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HYBRID SYSTEM BASED D –STATCOM FOR POWER QUALITY IMPROVEMENT WITH IOT

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Abstract*— In today's situation power requirement is highly considered necessity for each and every one for almost everything. Due to the great consumption, the present energy sources are exhausting gradually. Therefore it is indispensable to change the energy sources to non-conventional from conventional energy resources. Our work tends to the combine the use of two non-conventional energy sources. In this system, wind and solar energy is used as sources of required energy. But, the self-dependent function of Photo-voltaic and wind energy system would not provide a practical electricity source for generating power, majorly because of the randomness over the availability of the wind and solar irradiance. So, a combination of solar and wind energy production technique could create a huge capacity and practical power source. We proposed a technique in which wind and Photo-voltaic system as a hybrid model. It is pollution less and free of cost. If the solar energy is incorporated with the grid, the quality of power generated in the system will have a contrary effect. Quality of Power in this hybrid system has been improvised by utilizing D-STATCOM. It advances the quality of power in a system. In this project, we are going to integrate the solar energy and wind energy to the grid to improve the power quality of the system. We are going to use the PV array, wind turbine boost converter, inverter, controller, bridge rectifier and relay. In this project, D-STATCOM has been employed to strengthen the power quality of the hybrid micro-grid. A D-STATCOM connected at the point of common coupling (PCC), can be utilized to mitigate both the voltage and the current related power quality issues. To make the source currents balanced and pure sinusoidal, D-STATCOM injects the harmonic and reactive components of the load current, when operated in current control mode. In addition to this wind and solar panel, voltage and current data will be monitoring in online webpage, and here load controlling is done by using IOT (internet of things).*

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Keywords — D-STATCOM, PCC.

I. INTRODUCTION

The human need for electrical energy is growing slowly due to globalization and industrialization. In accordance with the above situation, nations around the world have been enchanting processes since the twentieth century, but the key challenge is to solve the extinction of energy prevention and to protect our atmosphere from emissions by changing new energy technology. The solar energy in the center of them is the main spotlight of the energy which can be produced and consumed. The development of photovoltaics' is recognized as the key methodological data and predicting technology due to its prevalence in the protection of the environment. Topology for inverters is the leading topology of the PV grid. As crossing point tools through solar cells and grid, inverter plays a critical role in creating and consuming the latest energy schemes, actively disrupting the financial side and stability of the PV grid network. The power quality is improved by D-STATCOM, A STATCOM is a power electronics device which is proficient to generate or absorb reactive power at its output terminals. It is capable of handling the real power as well if connected with a battery storage device. It does not require high value of inductive and capacitive components to impart reactive power support to transmission lines. The main advantages of the STATCOM are requirement of less installation area due to compact size and higher reactive power yield to

low voltages. STATCOM also imparts greater damping characteristics from the dynamic stability point of view.

II. LITERATURE SURVEY

[1] Getachew Bekele, Design of a photovoltaic-wind hybrid power generation system.
Getachew Bekele et.al, design the hybrid wind and photovoltaic power generation system for the Ethiopian remote area. The end conclusions of the analysis resulted with fulfilled functioning of the technique and the deficiency of power is enclosed till twenty percent.

Y.M.Irwan, A New Technique of Photovoltaic/Wind Hybrid System in Perlis,Energy Procedia .
Y.M.Irwan et.al, stated the novel procedures for power production using hybrid model. The production of power using wind energy as source is implemented for the purpose of providing coolant for the Photo-Voltaic system. The relation of Savinious and Darrieus is utilized along with Photo-voltaic system. The novel method for design of hybrid system could improvise the implementation.

[3] Mohammed Gwani et.al, Urban Eco-Greenergy Hybrid Wind-Solar Photovoltaic Energy System & Its Applications, ISSN.
Mohammed Gwani et.al, this system is used for energy generation using hybrid solar-wind but this is combination of vertical axis wind turbine with omni directional guide vanes (ODGV). This work produces power as source of energy for lights in streets and other applications.

III. EXISTING METHOD AND PROPOSED SYSTEM

EXISTING METHOD

The existing system is hybrid solar and wind power generation. The performed analysis related to fossil fuel conservation and production of carbon while the power is produced. Studied about the appropriate model and functioning ability of the solar and wind energy system as hybrid model. The dually served induction producer is utilized for production of power. The conclusion of the analysis resulted that the utilized power electronics for production of power.

PROPOSED SYSTEM

Solar photovoltaic system is combined with grid makes the proposed system as a type of electrical inverter which changes DC power from Photo-Voltaic system into AC power. Once the PV system is connected to the grid, after satisfying the limited demand, it can send the extra energy into the grid. So when the demand is greater than the output, the grid obtains extra electricity. Hybrid power system made of Wind and solar energy

comprises of photovoltaic array, wind turbines, controller and battery for storage. The energy is in DC form, it is stored in battery and controller supply power for DC loads. The DC to DC converter used at this time is the Boost converter, where the input voltage (DC) is lower than the output voltage (DC). For the PV system with controller, therefore, boost converter is required to boost PV system voltage. The DC-DC boost converter has an inductor, condenser, diode and MOSFET. The input voltage for this Boost converter is taken from the PV array module and it is boosted up to the desired level and it is maintained with a reference value with the help of Controller. D-STATCOM is combined at the state of usual

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connection. The proposed controller is supposed to either deliver or absorb the reactive power to maintain the voltage stability of the entire system.as the result the power quality is improved. The voltage and current data can be monitoring in real time through online. The loads can be controlled through online web page based on IOT internet of things. The online web page can be designed with the help of HTML page.

IV. BLOCK DIAGRAM

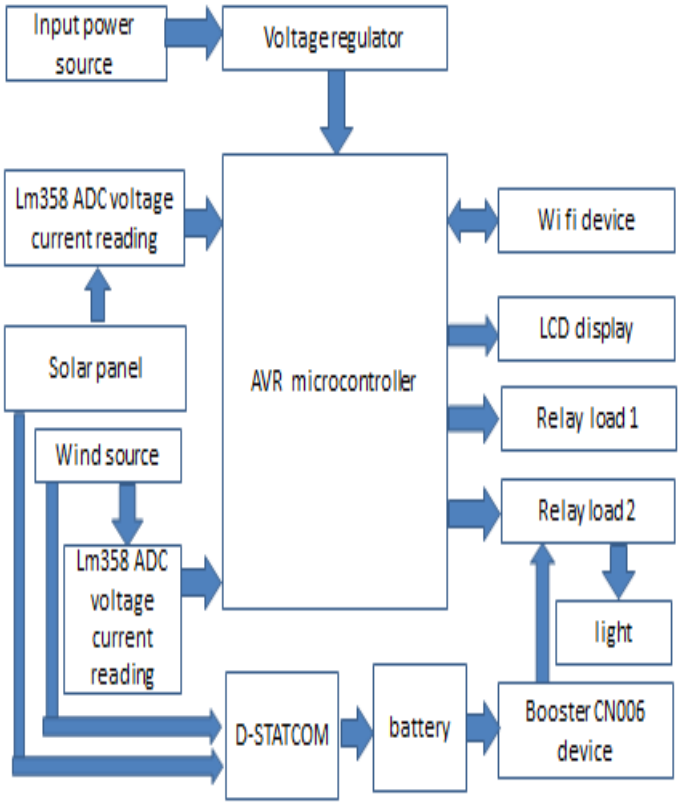

Fig.no: 1: Block Diagram

V. HARDWARE COMPONENTS

AVR MICROCONTROLLER

Features

- Dual eight-bit Counter/Timer with distinct Pre-scaler, single Mode for Comparison
- Single 16-bit Counter/Timer with distinct Pre-scaler, Mode for comparison, and Mode for capturing.
- Reliable Counter for Time with distinct Oscillator
- 3 Channels for Pulse Width Modulation
- 8-channel Analog to Digital Convertor in packages of TQFP and QFN/MLF
- 10-bit precision for 8 Channels

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- 2-wire Interface of type serial which is byte-oriented
- USART (Serial) of Programmable type
- SPI (Serial) Interface as Master/Slave mechanism
- Watchdog Timer with distinct Oscillator (On-chip) as Programmable type
- Analog Comparator (On-chip)

Fig.no:2 : AVR microcontroller

LCD DISPLAY

Fig.no:3 : 16 x 2 character LCD display

The term "LCD" can be expanded as Liquid Crystal Display. LCD is receiving vast utilization substituting LEDs (7 segment LEDs or more than 7 segment LEDs) due to the following causes:

- The reducing prices of LCDs.
- The capability to display graphics, numbers, and characters. This is in opposite to LEDs that are restricted to a few characters and numbers.
- Combination of a restoring microcontroller into the LCD, therefore releasing the CPU of the duty of restoring the LCD. In opposition, the LED should be restored by the CPU to continue to display the required information.
- Programming for graphics and characters is quite easy and user-friendly.

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RELAY

Fig.no: 4: Relay

An Electro-mechanical relay is a controllable (electrically) switches vastly utilized in commercial regulations, vehicles and other applications. It permits the separation of 2 distinct blocks of a model with 2

dissimilar sources of voltage i.e., a little quantity of current/ voltage on first side could manage a huge quantity of current/ voltage on the second side however there is no probability that those 2 voltages being combined.

Applications of Relay

- Usually utilized in circuits for switching purpose.
- To regulate Heavy loads at a pre-set condition/ time (On/Off)
- Utilized in precautionary circuits to detach the load from supply in case of failure
- Utilized in vehicles for the purpose of regulating glass motors and indicators etc.

POWER SUPPLY

Beginning with an Alternating Current voltage, a constant Direct Current voltage is received by correcting the Alternating Current voltage, then purifying to a Direct Current state, and lastly, controlling to get a required constant Direct Current voltage. The control is commonly acquired from an IC voltage control unit that fetches a Direct Current voltage and gives a somewhat lesser Direct Current voltage that stays the same even if the input Direct Current voltage changes, or the output load combined to the Direct Current voltage varies.

LIGHT

Fig.no: 5 : 5V LED bulb

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5V, 6W USB LED Bulb provides intense white alerting light while the power cut situation occurs. This bulb is advantageous even in incidences of power crisis by utilizing Smart phones or Power bank through the use of OTG.

General Specifications

Sales Package	1 UNIT
Power Requirement	USB
Number of Bulbs	1
Light Color	WHITE
Lamp Adjustment	YES
Inbuilt Battery	Yes
Number of Batteries	0
W x H x D	5 cm x 5 cm x 5 cm
Weight	50 g

BOOSTER CN006 DEVICE

Fig.no: 6: DC-DC Booster

It is one of the plainest kinds of converter used for the mode of switching. It gets a voltage as input and increases or boosts the obtained voltage. The components are a diode, a semiconductor switch, an inductor, and a capacitor. Further required is a periodic square wave source.

BATTERY

Batteries are an assembly of 1 or many cells in which, a flow of electrons is generated by the chemical reactions that takes place in a circuit. These are built with 3 primary constituents: an anode (negative), a cathode (positive), and a type of electrolyte (a material, which reacts (chemically) with positive and negative side). While positive and negative side of a battery is combined to a circuit, a reaction (chemical) occurs between the negative side and the electrolyte. It leads to the flow of electrons via the circuit and again back into the positive side where one more reaction (chemical) occurs. While the substance in the positive or negative side is utilized or not capable of being utilized in the reaction, the battery is not able to generate power. At that instance, the battery is "dead." Batteries which should be disposed after usage are termed as basic batteries. Batteries which could be recharged are termed as secondary batteries.

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Fig.no: 7: Battery

WIND TURBINE

Wind turbine technology is growing. The novel ideas, greater turbines as onshore and offshore, and turbines as floating, needs varying study noticing understandable modeling of load. Loads in the survival and operational incidences comprising cases of fault, regulating operations, and forces that are response-stimulated regulate the conditions of restrictions. Industry for Wind turbine has a considerable knowledge in under-standard uses. But, the floating wind turbines are in the stage of research.

SOLAR PANEL

Fig.no 8: Solar panel

Technical characteristics:

- OCV (Open Circuit Voltage) – Voc: 6V±8%
- SCC (Short Circuit Current) – Isc: 105mA±8%
- MPV (Maximum Power Voltage) – Vmp: 4.0V±8%
- MPC (Maximum Power Current) – Imp: 100.0mA±8%
- MP (Maximum Power) – Ppm: 0.4W±8%

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Description of Solar Panel

- They are enclosed and secured by the use of a strong external frame
- Power for Output (maximum): 0.72W
- Operating Voltage (maximum): 6.6V
- Current for charging (maximum): 110mA
- Power for Output (minimum): 0.6W
- Operating Voltage (minimum): 6V
- Current for charging (minimum): 100mA

LM358 ADC

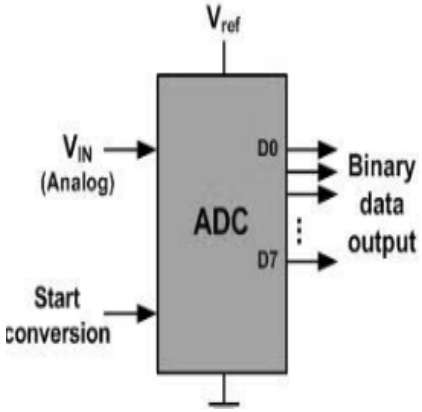

Fig.no:8 : ADC IC

An ADC is a circuit which changes the value of analog voltage (continuous) to the value of digital voltage (binary) which could be studied by the use of a digital system that can then be utilized for calculation in digital form. This type of circuits could be discovered as a single Analog to Digital Convertor Integrated Circuits by embedded into a microcontroller or by themselves.

REGULATOR

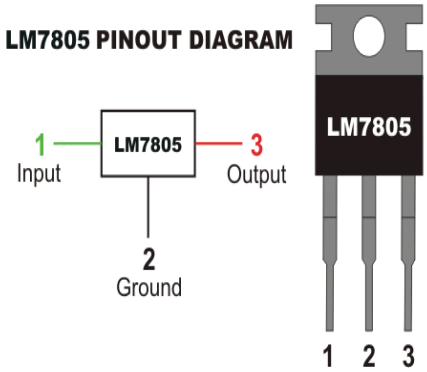

Fig.no:9 : LM7805 pin out diagram

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It consists of a group of vastly utilized Integrated Circuits. Integrated Circuit units for Regulator comprises of the circuitry for source of reference, amplifier of comparator type, regulating system, and protection for overload all in one Integrated Circuit. Even though the inside making of the Integrated Circuit is dissimilar from which illustrated for separate circuits of voltage regulator, the outside functioning is more similar. Integrated Circuit units give control of either a constant voltage (positive), a constant voltage (negative), or an variable/flexible voltage. A supply for power could be made utilizing a transformer combined to the supply line of Alternating Current to step the Alternating Current voltage to amplitude that is required, then correcting that Alternating Current voltage, purifying with RC filter and a capacitor, if required, and lastly controlling the Direct Current voltage by utilizing an Integrated Circuit regulator.

WIFI DEVICE

It is otherwise termed as NODE MCU (ESP8266).
It has the following abilities

- 802.11 b/g/n, supporting WPA/WPA2 (2.4 Giga Hertz Wi-Fi),
- 16 GPIO (general-purpose input/output),
- I²C (Inter-Integrated Circuit) communication protocol as serial,
- 10-bit ADC (analog-to-digital conversion)
- SPI (Serial Peripheral Interface) communication protocol as serial,
- Inter-IC Sound (I²S) combined end to end with Direct Memory Access (DMA), sharing pins with GPIO,
- On dedicated pins, plus a transmit-only UART can be enabled on GPIO2 (UART), and
- PWM (Pulse-width modulation).

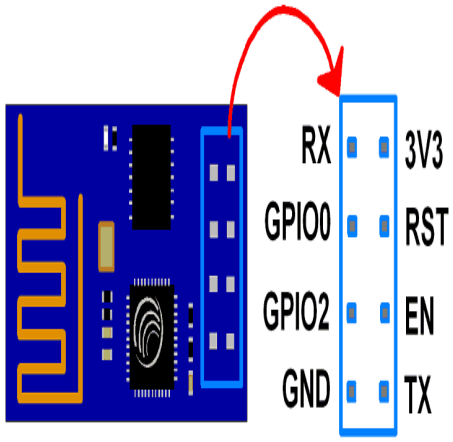

Fig.no:10 : ESP8266 pin diagram

D-STATCOM

The term “DSTATCOM” can be expanded as Distribution Static Compensator. It is a source of voltage converter combined in equivalent to the load bus bar via a reactor or a transformer. It is generally utilized for the purpose of rectification of power factor, flicker in voltage, non-passive purifying, etc., rather than voltage reduction. As the involvement to the bus bar voltage equates the inserted current magnified by the resistance, a great current (reactive) would be get while such a malfunction. Even if it could be utilized for

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voltage dip reduction purpose, it is not the good substitute when compared to DVR.

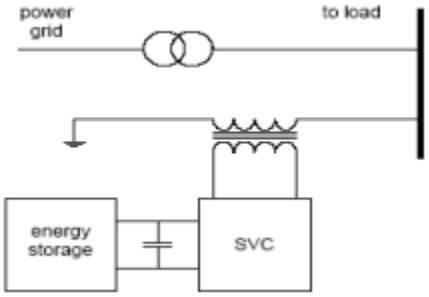

Fig.no:11 : Standard Configuration for a shunt Voltage Controller

VI. SOFTWARE USED

KEIL C

Development tools in Keil for a type of Microcontroller (8051) aid each stage of Software developer from the specialized applications engineer to the student merely studying about embedded software development. The Keil C51 C Compiler for the microcontroller (8051) is the famous 8051 C compiler throughout the world.

They are created for the expert software developer, but coders of all stages could utilize them to acquire the maximum from the microcontroller architectures (embedded) which are aided. They approve the famous microcontrollers and are dispersed in various bundles and outlines, based on their architecture.

- Microcontroller Development Kit, for several ARM7, ARM9, and Cortex-Mx based devices (**MDK-ARM**)
- Keil Professional Developer's Kit, for C166, XE166, and XC2000 devices (**PK166**)
- Keil 251 Development Tools, for 251 devices (**DK251**)
- Keil 8051 Development Tools, for Classic & Extended 8051 devices (**PK51**)

Further, Keil supplies a various sources of boards for evaluation, adapters for USB-JTAG, third-party tools, and emulators that complement the variety of supplements.

VII. RESULTS

Our system is successfully implemented to serve the purpose of the system in an effective manner. The hardware prototype model are represented as follows,

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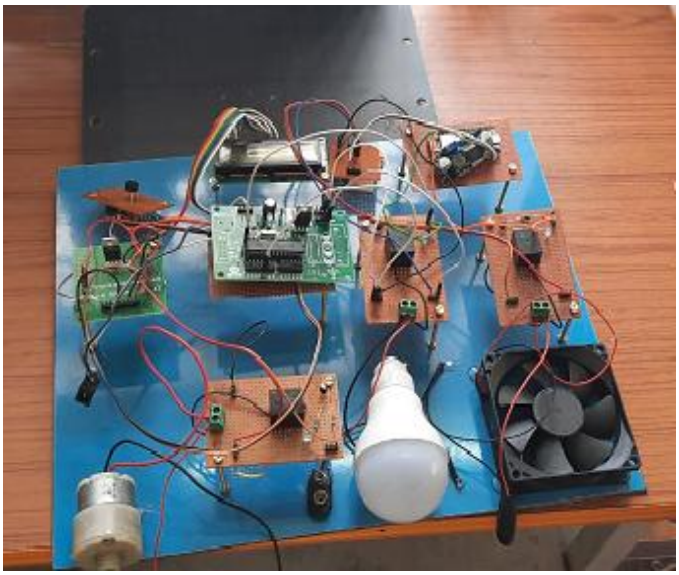

Fig.no:12 : Hardware Prototype model

VIII. CONCLUSION

Effect of connecting wind source and solar energy to the grid (a low voltage distribution system) and operation with DSTATCOM has been demonstrated in this project. The proposed system demonstrates effective operation of the scheme with good voltage regulation, harmonic elimination, and load balancing in different operating condition. The complete power flow analysis at PCC is presented and total harmonic distortion (THD) in grid current is also shown. Further the system enables us to control the grid even from distance using internet of things (IOT). Also, the analysis of the performance of the grid can be viewed in online webpage for effective monitoring of the system. Thus, it ensures the usage of Solar and wind energy in an effective manner and so it produces beneficial eco-friendly results.

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