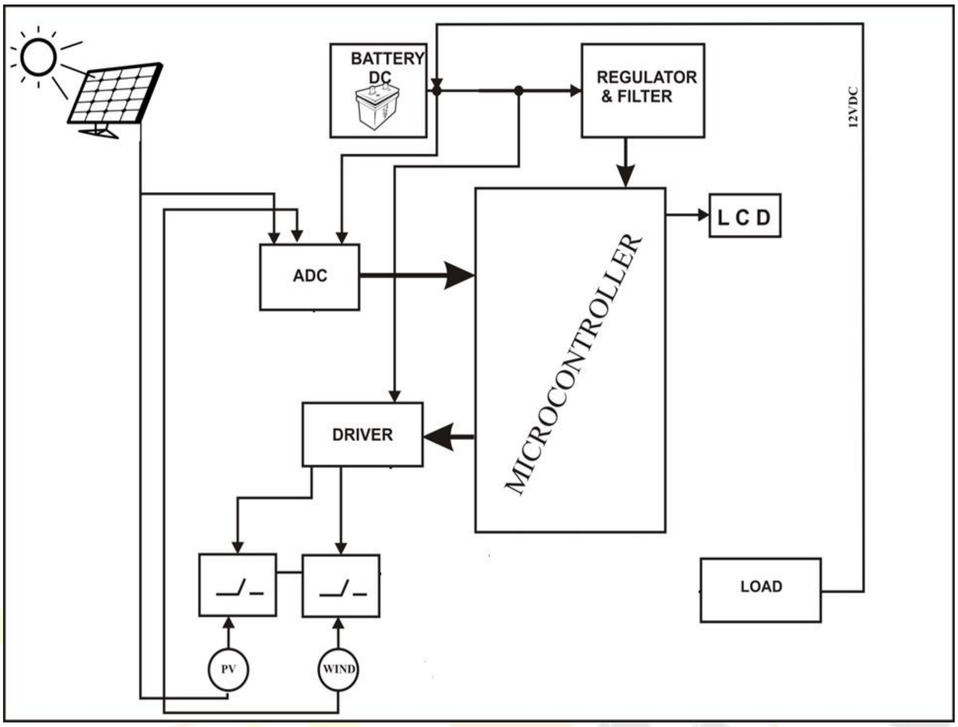


Fig: Functional Block Diagram

In block diagram we can understand overview of systems connection, the PV array are connected to the ADC with VAWT for Digital Signal which is feed to the microcontroller . Lcd is interfaced with the controller for displaying the battery Voltage and voltage generated by each Generator and PV array and VAWT. System Architecture: Understanding the architecture of system from an block diagram . We have used two Solar panels each of 20 W rating and 3 VAWT(Vertical Axis Wind Turbin) all are connected to the driver and the ADC IC for Signal Amplification and converting Analog signal to digital signal .For regulated flow we used voltage Regulator and a capacitive filter Pic Microcntroller act as the Brain of system to which has been programmed for the charging of the battery.

3.Component Selected

3.1 Vertical Axis Wind Turbin

The Design of the turbin is inspired from savonius wind turbin these turbines are one of the simplest self-starting VAWTs. Aerodynamically, they are drag-type devices, consisting of two or three scoops. The differential drag causes the Savonius turbine to spin. The Design is used because it can drag the rotor at very low speed also which makes it effective to use in low heights . The power generated by wind turbine (P) is given as,

$$P= 0.5 \text{ X } C_p \text{ X } p \text{ X } A_s \text{ X } V^3 \qquad (1)$$

Where p is the air Density is the density of air in kg/m3 A_s ,is the swept area of turbine in m^2, V is the wind velocity in m/s and C_p coefficient of power and its maximum value for Savonius wind turbine is 0.28. In the present work Savonius micro-wind turbine blades are Combined with DC Generators to generate 100 W at a wind velocity of 12 m/s is designed. Wind turbine is provided with three circular blades arranged with 1200 angle of separation as shown in Fig. 1. This configuration will not have the start-up problems as at any point of time at least one blade will be facing the wind direction. A central shaft is provided to support the turbine

Fig 2: Vertical Axis Wind Turbin

SOLAR PV MODULE

A 12 V 20W polycrystalline solar module used in the present work is shown in Fig. 3 It can produce an open circuit voltage of 21.5 V and the current of 1.2 A. Two number of such solar modules are used to generate 20 W power.

Fig 3: 20 Watt Polycrystalline Solar Panel

3.3Charge Controlling Circuit :

A PIC controller is employed for charge control, while driver ICs are utilized to operate relays due to the PIC's voltage limitations. Analog-to-digital conversion is achieved through ADC, facilitating monitoring of battery charge levels, wind turbine voltage, and solar panel output. An LCD display provides real-time feedback on system parameters. The PIC program incorporates logic to disconnect generating elements when the battery reaches full charge and dynamically adjusts generator connections based on voltage levels to optimize energy utilization. This control system enhances the performance and reliability of the hybrid wind-solar system, promoting sustainable energy generation for domestic applications.

Controller Circuit Includes

1.PIC Microcontroller IC

2.Driver IC

3. ADC

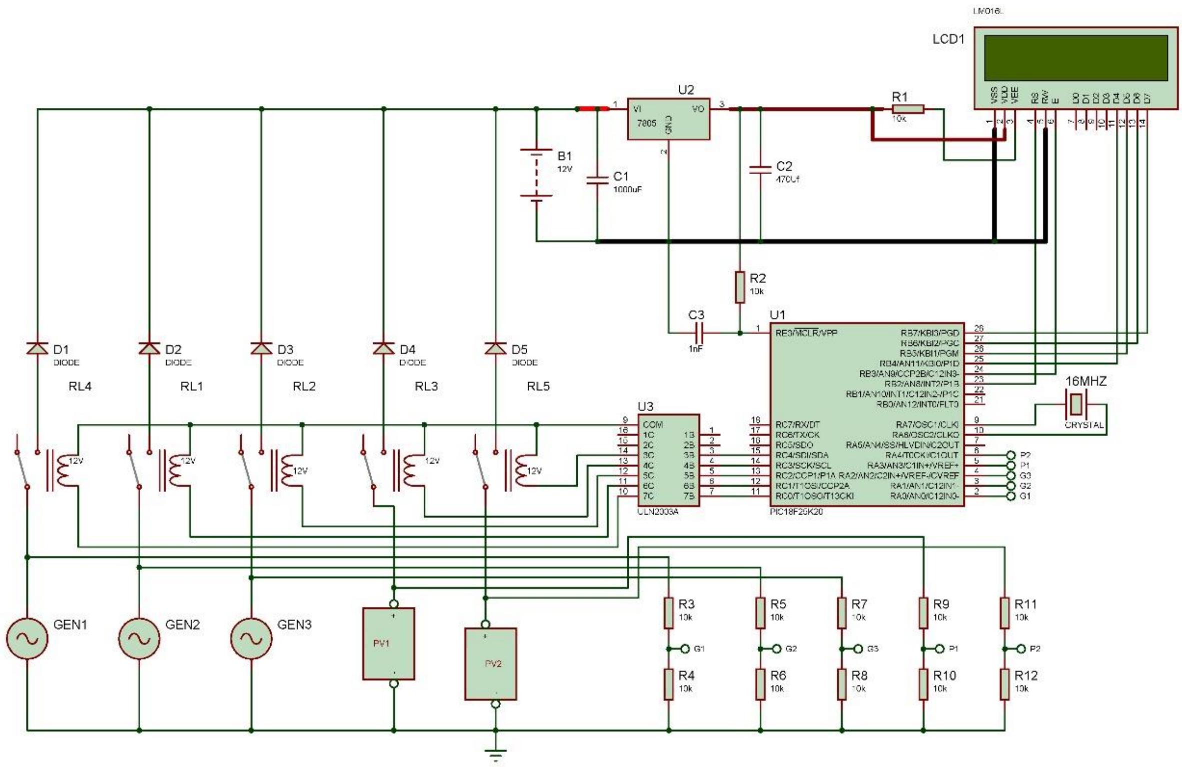
4.LCD Display

5.Relay

6.Printed Circuit Board

7. Li -ion Battery(9000mAh)

Circuit Diagram:



Working : The Working of the circuit is as follow : 1) When the model is kept under proper sunlight and at sufficient height . As the Sunlight fall on solar panel . It starts generating the power we have used 2 solar panels Each of 20W rating it produce Maximum Voltage of 18 V and current 1.2 A and the 3 VAWT Each of 5V ratings

2) As the generation start the readings are showed in the LCD Display which is sent by the PIC controller

3)The PIC controller continuously Moniter the Readings if the Generated voltage is above 12 V the PIC sends signal to the Driver to Relay for Disconnecting G1 generator and When the Battery is Fully charged all the Generators and Solar panels are disconnected

4)We have used Dc generators but when the motor's generating voltage is less than the Battery voltage it can act as a motor to avoid this we have used Diods in Series with Motor to ensure the Unidirectional flow of current .

1) **<u>PIC16F – 8 Bit Microcontroller</u>**

PIC16F is microcontroller from 'PIC16F' family and is made by MICROCHIP TECHNOLOGY. It is an 8-Bit CMOS Microcontroller with nano-Watt Technology. This microcontroller is popular among hobbyists and engineers due its features and cost. PIC16F is a microcontroller good for experimenting and developing applications because it has high flash memory rewrite cycle. Also there are a lot of tutorials and support available online. The controller has 16KBytes flash memory which is enough for many applications. Along with 24 programmable Input/output pins which are developed to handle 20mA current (direct LED driving capability) the system can interface many peripherals easily. With Watchdog timer to reset under error automatically the controller can be used to develop applications of permanent installation.

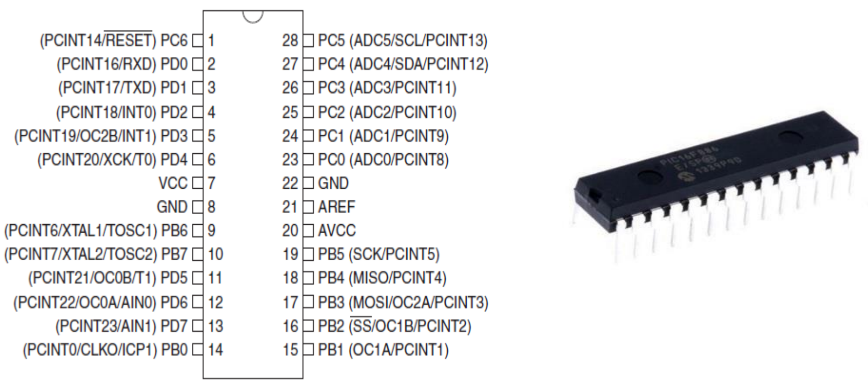
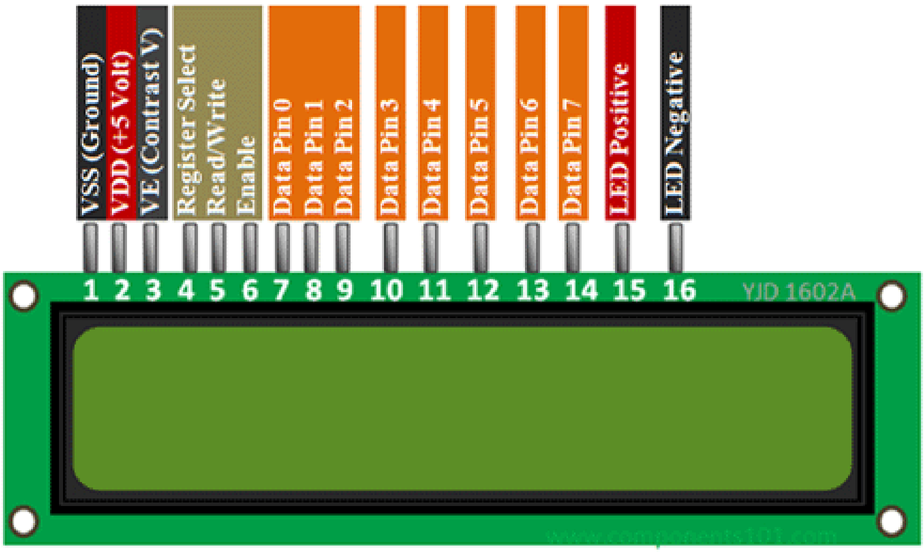


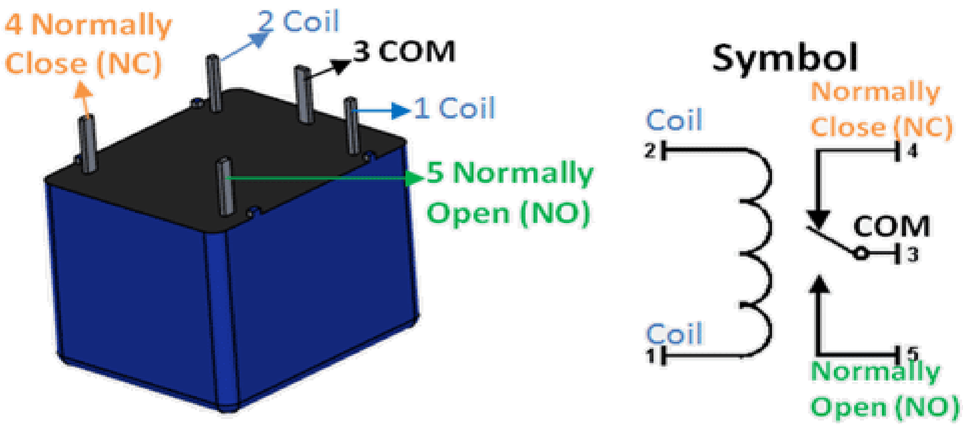
Fig : PIC Controller Pin Diagram

2) LIQUID CRYSTAL DISPLAY(LCD) **Features of 16×2 LCD module**



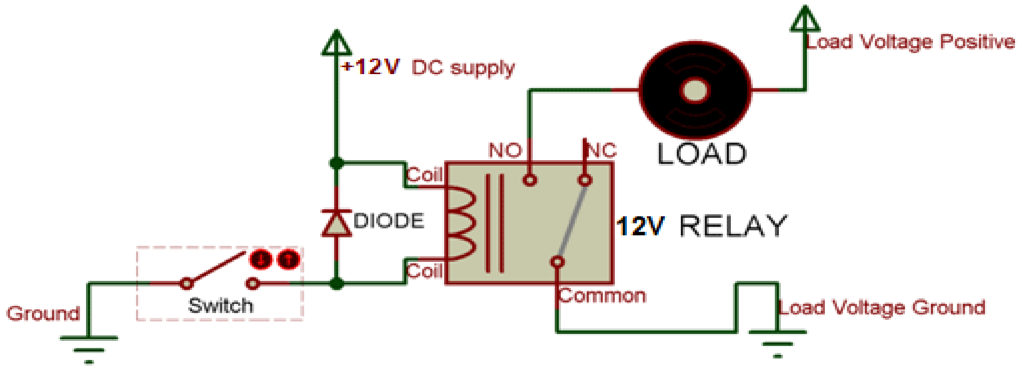
LCD modules are very commonly used in most embedded projects, the reason being its cheap price, availability and programmer friendly. Most of us would have come across these displays in our day to day life, either at PCO's or calculators. The appearance and the pinouts have already been visualized above now let us get a bit technical

RELAY



How to Use a Relay.

Relays are most commonly used switching device in electronics. There are two important parameters of relay, first is the Trigger Voltage, this is the voltage required to turn on the relay that is to change the contact from Common → NC to Common → NO. The other parameter is your Load Voltage & Current, this is the amount of voltage or current that the NC, NO or Common terminal of the relay could withstand, in our case for DC it is maximum of 30V and 10A. Make sure the load you are using falls into this range.



The above diagram is for relay triggering circuit. Since the relay has 12V trigger voltage we have used a +12V DC supply to one end of the coil and the other end to ground through a switch. For switching we are using a transistor as a switching device. You can also notice a diode connected across the coil of the relay, this diode is called the Fly back Diode. The purpose of the diode is to protect the switch from high voltage spike that can produced by the relay coil. As shown one end of the load can be connected to the Common pin and the other end is either connected to NO or NC. If connected to NO the load remains disconnected before trigger and if connected to NC the load remains connected before trigger.

4) Result :

4.1 Performance of solar Panel

Performance test on the solar module is conducted on a clear sunny day at different time of the day and the obtained results are listed below in Table . It is observed that, the power generation increases from morning 8 to afternoon 14Hrs after which it decreases. The maximum power of 15.73W is produced in the afternoon at 14 Hrs of a day. Variation in the power produced by the solar module is also shown in Fig. 11.

TIME (24 HR)	CURRENT	VOLTAGE	POWER
8	0.81	11.2	9.072
10	1.15	11.8	13.57
12	1.25	12	15
14	1.3	12.1	15.73
16	1.18	11.8	13.9
18	0.91	11.2	10.192

4.2 Performance of VAWT

Performance tests are conducted on wind turbine at different wind velocity using pedestal fan. Wind velocity is measured using anemometer. The output of the wind turbine is connected to the 12 V battery through the bridge rectifier. voltage and current are measured by using multimeter and results obtained from the performance tests are given in Table below. It is observed that with the increase in the wind velocity the power output increases as shown in Fig. 10. Wind turbine starts generating the power at the wind velocity of 3.2 m/s and at the wind velocity of 8.2 m/s it is able to feed 24.52 W of power to the battery bank.

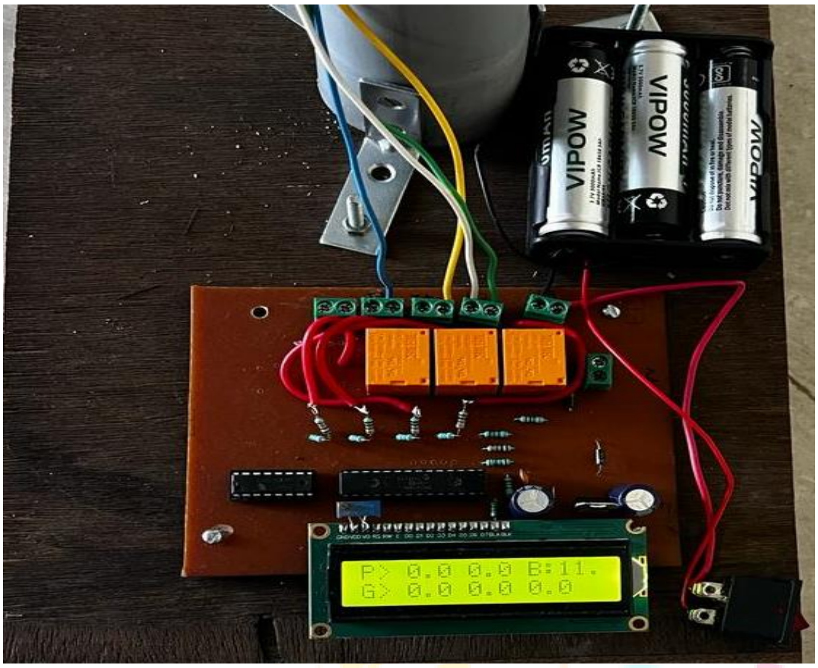
Wind Speed In m/s	CURRENT	VOLTAGE	POWER
3	0.1	4.8	0.48
5	0.92	4.9	4.5
8	1.3	5	6.5
10	1.35	5.2	6.75
12	1.4	5.4	7.56

Performance of wind-solar tree

Performance of the wind-solar tree is monitored manually. It is observed that, all the wind turbines start rotating at a wind velocity of 2.8 m/s. However, the power feeding to the battery will begin at a wind velocity of 3.2 m/s. At a wind velocity of 5 m/s the total power produced is 10W. Recently at a wind velocity of 8.2 m/s wind turbines produced 12 W of power. Constant flow of wind is required for the generation of the power continuously. Solar modules total capacity is 40W. It is observed that on a bright sunny day the total power produced from these solar modules is 32 W and it is produced in the afternoon at 14 Hrs of the day. With both the wind turbines and solar panels in operation, the maximum power observed is 90 W. The generated power is stored in the battery bank of 9000mAh and using an PIC controlled Charger

Final Model :

Fig : Two Way Power Tree



Conclusion: We have Observed that when the single solar panel was used to charge the Battery it took 4 hrs to fully charge the Battery and with 2 solar panels it took 2 hrs and with the Two Way Power Tree it was charged in 45 min the Moreover, the Two Way Power Tree offers the advantages of being space-efficient and low-cost. Its compact design allows for optimal utilization of space, making it suitable for various environments with limited space availability. Furthermore, its low-cost nature makes it an economically viable solution for charging batteries efficiently.Therefore, considering its effectiveness in rapid battery charging, space efficiency, and low cost, the Two Way Power Tree emerges as the most practical and efficient solution among the options tested.

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