Fabrication of Wind Turbine Power Generation System

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APPROVAL

This is to certify that the project on **"Fabrication of Wind Turbine Power Generation System"** By **Suvo Das**, (ID No: BME 1803016529**), Md. Hasan Mahmud**, (ID No: BME 1803016502**), Prosenjit Das**, (ID No: BME 1803016527**), Prodip Das**, (ID No: BME 1803016505**), Ripon Samadder** (ID No: BME 1803016523) has been carried out under our supervision. The project has been carried out in partial fulfillment of the requirements of the degree of Bachelor of Science (B.Sc.) in Mechanical Engineering of years of 2022 and has been approved as to its style and contents.

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DECLERATION

We, hereby, declare that the work presented in this project is the outcome of the investigation and research work performed by us under the supervision of **Mohammad Din Al-Amin**, Lecturer and Co-Ordinator, Department of Mechanical Engineering, Sonargaon University (SU). We also declare that no part of this project and thesis has been or is being submitted elsewhere for the award of any degree.

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ABSTRACT

Wind energy is the current “star” in the field of renewable energy for electrical production. Still, the power generated by wind turbines over time is characteristically uneven due to the unpredictable nature of their primary source of power. Economic and social values, will grow increasingly competitive with Traditional energy technologies, so that by the middle of the 21st century, renewable Energy, in its various forms, should be supplying half of the world’s energy needs. The paper describes the requirement of Wind Turbine and the comparison of Wind Energy with other Renewable Sources of Energy. A small Wind Mill suitable for domestic application is designed and fabricated. This system is generated power from wind turbine. All of this power store in a battery. In this paper we discuss about a wind turbine power generator system. The analysis shows the optimal solution and the limits of the investment costs required for the system construction.

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LIST OF FUGURE

Chapter 1 Introduction

1.1 Introduction

The wind power production is decentralized in the regions with high average wind speeds. This is different to the conventional production units of large capacity, connected to the high-voltage grids, whose location and power have been planned. These types of production are centrally controlled to participate in the control of the frequency and voltage of grid.[1] The fundamental characteristic of the decentralized production is to be lead in most cases by other factors than the electricity demand. For example, the weather conditions for which performed wind turbines. These factors cause uncertainties on the geographical location, the dynamics of the development, the levels and times of the production activity.[2] Theses consequences influence the development, the management and the exploitation of power systems. These last ones must be ready on one hand, absorbing the decentralized production when it is active, and on the other hand, delivering the replacement power when the production is inactive.[3]

Because it's unpredictable in the short term, the wind power is beneficial only in particular situations when there is a good correlation between the production and the consumption, or between the production and the specific needs of the grid.[4] The advantages of the decentralized wind generation appear at maximizing incomes from the production with minimal impact on the power system reliability. Currently, the wind turbines do not participate in the production settings. The mentality has already been changed; the decentralized production is destined to grow part into centralized production plant.[5] The randomness of wind results that a single wind turbine cannot adapt the production to the consumption. Nevertheless, this adaptation should be done by the intervention of sources having a power reserve allowing a fast regulation of the production.[6]

1.2 Objectives

The objectives of this project are:

- To study about **Fabrication of Wind Turbine Power Generation System.**
- To design and construct a wind power generation system.
- To test the performance of the system.

1. 3 Methodology

Our used methodology for the project:

- **Fabrication of Wind Turbine Power Generation System** and designing a block diagram & circuit diagram to know which components need to construct it.
- Collecting the all components and programming for the micro-controller to controlled the system.
- Setting all components in a PCB board & soldering. Then assembling the whole block in a board and finally run the system & checking.

Chapter 02 Literature Review

2.1 Introduction

In this section topics related to **Fabrication of Wind Turbine Power Generation System** are included. These provide a sampling of problems appropriate for application of **Wind Turbine Power Generation**. The references are summarized below.

2.2 Literature Review

S. C. Bhattacharya, Energy for Sustainable Development: a critical review and analysis, Energy for sustainable Development, 16(3), 260-71, (2012) [1] The force created by the wind during a hurricane generally produces significant damage. According to the National Hurricane Center, a category 5 hurricane is accompanied by winds with speeds of 150 miles per hour or higher, which most likely causes catastrophic damage to structures. This damage generally starts as a failure of the roof, and following destruction of the rest of the structure including walls and interiors. **Alliance for Rural Electrification (ARE). Hybrid power systems based on renewable energies. ARE Position Paper (2008) [2]** One characteristic of hurricane winds that also contributes to the lifting of the roofs and destruction of the structures is the fluctuation of the flow field. If the speed and patterns of the flow were constant, it would be easier for the engineers to design a structure capable of enduring these forces. However, changing conditions produce fatigue in the different supporting elements that ultimately cause failure. Another characteristic of a hurricane wind is the turbulence that accompanies the flow of wind. Turbulent flows carry much more energy than laminar flows, and this energy can be transferred into the structure causing the failure (Manwell.)

M. **Thirugnanasambandam, S. Iniyan, R. Goic, Renewable and Sustainable Energy Reviews 14(1), 312–22, (2010) [3]** The main concern of this project is the uplift effect cause by the strong winds. The empty space that forms between the layers of air and the surface of the roof cause a vacuum effect that produces the uplift and ultimately the failure of the roof. Another risk presented by high hurricane winds happens when the direction of the wind is at an angle with the roof. The conical vortices formed when winds strike the house in the corners. These vortices increase the pressure difference that causes lift and produce a greater uplift effect. **I. P. Panapakidis, D. N. Sarafianos, M. C. Alexiadis, Renewable and Sustainable Energy Reviews, 16(1), 551–563, (2012)[4]** Hybrid power generation is a hot topic in renewable engineering systems. Many people have worked in this filed. Below is a summary of the most relevant work in the literature.

V. R. Vanajaa, Int. Journal of Applied Engineering Research,11(4),2579–2586 (2016) [5] In this paper, optimal design of a hybrid solar-wind-diesel power system to electrify rural areas using imperialist competitive algorithm was designed. Some artificial intelligence optimization techniques were presented as well. The ultimate goal was to minimize the net cost of the hybrid system for 20 years. The imperialist competitive algorithm was shown to be the fastest and the most accurate.

In **G. M. Joselin, S. Iniyan, E. Sreevalsan, S. Rajapandian, Renewable and Sustainable Energy Reviews; 11(6):1117–45 (2007) [6]**, isolated wind-photovoltaic hybrid power system with battery storage was presented and supposed to be able to supply electricity to two laboratories with a peak electrical load of 1072 W. Statistical comparisons were performed to compare between the energy generated and the energy consumed. Monthly data were obtained and compared, and as a result of the comparison, it was shown that the generated power was above the consumed power. **R. Saidur, M. R. Islam, N. A. Rahim, K. H.Solangi, A review on global wind energy policy, Renewable and Sustainable Energy Reviews, 14(7),1744–1762, (2010) [7]** a Solar-Wind hybrid power system was presented. The system was controlled based on micro controller. This assures optimum resource utilization and efficiency improvement as compared with their individual mode of generation. It also makes the system more reliable and dependable.

A. Bataineh, A. Alqudah, A. Athamneh, Jordan. Energy and Environment Research, 4(3), 9–20, (2014) [8], several hybrid energy system models were analyzed. HOMER software was used to evaluate the systems and a remote island was taken into consideration to study the most cost-effective configuration. **A. J. Peterson, R. Perez, B. Bailey, K. Elsholz, Solar Energy, 65, 227-235, (1999) [9]** the focus was on the optimal design of a solar-hydrogen hybrid based standalone system. The main goal was to achieve a minimum cost during 20 years system life. Two different configurations for fuel cell and photovoltaic hybrid system were considered. The two configurations were studied and optimized using Fuzzy Particle Swarm Optimization Algorithm where the main target was the efficiency and the cost.

J. **A. Razak, S. Kamaruzzaman, A. Yusoff, International Journal of Energy, 3(1), 77 – 81, (2007) [10]** The hybridization of diesel generator source system with renewable energy sources was explored and demonstrated. Results showed the possibility of renewable energy to substitute diesel as a source of power. This hybridization idea came to reduce the operation cost and air pollution. **W. Kellog, M. H. Nehrir, G. Venkataramanan, V. Gerez, Electric Power Systems Research, 39, 35-38, (1996) [11]** a solar and wind hybrid system was optimally designed for a remotely drip irrigation system. Cost optimization of the wind-solar hybrid system was taken into consideration to provide functional guidelines for the manufacturers of small-scale wind-solar hybrid systems.

In **S. Kamaruzzaman, Z. Azami, A. Yusoff , M. N. Zulkifli, A. R. Juhari, S. M. Nor, Transactions on Mathematics 4 (7),130-140 (2008) [12],** the feasibility analysis of renewable energy supply options electrifying a small hotel was presented. The paper investigated both technical and economical aspects. The paper showed that on-grid small wind turbine scheme was the most realistic supply option. The paper also showed that the Net Present Cost (NPC) of grid-connected wind energy scheme decreases when the carbon tax increases. The paper concluded that the implementation of the wind and hybrid wind/solar energy resources will increase in the future.

In **T. Lambert, HOMER: The Hybrid Optimization Model for Electrical Renewables [13]**, a methodology for calculating the sizing and optimizing a stand-alone SPV/diesel/battery hybrid system was developed. The methodology used particle swarm optimization algorithm to minimize the system cost. The work is applicable in the cases where reliable hybrid SPV/diesel system for small railway station is required. In **S. Kamel, C. Dahl, Agriculture in Egypt, Energy, 30, 1271-1281 (2005) [14],** the goal was to design an optimal economic renewable energy system.

2.3 Summary

We try to do this project by reading the above literature, and we have been able to make our project successful.

Chapter 03 Methodology

3.1 Introduction:

In this chapter we describe our project block diagram, circuit diagram, project working principle and final project view.

3.2 Block Diagram

The way of whole project works is generated power from wind energy. That store in a battery. Here we use wind turbine, charge controller unit, battery, inverter, switch, light and fan. All are in layout in below block diagram.

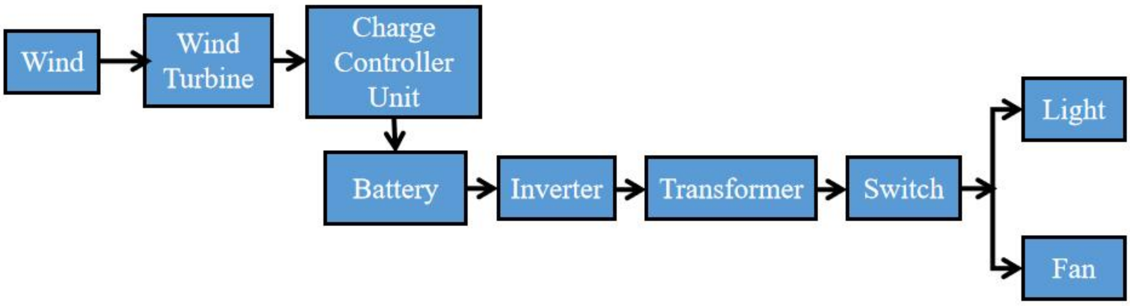

Figure 3.1: Block Diagram of Our System

3.3 Circuit Diagram

The schematic diagram here is representing the electrical circuit and the components of the project. Here we have used standardized symbols and lines.

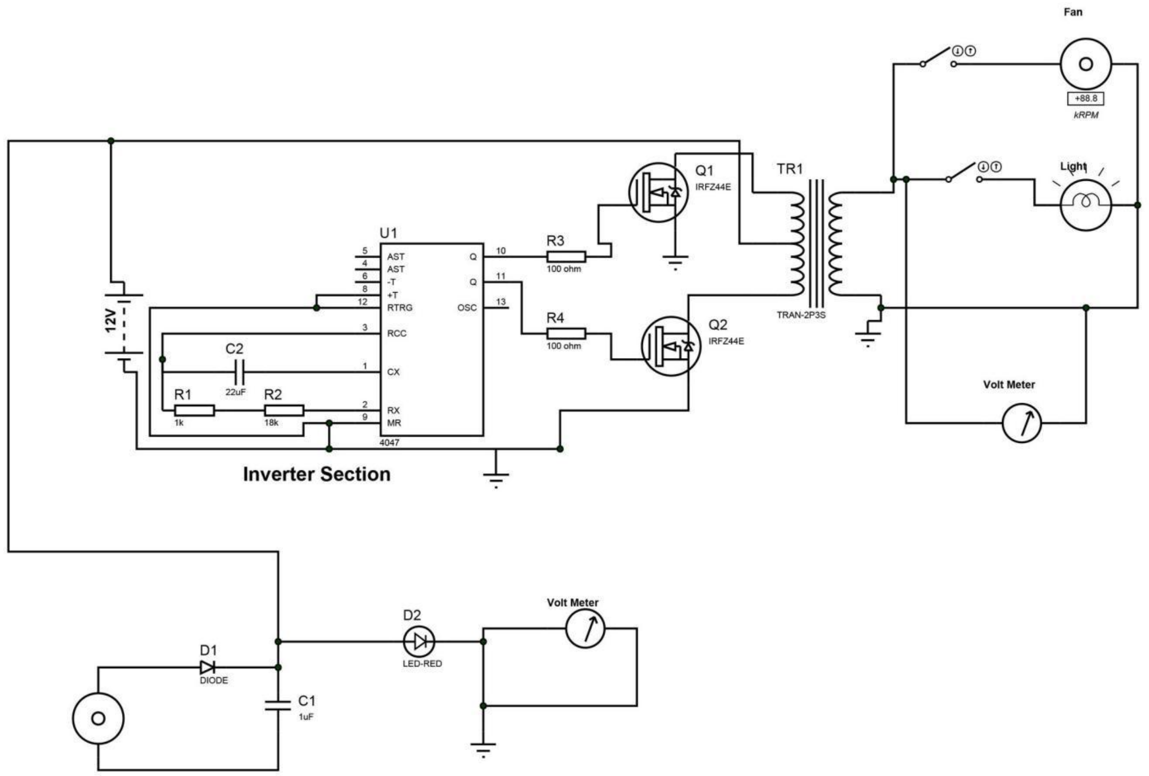

Figure 3.2: Circuit Diagram of Our Project

3.4 Working Principle

This **Wind Turbine Power Generation System** works on the principle of auto power generating from air sources. Here we use a turbine for power generating elements and restore it in a battery. In this project here store some power from wind turbine and store it in the battery. Here the inverter circuit converts DC current to AC 220 voltage which can be used to run a load in this project. The load will be operate from the AC power. The battery voltage shown in a meter and AC power will be show in a voltmeter. This is the main procedure of our project

3.5 Project Prototype Image

Figure 3.3: Project Prototype Image

3.6 Required Instruments

- Wind Turbine
- Voltage Regulator
- Inverter Circuit
- Transformer
- Digital Indicator
- Voltmeter
- Battery
- DC Motor

3.7 Wind Turbine

A wind turbine is a rotating machine which converts the kinetic energy in wind into mechanical energy. If the mechanical energy is then converted to electrical energy, the machine is called a wind generator, wind turbine, wind power unit (WPU), wind energy converter (WEC), or aero- generator.
Wind turbines can be separated into two types based by the axis in which the turbine rotates. Turbines that rotate around a horizontal axis are more common. Vertical-axis turbines are less frequently used.

Horizontal Axis Wind Turbines

Figure 3.4: Horizontal Axis wind Turbine

Horizontal-axis wind turbines (HAWT) have the main rotor shaft and electrical generator at the top of a tower, and must be pointed into the wind. Most have a gearbox, which turns the slow rotation of the blades into a quicker rotation that is more suitable to drive an electrical generator. Since a tower produces turbulence behind it, the turbine is usually pointed upwind of the tower. Turbine blades are made stiff to prevent the blades from being pushed into the tower by high winds. Additionally, the blades are placed a considerable distance in front of the tower and are sometimes tilted up a small amount.

Down wind machines have been built, despite the problem of turbulence, because they don't need an additional mechanism for keeping them in line with the wind, and because in high winds the blades can be allowed to bend which reduces their swept area and thus their wind resistance. Since cyclic (that is repetitive) turbulence may lead to fatigue failures most HAWTs are upwind machines.

HAWT FACILITY

- Variable blade pitch, which gives the turbine blades the optimum angle of attack. Allowing the angle of attack to be remotely adjusted gives greater control, so the turbine collects the maximum amount of wind energy for the time of day and season.

- The tall tower base allows access to stronger wind in sites with wind shear. In some wind shear sites, every ten meters up, the wind speed can increase by 20% and the power output by 34%.

- High efficiency, since the blades always move perpendicularly to the wind, receiving power through the whole rotation. In contrast, all vertical axis wind turbines, and most proposed airborne wind turbine designs, involve various types of reciprocating actions, requiring airfoil surfaces to backtrack against the wind for part of the cycle. Backtracking against the wind leads to inherently lower efficiency.

HAWT DISABILITY

- The tall towers and blades up to 90 meters long are difficult to transport. Transportation can now cost 20% of equipment costs.

- Tall HAWTs are difficult to install, needing very tall and expensive cranes and skilled operators.

- Massive tower construction is required to support the heavy blades, gearbox, and generator.

- Reflections from tall HAWTs may affect side lobes of radar installations creating signal clutter, although filtering can suppress it.
- Downwind variants suffer from fatigue and structural failure caused by turbulence when a blade passes through the tower's wind shadow (for this reason, the majority of HAWTs use an upwind design, with the rotor facing the wind in front of the tower).

- HAWTs require an additional yaw control mechanism to turn the blades toward the wind.

3.8 Transformer

A transformer is an electrical device used to change the value of an alternating voltage. Transformers are widely used in electrical work. They are encountered daily, in industrial, commercial and domestic situations. They vary in size from miniature units used in electronics to huge units used in power stations. The efficient transmission and distribution of electricity throughout the country would be impossible without the use of power transformers. Center Tapped Step down Transformer is a general purpose chassis mounting mains transformer. Transformer has 230V primary winding and center tapped secondary winding. The transformer has flying colored insulated connecting leads (Approx. 100 mm long). The Transformer act as step down transformer reducing AC - 230V to AC - 12V. The Transformer gives outputs of 12V, 12V and 0V. The Transformer's construction is written below with details of Solid Core and Winding. The transformer is a static electrical device that transfers energy by inductive coupling between its winding circuits. A varying current in the primary winding creates a varying magnetic flux in the transformer's core and thus a varying magnetic flux through the secondary winding.

Figure 3.5: Step up Transformer

This varying magnetic flux induces a varying electromotive force (E.M.F) or voltage in the secondary winding. The transformer has cores made of high permeability silicon steel. The steel has a permeability many times that of free space and the core thus serves to greatly reduce the magnetizing current and confine the flux to a path which closely couples the winding.

Full Wave Bridge Rectifier

This type of single-phase rectifier uses four individual rectifying diodes connected in a closed loop “bridge” configuration to produce the desired output. The main advantage of this bridge circuit is that it does not require a special Centre tapped transformer, thereby reducing its size and cost. The single secondary winding is connected to one side of the diode bridge network and the load to the other side as shown below. The filtered full wave rectifier is created from the FWR by adding a capacitor across the output.

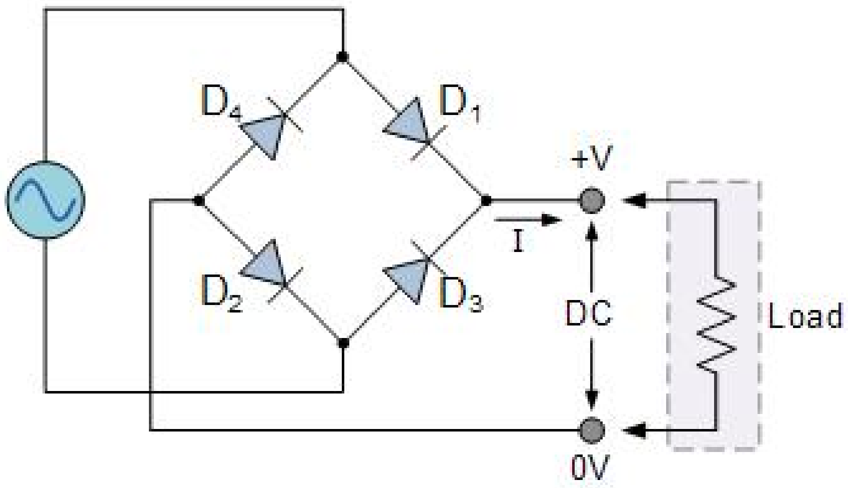

Figure 3.6: Full Wave Bridge Rectifier

The four diodes label led D1 to D4 are arranged in "series pairs" with only two diodes conducting current during each half cycle. During the positive half cycle of the supply, diodes D1 and D2 conduct in series while diodes D3 and D4 are reverse biased and the current flows through the load as shown below.

The Positive half Cycle: During the negative half cycle of the supply, diodes D3 and D4 conduct in series, but diodes D1 and D2 switch "OFF" as they are now reverse biased. The current flowing through the load is the same direction as before.

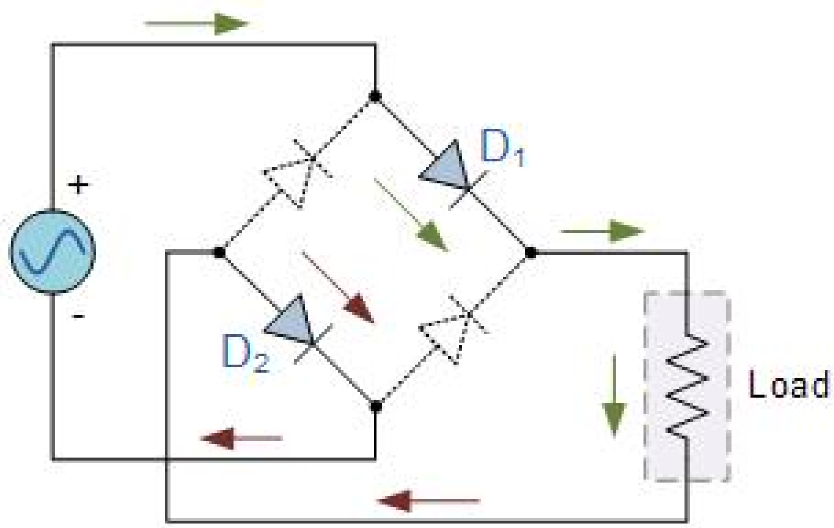

Figure 3.7: Positive Half Cycle of Full Wave Bridge Rectifier

The Negative Cycle:

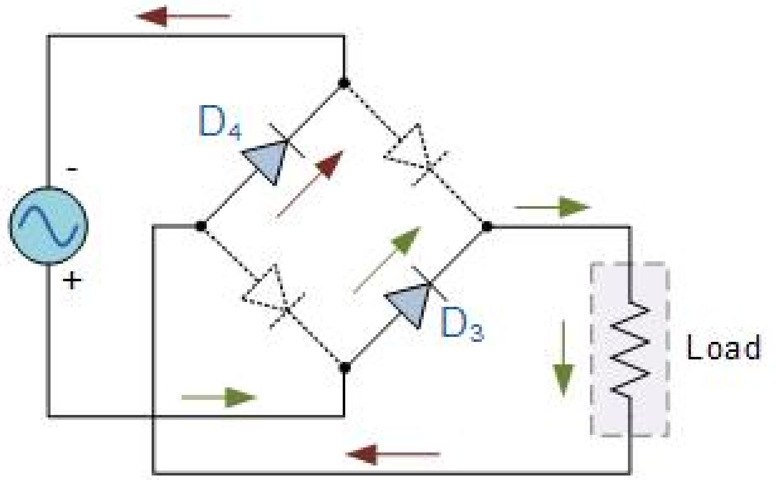

Figure 3.8: Negative Half Cycle of Full Wave Bridge Rectifier

As the current flowing through the load is unidirectional, so the voltage developed across the load is also unidirectional the same as for the previous two diode full-wave rectifier.

3.9 Mini DC Motor

An electric motor is a machine that converts electrical energy to mechanical energy. An electric generator is a machine that converts mechanical energy to electrical energy.

Figure 3.9: DC Motor

SPECIFICATIONS:

- Output: 12 Volts DC @ 1000 RPM
- Voltage output: 0-50VDC
- Maximum Generator Output: 15 watts

FEATURES

- Optimized for wind turbine speeds (it requires significantly lower RPMs to generate power than most motors/generators)
- 1/8" (3mm shaft diameter)
- The shaft has a flat spot for attaching the blade
- Generates 12 Volts at 1000 rpm
- Two 3/16 spade terminals for power connection
- Includes separate blocking diode

3.10 Inverter Circuit

- Power: 100W
- Input: DC12V
- Output: 0-110-220V
- Static no-load current: 0.1A or so
- Output frequency waveform: about 15KHZ high-frequency square wave
- Protection: No protection
- PCB board with military-grade board, the size of 6.6 cm * 5.3 cm

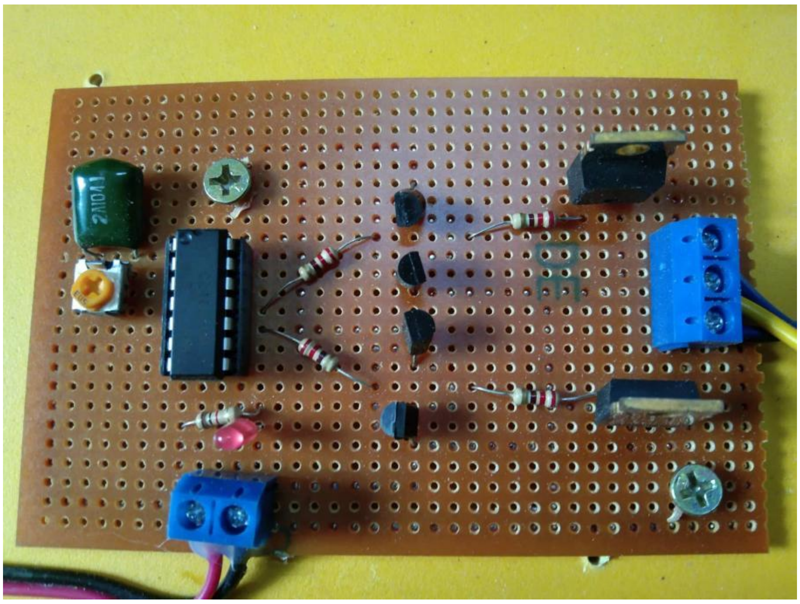

Figure 3.10: Inverter Circuit

Features:

The product should be widely used, the product has high energy efficiency, long life, low power consumption, easy to use protection, energy saving and durable, wild, night camp, night market vendors, driving home emergency energy is good helper. Manufacturers control cabinet-matched products and so on.

1. This board has a high-frequency square wave AC output; it is not usually with sensitive electrical! "" Such as: motor fan coil transformer etc. " Other: may not accept general resistance-type speech-type small electrical equipment, cheap resistance-box LED light etc.
2. Load electronic products (eg: power-saving lamps LED lights mobile phone charger DVD set-top boxes etc.) It is recommended that the high-frequency rectifier board be unplugged or small pieces of low-voltage gear, such as: 110V

3. In case of use, regular load work for consideration of power supply does not have to be carried out regularly for long periods of time. May cause artificial failure at first.

4. The power supply cannot be reversed, and other power supplies and power cables must be large enough
5. Do not overload or short circuit as there is no safety output. Out. Output high-frequency square-wave AC voltage will not measure or display much lower or higher than a normal multimeter (not accurate, not actual voltage)

3.11 5V REGULATOR IC

Voltage sources in a circuit may have fluctuations resulting in not providing fixed voltage outputs. A voltage regulator IC maintains the output voltage at a constant value. 7805 IC, a member of 78xx series of fixed linear voltage regulators used to maintain such fluctuations, is a popular voltage regulator integrated circuit (IC). The xx in 78xx indicates the output voltage it provides. 7805 IC provides +5 volts regulated power supply with provisions to add a heat sink.

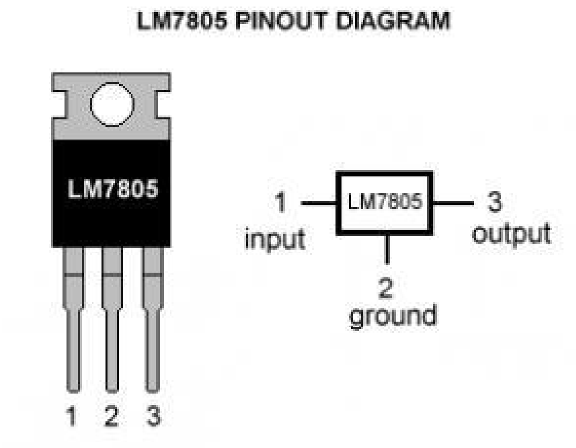

Figure 3.11: 5V Regulator IC

7805 IC Rating -

- Input voltage range 7V- 35V
- Current rating IC = 1A
- Output voltage range V Max=5.2V ,V Min=4.8V

3.12 12v BATTERY

A twelve-volt battery has six single cells in series producing a fully charged output voltage of 12.6 volts. A battery cell consists of two lead plates a positive plate covered with a paste of lead dioxide and a negative made of sponge lead, with an insulating material (separator) in between.

Quick Details

- Nominal Capacity: 200AH
- rechargeable 12v dc battery pack: 1PCS/CTN (according to the actual situation)
- Production Capacity: rechargeable 12v dc battery pack:50000PCS/Month
- Total Workers: 300
- QC Stuffs: 12
- Technical Engineers: 5

- Battery Production Lines: 5
- Factory space: 6000m2
- Maintenance Type: Free
- Voltage: 12V

Figure 3.12: 12V Battery

3.13 Digital Volt-ammeter

A voltmeter is an instrument used for measuring electric potential difference between two points in an electric circuit. It is connected in parallel. It usually has a high resistance so that it takes negligible current from the circuit. An ammeter (abbreviation of Ampere meter) is a measuring instrument used to measure the current in a circuit. Electric currents are measured in Amperes (A), hence the name. The ammeter is usually connected in series with the circuit in which the current is to be measured. An ammeter usually has low resistance so that it does not cause a significant voltage drop in the circuit being measured.

Features:

- Display color: Red & Blue LED (dual display).

- Display: 0.28″ LED digital.
- Operating voltage: DC 4.5 ~ 30V.
- Measure voltage: DC 0 ~ 100V.
- Minimum resolution (V): 0.1V.
- Refresh rate: ≥500ms / times.
- Measure accuracy: 1% (± 1 digit).
- Minimum resolution (A): 0.01A.
- Operating Current: <20mA.
- Measure current: 10A (direct measurement, built-in shunt).
- Operating temperature: -10 to 65°c.
- Operating Humidity: 10 to 80% (non-condensing).
- Mounting cutout: 45.5mm x 26.1mm.

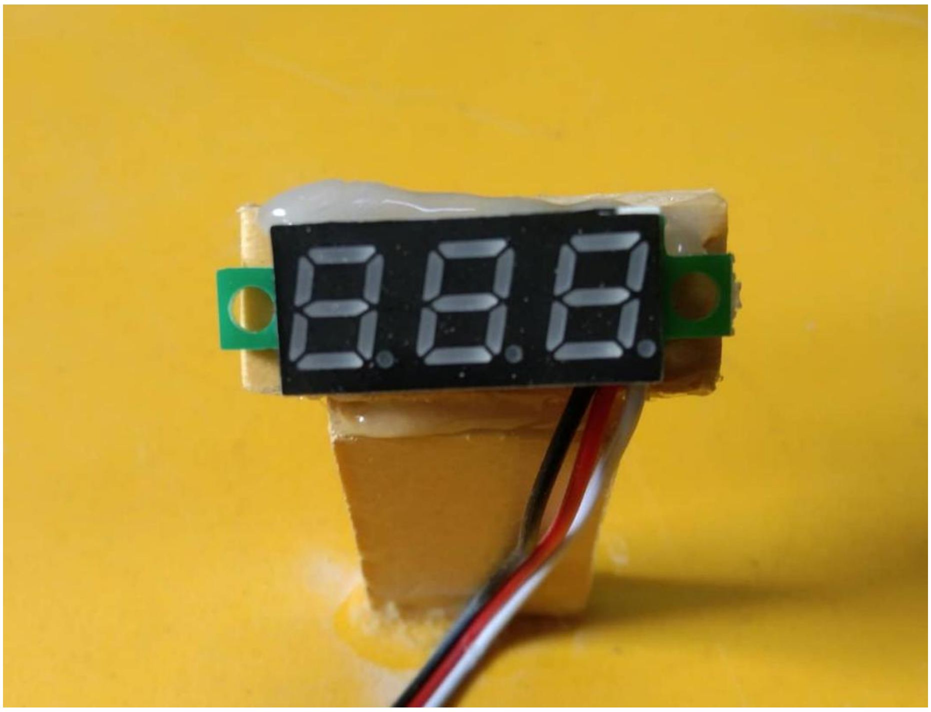

Figure 3.13: Mini Digital Voltmeter

3.14 Capacitor

Capacitor is an electronic component that stores electric charge. The capacitor is made of 2 close conductors (usually plates) that are separated by a dielectric material. The plates accumulate electric charge when connected to power source. One plate accumulates positive charge and the other plate accumulates negative charge. The capacitance is the amount of electric charge that is stored in the capacitor at voltage of 1 Volt. The capacitance is measured in units of (F). The capacitor disconnects current in direct current (DC) circuits and short circuit in alternating current (AC) circuits.

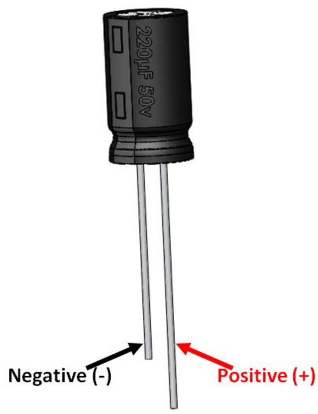

Figure 3.14: Capacitor Pin Out

Pin Configuration

The Electrolytic Capacitors have polarity. Meaning they have a positive and negative pin. The pin which is long is the positive pin and the pin which is short is the negative pin**.** You can also identify the polarity using the negative strip on the capacitor label. As shown in the picture above the negative pin will be directly under the negative symbol.

Features

- Capacitor Type - Electrolytic
- Has a high range of capacitance value starting from 0.01uF to 10000uF
- Has a high range of voltage value starting from 16V to 450V
- Can withstand a maximum of 105°C temperature

3.15 Resistor

A **resistor** is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses. High-power resistors that can dissipate many watts of electrical power as heat, may be used as part of motor controls, in power distribution

systems, or as test loads for generators. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage.
Variable resistors can be used to adjust circuit elements (such as a volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity.

Two typical schematic diagram symbols are as follows:

(a) resistor, (b) rheostat (variable resistor), and (c) potentiometer

Figure 3.15: IEC resistor symbol

The notation to state a resistor's value in a circuit diagram varies.

One common scheme is the RKM code following IEC 60062. It avoids using a decimal separator and replaces the decimal separator with a letter loosely associated with SI prefixes corresponding with the part's resistance. For example, *8K2* as part marking code, in a circuit diagram or in a bill of materials (BOM) indicates a resistor value of 8.2 kΩ. Additional zeros imply a tighter tolerance, for example *15M0* for three significant digits. When the value can be expressed without the need for a prefix (that is, multiplication 1), an "R" is used instead of the decimal separator. For example, *1R2* indicates 1.2 Ω, and *18R* indicates 18 Ω.

Specifications:

- Resistance: 220 Ohms
- Power (Watts): 0.25W, 1/4W
- Temperature Coefficient: 350ppm/Celsius
- Tolerance: +/- 5%
- Case: Axial

3.16 Proteus Software

The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronics design engineers and technicians to create schematics and electronics prints for manufacturing printed circuit boards. The first version of what is now the Proteus Design Suite was called PC-B and was written by the company chairman, John Jameson, for DOS in 1988. Schematic Capture support followed in 1990 with a port to the Windows environment shortly thereafter. Mixed mode SPICE Simulation was first integrated into Proteus in 1996 and micro controller simulation then arrived in Proteus in 1998.

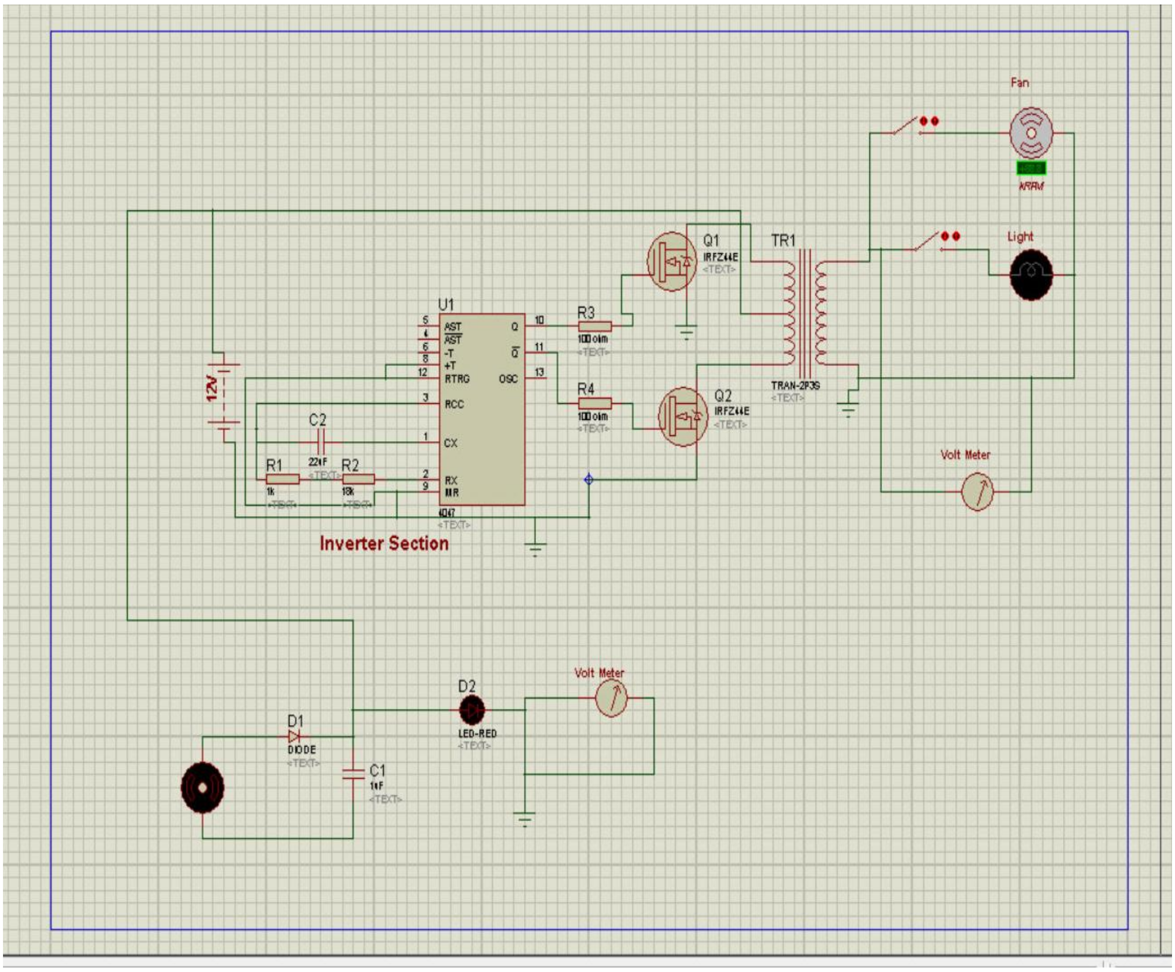

Figure 3.16: Our Project Design in Proteus Software

Chapter 4 Result and Discussion

4.1 RESULT

After making our project we observe it very careful. It works as we desire. Our project give output perfectly and all equipment are work perfectly. We check how much it works and we get perfect output from this project.

- Firstly, when the wind blows on the wind turbine, the turbine will generate charge here and it will also store the charge on the battery.
- After conversion from DC to AC via inverter circuit then it will able to ON AC load of this system.
- A display will show the battery charge and voltmeter show inverter power.

4.2 Discussion

While working on our project, we did face some difficulties as it is a very complex system but the end results, we came up with were quite satisfactory. We have put the whole system through several tasks to validate our work and also have taken necessary notes for future improvements. Some future recommendations that we have involves improvement in system design and wiring, adding features for more efficient.

4.3 Facility

There are many advantages of our system because of its accuracy. Some of the advantages are pointed out below:

- Simple air produce the power.
- No extra cost include here.
- No Oil consumption
- Less skill technicians is sufficient to operate.
- Installation is simplified very much.
- Less time and more profit.
- Simple construction.

4.4 Limitations

Though this project has many advantages but it has some limitations as well and they are listed below:

- Used cheap Chinese products for the prototype so there's some processing delay present in the circuit
- This project can now be only used for small scale purposes
- In air shortage situation it will not produce energy;

4.5 Applications

The application areas for this system in this modern and practical world are huge and some of these are given below:

- It can be used for natural power generation.
- It can used in road side.
- It can use alternative power generator.

Chapter 5 Conclusion

5.1 Conclusion

In this work a wind power generation system is designed which shows different characteristics of the system. The developed prototype exhibits the expected results. Further modifications and working limitations will put this work in the main league of use. This concept saves time & energy which leads to efficient working. The study of wind turbine and its characteristics showed that how it can be properly designed and used to get the maximum output. The power electronic circuitries have helped the concept of wind power a lot. The constructional work or the infrastructural work demands efficient and user-friendly system which will produce energy from wind.

5.2 Future Scope of Work

As we have already discussed about the limitations of this system so definitely there's room for improvement and thus we have lots of future scope of work available to us for this system. Some of these are listed below:

- We can add a more power generator option in future.
- In future we can use various sensor to measure current, voltage and frequency from this system.
- In future we can add lot load control which can control this load with lot far away from home.

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