Hybrid Power Generation System with Inverter using Android based Load Control

G. Nagaraju[1] | A. Satish Kumar[2] | K. Naresh [3] | T. Amar Kiran[4]

[1,2,,3]UG Students, Department of Electrical and Electronics Engineering,, Godavari Institute of Engineering and Technology (A), Rajahmundry, Andhra Pradesh, India.

[4]Assistant Professor, Department of Electrical and Electronics Engineering, Godavari Institute of Engineering and Technology (A), Rajamundary, Andhra Pradesh, India.

Abstract: In this paper designed a 12V Portable and Compact Hybrid Inverter that will key away from darkness. Solar Panel and Wind Mill is used to generate 12V DC Source. This Voltage is used to Charge 12V / 7 Ah Battery. In this proposed system, designed an Advance Hybrid Inverter System. This System uses two Sources to charge battery. Battery Voltage is further fed to Inverter Circuit, designed using Mosfet and CD4047 IC. This System is also equipped with Android based Load Control System. Android based Load System is designed using Arduino Microcontroller, Bluetooth Module and Relay Module as Major components. User can control Load within the average Range of 20-30 Feet Distance. Variable voltage of DC is taken through 12V Solar Pane and Wind Mill. This Voltage is given to the Charging Circuit using LM317; Output from LM317 is adjusted to 12V and given to 12V/7Ah Battery. Charged Battery Voltage is given to the Inverted Circuit. Inverter circuit consists of a Astable Oscillator (CD4047). This IC Produces a Complementary Square Wave at Pin 10 and 11. Power Mosfets T1 and T2 are connected to output of CD4047 and it serve as drivers for the high-voltage generator, realized using step-up transformer. Here 9-0-9 Step down Transformer is connected in Reverse. Output from Transformer is 230V which is connected to AC Load (Bulb) via a Dual Channel Relay. This Relay Module can be switched On / Off using Bluetooth Based Android Application.

KEYWORDS: Solar panel, Wind Mill, Hybrid System, Arduino Microcontroller.

DOI of the Article: https://doi.org/10.46501/GIETEE25

Available online at: https://ijmtst.com/icceeses2021.html

As per UGC guidelines an electronic bar code is provided to seure your paper

To Cite this Article: G. Nagaraju; A. Satish Kumar; K. Naresh and T. Amar Kiran. Hybrid Power Generation System with Inverter using Android based Load Control. *International Journal for Modern Trends in Science and Technology* 2021, *7*, pp. 174-181. https://doi.org/10.46501/GIETEE25

Article Info. Received: 20 May 2021; Accepted: 25 June 2021; Published: 30 June 2021

INTRODUCTION

Hybrid renewable energy systems (HRES) are becoming popular as stand-alone power systems for providing electricity in remote areas due to advances in renewable energy technologies and subsequent rise in prices of petroleum products. A hybrid energy system, or hybrid power, usually consists of two or more renewable energy sources used together to provide increased system efficiency as well as greater balance in energy supply. The key to cost reductions of this order is, of course, the right sort of support for innovation and development - something that has been lacking for the past and, arguably, is still only patchy at present. Research and development efforts in solar, wind, and other renewable energy technologies are required to continue for:

- improving their performance,
- establishing techniques for accurately predicting their output
- reliably integrating them with other conventional generating sources

Economic aspects of these technologies are sufficiently promising to include them in developing power generation capacity for developing countries.

Hybrid energy systems can offer a valuable means of supplying electricity to remote areas. Future success of these systems relies on the continuous research, development and demonstration of renewable energy technologies, featuring improved operating performance, cost reduction and improved reliability.

A. Advantages of Hybrid System

According to many renewable energy experts, a small "hybrid" electric system that combines home wind electric and home solar electric (photovoltaic or PV) technologies offers several advantages over either single system.

In much of the United States, wind speeds are low in the summer when the sun shines brightest and longest. The wind is strong in the winter when less sunlight is available. Because the peak operating times for wind and solar systems occur at different times of the day and year, hybrid systems are more likely to produce power when you need it.

Many hybrid systems are stand-alone systems, which operate "off-grid" -- not connected to an electricity distribution system. For the times when neither the wind nor the solar system are producing, most hybrid systems provide power through batteries and/or an engine generator powered by conventional fuels, such as diesel. If the batteries run low, the engine generator can provide power and recharge the batteries.

Adding an engine generator makes the system more complex, but modern electronic controllers can operate these systems automatically. An engine generator can also reduce the size of the other components needed for the system. Keep in mind that the storage capacity must be large enough to supply electrical needs during non-charging periods. Battery banks are typically sized to supply the electric load for one to three days.

B. Applications of Solar Wind Hybrid Energy System (SWHES)

Solar Wind Hybrid Energy Systems are using in almost all field small electric power usage. Some of the applications of SWHES are given below.

- **Grid connected:** The large power rating of SWHES, where the access of wind and sun irradiation is more, they can be connected to Grid. In these types of generation, if the system failed to generate power the Grid will supply the load.
- **Stand alone:** Almost all applications are stand - alone not connected to the grid.
- **Street lighting:** The foremost application of is solar street lighting. Solar Street light become as lighting. Use of this reduces the load from conventional power plants.
- **Household**: Residential appliances can use power generated through hybrid solar wind energy system. Hybrid Energy system are used to supply electricity to different offices or other parts of the building in reliable manner.
- **Remote Applications:** like military services where it is impossible to provide conventional power supply these systems are useful.

IMPLEMENTATION

2.1 Major Components used in this Project

1. Arduino Microcontroller
2. Dual Channel Relay
3. 3W Dual AC Load
4. Bluetooth Module
5. DC to AC Inverter Circuit
6. 12V / 3 Watt Solar Panel
7. 12V Wind Mill Prototype
8. 12V / 9Ah Battery
9. Wind Mill Structure
10. LCD 2x16 Module
11. Voltage Regulators
12. Filter Capacitors
13. Charging Circuit using LM317
14. Other Misc Components

2.2 Hardware Description

2.2.1 ARDUINO UNO

Arduino is common term for a software company, project, and user community that designs and manufactures computer open-source hardware, open-source software, and microcontroller-based kits for building digital devices and interactive objects that can sense and control physical devices.

The project is based on microcontroller board designs, produced by several vendors, using various microcontrollers. These systems provide sets of digital and analog I/O pins that can interface to various expansion boards (termed *shields*) and other circuits. The boards feature serial communication interfaces, including Universal Serial Bus (USB) on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino project provides an integrated development environment (IDE) based on a programming language named *Processing*, which also supports the languages C and C++.

Fig 1: Arduino Uno

The first Arduino was introduced in 2005, aiming to provide a low cost, easy way for novices and professionals to create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats, and motion detectors.

Arduino programs may be written in any programming language with a compiler that produces binary machine code. Atmel provides a development environment for their microcontrollers, AVR Studio and the newer Atmel Studio.

The Arduino project provides the Arduino integrated development environment (IDE), which is a cross-platform application written in the programming language Java. It originated from the IDE for the languages *Processing* and *Wiring*. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and provides simple one-click mechanism to compile and load programs to an Arduino board. A program written with the IDE for Arduino is called a "sketch".[21]

The Arduino IDE supports the languages C and C++ using special rules to organize code. The Arduino IDE supplies a software library called Wiring from the Wiring project, which provides many common input and output procedures. A typical Arduino C/C++ sketch consist of two functions that are compiled and linked with a program stub *main()* into an executable cyclic executive program:

- *setup()*: a function that runs once at the start of a program and that can initialize settings.
- *loop()*: a function called repeatedly until the board powers off.

After compiling and linking with the GNU toolchain, also included with the IDE distribution, the Arduino IDE employs the program *avrdude* to convert the executable code into a text file in hexadecimal coding that is loaded into the Arduino board by a loader program in the board's firmware.

Applications

See also: List of open-source hardware projects

- Xoscillo, an open-source oscilloscope[26]
- Scientific equipment[27] such as the Chemduino[28]
- Arduinome, a MIDI controller device that mimics the Monome
- OBDuino, a trip computer that uses the on-board diagnostics interface found in most modern cars
- Ardupilot, drone software and hardware
- ArduinoPhone, a do-it-yourself cellphone[29][30]
- *GertDuino*, an Arduino mate for the Raspberry Pi[31]
- Water quality testing platform[32]
- Homemade CNC using Arduino and DC motors with close loop control by Homofaciens

Arduino Uno - Details

The Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

"Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

2.2.2 Arduino IDE

The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino compatible boards, but also, with the help of 3rd party cores, other vendor development boards.

Arduino is a prototype platform (open-source) based on an easy-to-use hardware and software. It consists of a circuit board, which can be programmed (referred to as a microcontroller) and a ready-made software called Arduino IDE (Integrated Development Environment), which is used to write and upload the computer code to the physical board.

Arduino provides a standard form factor that breaks the functions of the micro-controller into a more accessible package.

2.2.3. Solar Panel

Solar panel refers to a panel designed to absorb the sun's rays as a source of energy for generating electricity or heating.

A photovoltaic (in short PV) module is a packaged, connected assembly of typically 6×10 solar cells. Solar Photovoltaic panels constitute the solar array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications. Each module is rated by its DC output power under standard test conditions, and typically ranges from 100 to 365 watts. The efficiency of a module determines the area of a module given the same rated output – an 8%

efficient 230 watt module will have twice the area of a 16% efficient 230 watt module. There are a few solar panels available that are exceeding 19% efficiency. A single solar module can produce only a limited amount of power; most installations contain multiple modules. A photovoltaic system typically includes a panel or an array of solar modules, a solar inverter, and sometimes a battery and/or solar tracker and interconnection wiring.

Applications

There are many practical applications for the use of solar panels or photovoltaics. It can first be used in agriculture as a power source for irrigation. In health care solar panels can be used to refrigerate medical supplies. It can also be used for infrastructure. PV modules are used in photovoltaic systems and include a large variety of electric devices:

- Photovoltaic power stations
- Rooftop solar PV systems
- Standalone PV systems
- Solar hybrid power systems
- Concentrated photovoltaics
- Solar planes
- Solar-pumped lasers
- Solar vehicles
- Solar panels on spacecrafts and *space stations*

2.2.4. Wind Mill

A windmill is a structure that converts wind power into rotational energy by means of vanes called sails or blades, specifically to mill grain (gristmills), but the term is also extended to wind pumps, wind turbines and other applications.[1] Windmills were used throughout the high medieval and early modern periods; the horizontal windmill first appeared in Greater Iran during the 9th century, the vertical windmill in northwestern Europe in the 12th century.A windmill is a structure used to harness the power of the wind for purposes like grinding grain, pumping water, and generating electricity.

The power of the wind was first harnessed by sailors, who were able to understand lift and harness the winds power through sails. This knowledge led to the development of the first vertical axis sail-type windmill used by the ancient Persians and Chinese for grinding grain and pumping water.

They consisted of vanes called sails or blades that when prompted to turn by the wind, converted the wind's energy into rotational energy that could be utilized. Early European windmills with horizontal axis systems were the foundation for current wind turbine technology used for energy production.

Wind turbines work on a simple principle: instead of using electricity to make wind—like a fan—wind turbines use wind to make electricity. Wind turns the propeller-like blades of a turbine around a rotor, which spins a generator, which creates electricity.

Wind is a form of solar energy caused by a combination of three concurrent events:

1. The sun unevenly heating the atmosphere
2. Irregularities of the earth's surface
3. The rotation of the earth.

2.2.5. MIT App Inverter – Android Application Development Platform

MIT App Inventor is a web application integrated development environment originally provided by Google, and now maintained by the Massachusetts Institute of Technology (MIT). It allows newcomers to computer programming to create application software (apps) for two operating systems (OS): Android (operating system) |Android, and iOS.

It is free and open-source software released under Multi-licensing| dual licensing: a Creative Commons license# Attribution| Creative Commons Attribution Share Alike 3.0 Unported license, and an Apache License 2.0 for the source code.

It uses a graphical user interface (GUI) very similar to the programming languages Scratch (programming language) and the Star Logo, which allows users to drag and drop visual objects to create an application that can run on mobile devices. In creating App Inventor, Google drew upon significant prior research in

educational computing, and work done within Google on online development environments.[1]

App Inventor and the projects on which it is based are informed by constructionist learning theories, which emphasize that programming can be a vehicle for engaging powerful ideas through active learning.

The MIT AI2 Companion appenables real-time debugging on connected devices via Wi-Fi, or Universal Serial Bus (USB).

2.3. Block Diagram

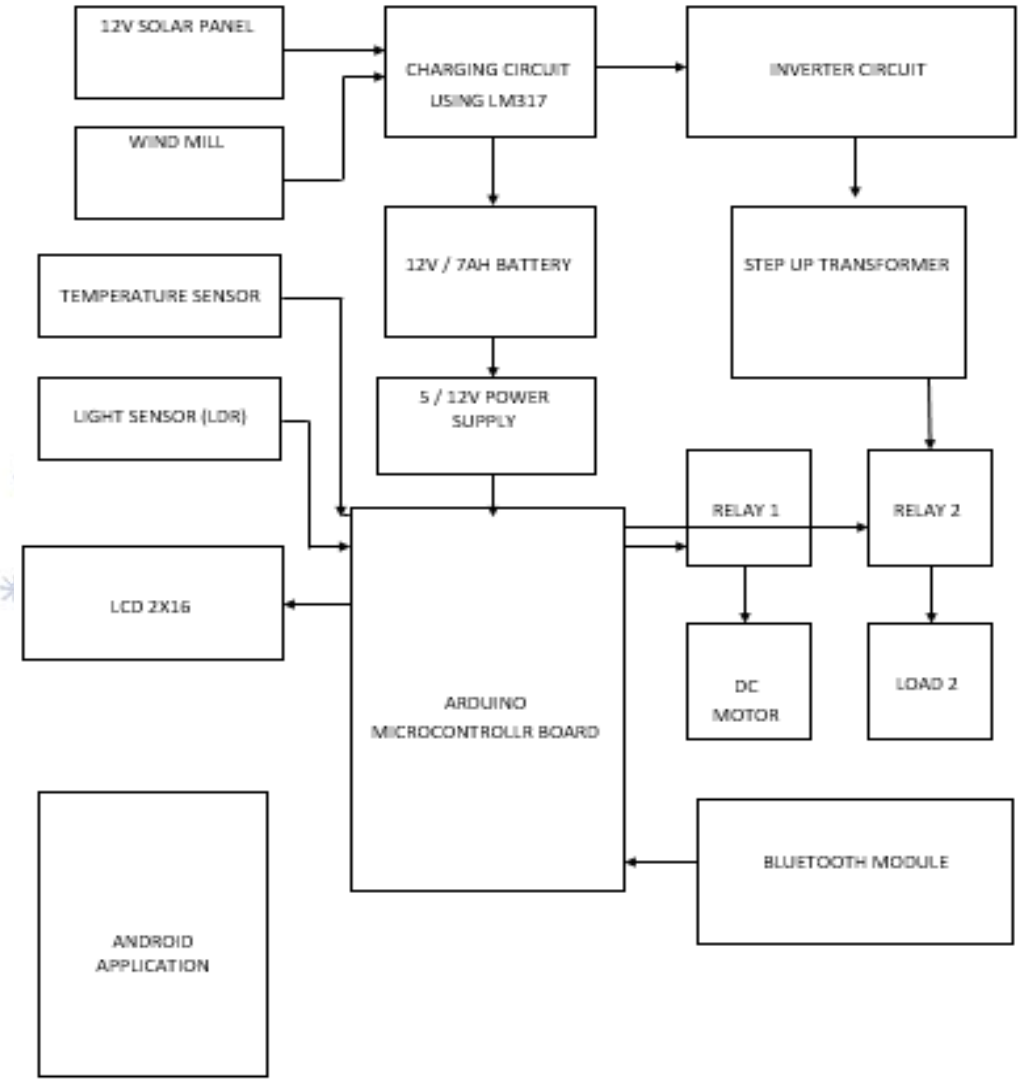

Fig 2: Block diagram of hardware model

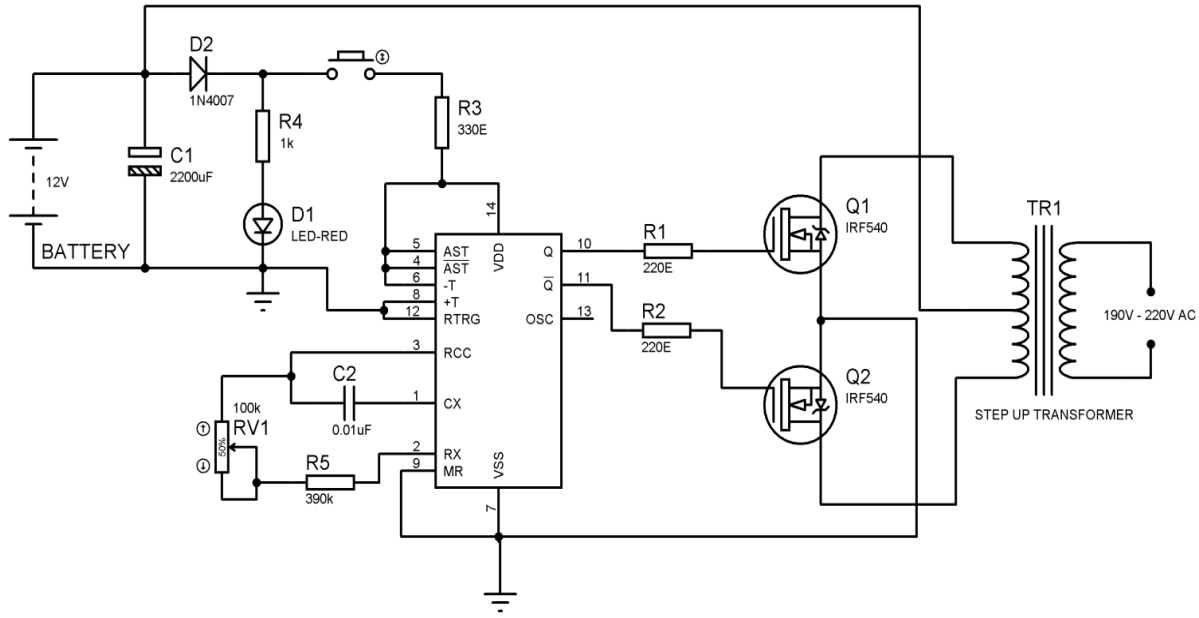

Fig 3: Circuit Diagram (Inverter Section)

CONCLUSIONS

Hybrid power generation system is good and effective solution for power generation than conventional energy resources. It has greater efficiency. It can provide to remote places where government is unable to reach. So that the power can be utilize where it generated so that it will reduce the transmission losses and cost. Cost reduction can be done by increasing the production of the equipment. People should motivate to use the non conventional energy resources. It is highly safe for the environment as it doesn't produce any emission and harmful waste product like conventional energy resources. It is cost effective solution for generation. It only need initial investment. It has also long life span. Overall it is good, reliable and affordable solution for electricity generation.

REFERENCES

[1] Y. M. Safan, S. Shaaban and M. I. A. El-Sebah, "Hybrid control of a solar tracking system using SUI-PID controller," 2017 Sensors Networks Smart and Emerging Technologies (SENSET), Beirut, 2017, pp. 1-4.

[2] G. Liu, A. O. Baba and L. Zhu, "Hybrid controller for dual axes solar tracking system," 2017 36th Chinese Control Conference (CCC), Dalian, 2017, pp. 3203-3207.

[3] Smirnov, S. A. Malugin and A. V. Bakanov, "Designing integrated PV facility with dual-axis solar tracking system mounted on the south building face," 2017 International Conference on Industrial Engineering, Applications and Manufacturing (ICIEAM), St. Petersburg, 2017, pp. 1-4.

[4] S. Gutiérrez, "Prototype for an off-grid photovoltaic system with low cost solar tracking," 2017 IEEE Mexican Humanitarian Technology Conference (MHTC), Puebla, 2017, pp. 7-11.

[5] K. S. Vastav, S. Nema, P. Swarnkar and D. Rajesh, "Automatic solar tracking system using DELTA PLC," 2016 International Conference on Electrical Power and Energy Systems (ICEPES), Bhopal, 2016, pp. 16-21

[6] K. Boudaraia, H. Mahmoudi, M. Abbou and M. Hilal, "DC motor position control of a solar tracking system using second order sliding mode," 2016 5th International Conference on Multimedia Computing and Systems (ICMCS), Marrakech, 2016, pp. 594-598.

[7] K. Sujatha, R. S. Ponmagal, T. Godhavari and K. S. R. Kumar, "Automation of solar system for Maximum Power Point tracking using Artificial Neural Networks and IoT," 2016 IEEE Uttar Pradesh Section International Conference on Electrical, Computer and Electronics Engineering (UPCON), Varanasi, 2016, pp.61-66.

[8] S. Ray and A. K. Tripathi, "Design and development of Tilted Single Axis and Azimuth-Altitude Dual Axis Solar Tracking systems," 2016 IEEE 1st International

Conference on Power Electronics, Intelligent Control and Energy Systems (ICPEICES), Delhi, 2016, pp. 1-6.

[9] V. B. Venkateswaran and V. Manoj, "State estimation of power system containing FACTS Controller and PMU," 2015 IEEE 9th International Conference on Intelligent Systems and Control (ISCO), 2015, pp. 1-6, doi: 10.1109/ISCO.2015.7282281.

[10] Manohar, K., Durga, B., Manoj, V., & Chaitanya, D. K. (2011). Design Of Fuzzy Logic Controller In DC Link To Reduce Switching Losses In VSC Using MATLAB-SIMULINK. *Journal Of Research in Recent Trends*.

[11] Manoj, V., Manohar, K., & Prasad, B. D. (2012). Reduction of switching losses in VSC using DC link fuzzy logic controller *Innovative Systems Design and Engineering ISSN*, 2222-1727.

[12] M. Prabakaran, A. P. Kumar and R. Hariharan, "Hybrid H-6 inverter coupled automatic dual axis solar tracking system," 2016 International Conference on Electrical, Electronics, and Optimization Techniques (ICEEOT), Chennai, 2016, pp. 4722-4731.

[13] Dinesh, L., Harish, S., & Manoj, V. (2015). Simulation of UPQC-IG with adaptive neuro fuzzy controller (ANFIS) for power quality improvement. *Int J Electr Eng*, *10*, 249-268.