

HYBRID (SOLAR,WIND) ENERGY MONITORING WITH AI PREDICTION

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Abstract - Electric It is currently difficult to reach the rural population that is not electrified by expanding the grid because the connection is neither economically feasible nor supported by the major players. Furthermore, because of the rising cost of oil and its unacceptable consequences on customers and the environment, conventional energy solutions like fuel-based systems are progressively being removed from the agendas for rural development. This problem can be resolved by employing "hybrid power generation using solar and wind energy." The best way to supply "high quality" power is through hybrid systems. The proposed technology uses wind and sun power to produce energy. In order to improve sustainability and energy efficiency, this project offers real-time monitoring of a hybrid energy system using IoT and AI prediction. The suggested prototype combines wind and solar energy to create a hybrid renewable system that can produce electricity continuously. The central control unit is an Arduino microcontroller that interfaces with DHT11 sensors to measure environmental parameters like temperature and humidity as well as voltage and current sensors to track power output. For remote monitoring and visualization, real-time sensor data is simultaneously sent to an IoT platform and shown locally on an LCD. Better load control and optimal energy use are made possible by a Python-based AI prediction model that forecasts energy generation patterns by analyzing both historical and current data. There is a potentiometer for manual parameter adjustment, and LEDs show the power availability and system status visually. A 12V battery and adapter are used to power the system, guaranteeing steady functioning. The created prototype shows how well artificial intelligence, IoT technology, and hybrid renewable energy can be combined. The system is appropriate for smart energy management applications in homes and small-scale renewable installations because it offers real-time insights, predictive analysis, and remote accessibility.

Key Words: : Solar Energy, Wind Energy, Internet of Things, Wireless-Fidelity, Embedded C

1. INTRODUCTION

The hybrid power plant has a fully operational electrical supply system and is extremely flexible to different remote power needs. The battery, power management hub, and power supply are the three main components of the system. The hybrid power plant is a fully operational electrical supply system that can be easily adjusted to meet different remote power needs [1]. The battery, power management hub, and power supply are the three main components of the system. Limitations in fuel flexibility, dependability, economy, emissions, and costs can be overcome via hybrid

systems. network of linked, internet-accessible physical objects is known as the Internet of Things (IoT).

In order to improve reliability and lower pollution emissions, solar and wind energy have been selected. The Arduino UNO R3 module provides internet access for the system [2]. As a result, this project has included the use of sustainable resources like solar and wind to produce power. because of their number, accessibility, and simplicity of usage in generating power [3]. Combining solar and wind energy resources improves system energy service, lowers pollution emissions, and increases dependability. The Internet of Things (IoT) refers to physical items that are globally distributed and linked to the internet. More efficiency provided by IoT makes it possible to get precise and timely results. Since automation is now essential, the IOT devices WiFi module is utilized to communicate information with the internet.

OVERVIEW HYBRID ENERGY MONITORING SYSTEM

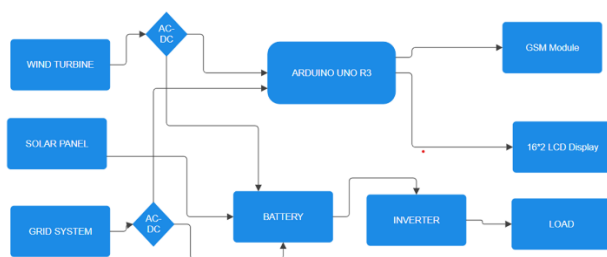
The need for renewable energy has been increasing recently due to the misuse of non-renewable resources and their growing costs. Solar and wind energy have the greatest potential to meet our energy demands, except from hydropower. Large quantities of electricity can be produced just by wind energy, but it is quite erratic as it might emerge one moment and vanish the next.

In a similar vein, solar energy is accessible throughout the day. Nevertheless, the strength of the sun and the erratic shadows cast by trees, clouds, birds, and other objects cause variations in the quantity of solar radiation. This basic drawback is shared by solar and wind systems due to their intermittent and uncertain nature. Nonetheless, combining these two irregular sources can significantly improve the system's reliability and power transfer efficiency [5]. If a source is either unavailable or insufficient to meet the load's demands, the alternate energy source can make up the gap. The proposed system uses wind and sun energy to produce electricity. A 9V solar panel employs photoelectric power to collect sunlight depending on its intensity. A hybrid energy system is what we call a solar-wind energy system combo [6]. After being stored in a 9V rechargeable battery, the created energy is used to power additional AC and DC consumption. It transmits data over WiFi using an ARDUINO UNO R3. Loads are controlled both manually and remotely using a Blynk application. Both the WiFi module and the CPU are Node MCUs [7]. As a result, people are utilizing more electrical and electronic devices as technology advances, which increases the need for power. To meet the load demand, a number of electric power production techniques are used.

Furthermore, because oil is becoming more expensive and has negative consequences on both customers and the environment, traditional energy solutions like fuel-based systems are progressively being removed from the agendas for rural development. To cut pollution and preserve non-renewable energy resources like coal, petroleum, and so on, power generation is increasingly using renewable energy sources like solar, wind, and others. However, the main issue is the constant power supply in all conditions and seasons [8].

Using "hybrid power generation using solar and wind energy" might address this problem." It has been demonstrated that hybrid systems are the most efficient way to provide "high-quality" electricity. A hybrid power plant is a complete electrical supply system that can be easily modified to meet different remote power needs. The power source, battery, and power management center are the system's three primary parts. Fuel flexibility, reliability, efficiency, pollution, and financial restrictions may all be managed by hybrid systems [9]. Solar cells, sometimes referred to as solar photovoltaic cells, are devices that employ the photovoltaic effect to transform solar energy into electrical energy. These cells are used in real-time applications like as train signaling systems, house lighting systems, street lighting systems, and distant phone systems. Big wind turbines are made to spin in the direction of the wind and produce electricity. We added some IoT and computer programming to operate the panel via a smartphone app since solar and wind energy are used to generate leverage. We will require more code to manage it portably now that we are in the virtual world [10]. An ecosystem of physically linked objects that are accessible online is known as the Internet of Things (IoT). In order to improve reliability and help reduce pollution, solar and wind energy have been chosen. The system is connected to the internet using the Node Arduino UNO R3.

2. FUCTIONS BLOCK DIAGRAM



Wind Turbine: Converts wind energy into electrical power and supplies it to the hybrid system.

Solar Panel: Generates DC electricity from sunlight as a primary renewable energy source.

Arduino UNO R3: Controls the system by monitoring power sources, battery status, and data communication.

Battery: Stores excess energy to ensure continuous power supply during low generation conditions.

Grid System: Provides backup power when renewable energy sources are unavailable.

GSM Modem: Sends real-time system data and alerts to remote users via mobile networks.

16x2 LCD Display: Displays system parameters such as voltage, power source status, and battery level.

Inverter: Converts DC power from the battery into usable AC power.

Load: Represents the electrical devices Powered by the hybrid energy system.

3. CIRCUIT DIAGRAM

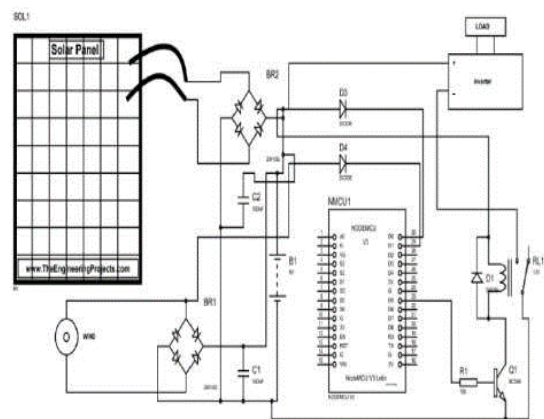


Fig -1: Circuit diagram

The The positive solar panel terminal should be connected to the voltage sensor's positive terminal, and the negative solar panel terminal should be connected to the voltage sensor's negative terminal. The voltage sensor's OUT pin will be linked to the Node Arduino UNO R3 A0, and the Node MCU Module will be connected to the voltage sensor's ground.

In order to connect the inverter or battery, this element will measure the voltage before attaching the relay module. The Node Arduino's 5V will be connected to the sensor's VCC pin. A 9V solar panel gathers sunlight and utilizes the photoelectric process to transform it into electrical energy based on its intensity.

A DC gear motor is used in conjunction with a windmill that is powered by a battery and a single shining LED to transform wind energy into electrical energy. A hybrid energy system is one that combines solar and wind power. A 12-volt rechargeable battery stores the produced energy, which may be used for both AC and DC applications. Later, an Arduino UNO R3 Node is used to transmit data over Wi-Fi. The Arduino contains the CPU and Wi-Fi module. The whole circuit schematic is shown below.

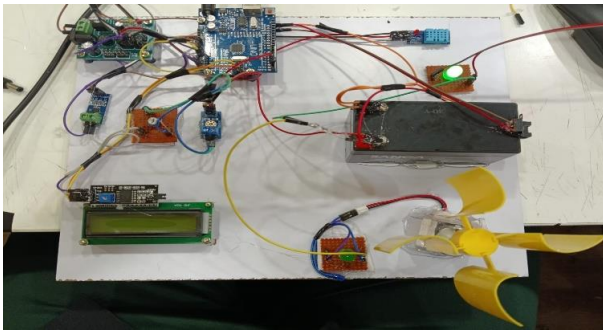


Fig -3: Components Installation on Cardboard

writing computer programs is to get greatest elements in least space and least time.

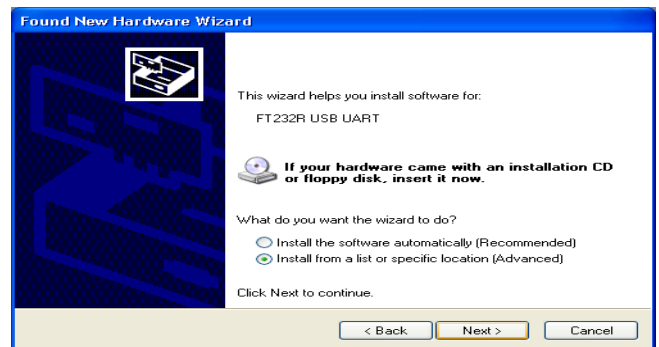


Fig -3: Software Installation

4. SOFTWARE TOOLS USED

1. EMBEDDED C

The Implanted C makes use of KEIL IDE programming. The framework program written in implanted C can be placed away in Microcontroller. The accompanying is a portion of the actual motives behind composing applications in C as opposed to get collectively. It is much less disturbing and much less tedious to write down in C then amassing. C is less traumatic to trade and refresh. You can utilize code available in capacity libraries. C code is compact to different microcontrollers with subsequent to 0 alteration. Genuine, installed C programming need nonstandard expansions to the C driver with a view to bolster charming components, as an example, settled point range catching, numerous unmistakable reminiscence banks, and fundamental I/O operations. Installed C utilize the greater part of the grammar and semantics of well known C, e.g., number one paintings, variable definition, facts type statement, contingent proclamations (if, switch. Case), circles (even as, for), capacities, exhibits and strings, structures and union, piece operations, macros, unions, and so on.

Embedded systems programming

Installed frameworks writing computer programs is not quite the same as creating applications on a desktop PCs. Key attributes of an implanted framework, when contrasted with PCs, are as per the following:

- Embedded gadgets have asset limitations (restricted ROM, constrained RAM, constrained stack space, less handling power)

- Components utilized as a part of installed framework and PCs are distinctive; implanted frameworks ordinarily utilizes littler, less power devouring segments. Inserted frameworks are more fixing to the equipment. Two remarkable components of Embedded Programming are code speed and code estimate. Code speed is represented by the handling power, timing requirements, while code size is administered by accessible program memory and utilization of programming dialect. Objective of implanted framework

1.Arduino IDE:

The Arduino IDE software is a open source software, where we can have the example codes for the beginners. In the Present world there are lot of version in the Arduino IDE in which present usage is Version1.0.5. It is very easy to connect the PC with Arduino Board.

First we have to install the Arduino IDE software according to the below instructions:

Implanted frameworks are modified utilizing distinctive sort of dialects:

- Machine Code
- Low level dialect, i.e., get together
- High level dialect like C, C++, and Java and so on.
- Application level dialect like Visual Basic, scripts, Access, and so on.

- ✓ Insert the CD-ROM or PENDRIVE which Contains the software and then Copy the Setup File to your desired location.
- ✓ After Copying, now click on the setup you will see window shown below.

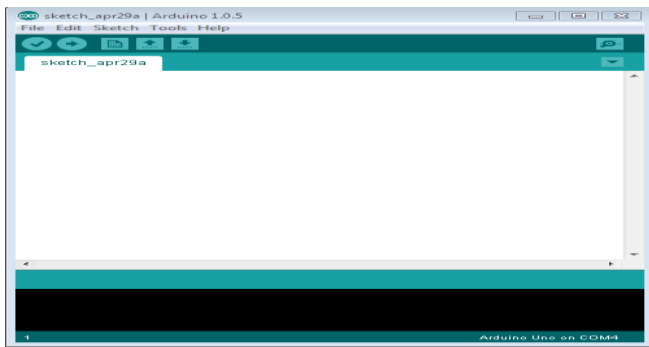


Fig -3: Arduino 1.0.5 Tool

5. RESULT AND DECISION

The Solar panels use sunlight to generate dc, which is then converted to ac through a rectifier and stored in a battery. The battery's output is dc, which is then sent to an inverter for conversion into ac consumption; the load we are utilizing is a zero-watt bulb. The red LED light on the PCB indicates that the solar panel is beginning to store energy in the battery as it receives energy from the sun. When we manually turn on the plug, the battery's stored energy is transferred to the inverter for additional dc to ac usage. We use a zero-watt lightbulb as the load so that solar energy can be used to light the bulb.

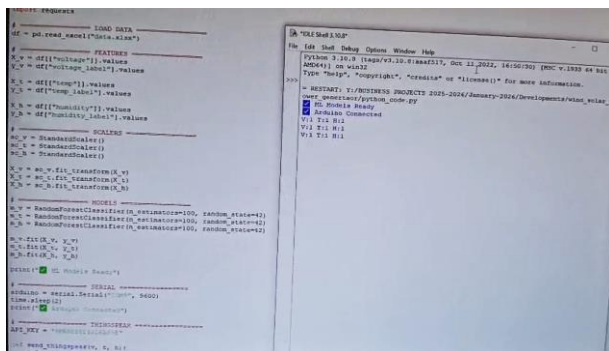


Fig 4: Code Implementation

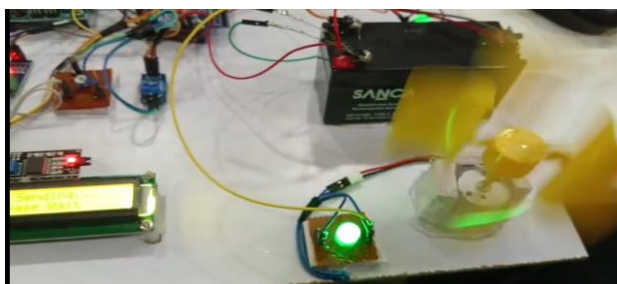


Fig 5: LED Glow due to Wind

Wind Energy Output

As wind energy is transferred to the windmill, dc energy is produced because the dynamo motor functions as a generator when it rotates in a different direction. Only the

LED bulb will get energy from the low power generated, and the bulb will glow as the windmill turns. The output is seen in the pictures below. The windmill will provide enough energy to light a lamp when there is sufficient wind to turn the shaft.

6. CONCLUSIONS

A hybrid solar-wind power plant uses both solar and wind insolation to produce energy. Because different seasons and times of the day are when wind and solar systems are most active. Hybrid systems are more likely to generate power when we need it. Indeed, renewables are already assisting in the achievement of important social, environmental, and economic objectives by enhancing the security of the energy supply. If there are alternative possibilities, renewable energy is one of the best for delivering power in remote areas or at particular distances from the grid. Indeed, renewable energy sources are already contributing to the achievement of important economic, environmental, and social goals by increasing the security of the energy supply, lowering greenhouse gas emissions and other pollutants, and creating local jobs that enhance general social welfare and living conditions. The best way to give rural areas "high quality" community energy services at the lowest feasible cost and with the most potential social and environmental benefits is through hybrid systems.

6. REFERENCES

[1] Kavita Sharma, Prateek Haksar, "Designing of Hybrid Power Generation System using Wind Energy- Photovoltaic Solar Energy- Solar Energy with Nanoantenna." International Journal of Engineering Research And Applications (IJERA) Vol. 2, Issue 1, Jan-Feb 2018, pp.812-815.

[2] Jenkins, P. Elmnifi, M. , Younis, A. and Emhamed, A, " Hybrid Power Generation by Using Solar and Wind Energy: Case Study." World Journal of Mechanics, 9, pp 81-93, 2019.

[3] Sandeep kumar, Vijay Kumar Garg, A Hybrid Model of Solar-Wind Power Generation System, International Journal of Advanced Research in Electrical ,Electronics and Instrumentation Engineering, Vol. 2, issue 8, Aug 2017.

[4] Abhishek Kumar Gupta, M.Shasilal, "A review on Renewable Energy Sources for Hybrid Power Generation." International Journal of Creative Research Thoughts, vol. 6, issue 1, Jan 2018.

[5] T.S. Balaji Damodhar and A. Sethil Kumar, "Design of high step up modified for hybrid solar/wind energy system," Middle- East.

[6] Rakeshkumar B. Shah, "Wind solar hybrid energy conversion system- literature review," International Journal of Scientific.

[7] S. Jain, and V. Agarwal, "An Integrated Hybrid Power Supply for Distributed Generation Applications Fed by Nonconventional Energy Sources," IEEE Transactions on Energy Conversion, vol. 23, June 2008.

[8] A. O. Ciuca, I. B. Istrate, and M. Scripcariu, "Hybrid Power-Application for Tourism in Isolated Areas," World Academy of Science, Engineering and Technology, vol. 53, pp 264-269, 2009.

[9] D. Sharma, N.K. Yadav, "Impact of Distributed generation on voltage profile using different optimization techniques." International conference on control, computing, communication and materials, allabahad, pp. 1-6, 2016.

[10] Ahmed, N.A., Miyatake, M., and Al-Othman, A.K. "Power Fluctuations Suppression of Stand-Alone Hybrid Generation Combining Solar Photovoltaic/Wind Turbine And Fuel Cell.

[11] Deshmukh, M.K., Deshmukh, S.S. "Modeling Of hybrid Renewable Energy Systems", Renewable and Sustainable Energy Reviews, vol. 12, no. 1, pp. 235-249.

[12] Tina, G., Gagliano, S., and Raiti, S. "Hybrid solar/wind power system probabilistic modelling for long-term performance assessment", Solar Energy, Vol. 80, pp. 578-588, 2006.

[13] Celik, A.N. "Techno-Economic Analysis Of Autonomous PV-Wind Hybrid Energy Systems Using Different Sizing Methods", Energy Conversion And Management, Vol. 44, pp. 1951-1968, 2003. differentiate among departments of the same organization).