Wind- Diesel Hybrid Power Generation System

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Abstract -- There are numerous issues acted by customary vitality such like oil supply weakness, outrageous contamination, and environmental change chances because of non-renewable energy source consuming. In this way, searching for elective non-traditional vitality assets has turned into a pressing issue. A standout amongst the most prevalent non-ordinary power assets are sun oriented vitality control plants which change over the sun based vitality or sun based warmth to power. However, the burden is that it doesn't work when there is shady or blustery climate. This has made the need to consolidate sunlight based vitality with twist vitality to get a strong power source known as a crossover sun based breeze control age framework. The recreation of the control calculation actualized by the microcontroller demonstrates the productivity and the materialness of the proposed framework. To confirm the execution of the proposed framework, a model is gathered in the labs of Electrical and PC Building division in Effat College, Jeddah, KSA. The proposed framework offers effective highlights in the region of savvy matrix. Fig. 1 demonstrates a schematic for the equipment square Chart utilized as a part of this exploration.

Index Terms- Renewable Energy- Hybrid Power.

I. INTRODUCTION

There are numerous issues acted by traditional vitality such like oil supply instability, extraordinary contamination, and environmental change chances because of non-renewable energy source consuming. In this manner, searching for elective non-ordinary vitality assets has turned into a critical issue. A standout amongst the most well-known non-regular power assets are sunlight based vitality control plants which change over the sun based vitality or sun based warmth to power. However, the drawback is that it doesn't work when there is overcast or blustery climate. In many nations the pinnacle working circumstances for wind and universes happen at various circumstances of the day and year, in this way, half and half frameworks will probably create control when it is required. This has made the need to consolidate sun powered vitality with twist vitality to get a strong power source known as a cross breed sunlight based breeze control age framework [1].

The mixture framework that consolidates wind, sunlight based, and diesel control age framework has turned out to be well known in view of its points of interest over either single framework. The principle points of interest of half breed frameworks are fuel sparing, bring down air defilement, funds in upkeep, noiseless frameworks, and association with other power supplies which empower higher administration quality than customary single-source age frameworks. The fundamental parts of half and half frameworks are: the power sources, the capacity gadgets, the power administration focus, and screen and control gadgets [2].

A stand-alone power framework, which works "off-matrix", is a decent answer for providing energy to rustic region where it is difficult to be associated with the principle network. There are two kinds of remain solitary photovoltaic power frameworks: coordinate coupled framework and independent framework. In coordinate coupled framework, there is no capacity gadgets and the sun based board is associated with a dc stack. In remain solitary photovoltaic framework, there are capacity gadgets in light of the fact that the request from the heap does not generally break even with the sunlight based board limit [3].

This paper proposes an adjustment of a half breed sun powered breeze control age framework in which the stream of energy from various sources is checked and controlled by utilizing a remote far off observing station and microcontroller. Notwithstanding sun powered boards and wind turbines, a reinforcement remain by diesel motor is utilized to supply control just when there is a deficiency in the power supply. There are two principle preferences of the proposed framework in this examination contrasted with others. To begin with, the vitality of the proposed framework is utilized shrewdly and proficiently by checking the heap control and the accessible sustainable power

source to characterize the amount of required power and to choose the best accessible source. Also, extra batteries are utilized as a dumped stack in the proposed framework, which can be utilized if there is a lack in the sustainable power source to limit the utilization of the diesel motor. Also, a remote observing framework will be utilized to help in self-investigating and a quick alert framework, which will limit upkeep endeavors. The reproduction of the control calculation actualized by the microcontroller demonstrates the proficiency and the

Applicability of the proposed system. To verify the usage of the proposed framework, a model is collected in the labs of Electrical and PC Designing office in Effat College, Jeddah, KSA. The proposed framework offers effective highlights in the territory of keen network [4,5].

The commitment of this work are:

(a) Efficiently observing the heap control and the accessible sustainable power source to characterize the amount of required power and to choose the best accessible source.

(b) Wireless checking framework will be utilized to help self-investigating and alerts for which it will limit the upkeep endeavors archive is a case of the coveted design for a specialized work. It contains data with respect to work area distributing design, type sizes, and typefaces. Style decides are given that disclose how to deal with conditions, units, figures, tables, condensing, and acronyms. Segments are likewise committed to the arrangement of affirmations, references, and creators' memoirs.

II. SCHEMES FOR CROSSOVER POWER FRAMEWORK

Crossover Sunlight based Breeze Diesel Power Age framework has distinctive schematics that every ha its own particular points of interest and execution. In the principal plot represented in Fig.1, the battery is charged specifically from the photovoltaic (PV) module and the breeze turbine where every ha its own charge controller. The heap gets its required power from all vitality sources by means of a reversed to change over the DC to air conditioning.

In the second schematic appeared in Fig. 2, the battery is charged in comparable route to the main plan however the main contrast is that the heap gets its required power by means of the battery not others. Likewise, there is no dump stack for this situation.

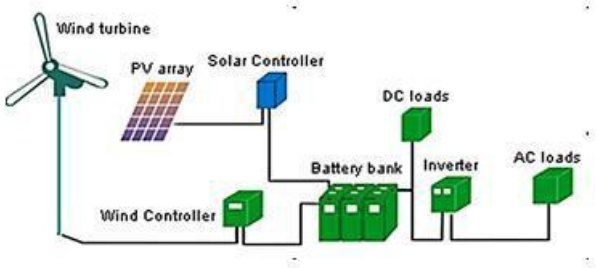

Fig. 1. Schematic used for hybrid power generation systems

III. HARDWARE BLOCK DIAGRAM

The system studied in this paper consists of:

- Energy sources: wind turbine, PV module, diesel generator set
- Load: DC Load, AC Load, dump load
- Storage device: Batteries
- Microcontroller: Arduino Uno
- Communication device: Xbee
- Sensors: voltage sensors, current sensors, fuel sensors, wind sensor, and light intensity sensors.

The charge controller receives the power from the energy sources (PV module and the wind turbine) and delivers the power to the battery if it is not fully charged, to the dump load if the battery is fully charged. If the battery is not fully charged and the output power from the renewable energy sources is not satisfactory, the diesel engine is turned on to supply the load with the needed power until the battery is fully charged again [6].

For wind turbine, if the breeze sensor perusing does not coordinate the correct measure of vitality delivered by wind turbine, the controller will send an order to the generator housed in the breeze turbine to close off. For the PV module, if the light force sensor perusing

does not coordinate the measure of energy created by the PV module, the controller will send an order to the distinction the PV module from the charge controller. In the two cases there may be mechanical or/and electrical issues which require the upkeep group to investigate these gadgets [7].

The system will take the power input from both the wind turbine and solar panel and send them to the charge controller. The charge controller will direct the power to the battery or the dump load battery based on battery voltage input. When the battery voltage sensor inputs data that the battery is full, the charge controller will switch to dump load. However, when the battery is undercharged, the diesel engine will be switched on to supply the load with the power needed until the battery is charged again [8].

Moreover, the other sensors will be used for the troubleshooting purpose. For example, the system will be able to identify problem in the wind turbine or the solar panel. Such as when the wind speed and the light intensity sensors reading do not match with the input power given to the system that is read by the voltage and current sensors.

Furthermore, the fuel level sensor will sense the diesel engine is running out of fuel. This data of identified problems in the system will be sent to the wireless (Xbee) block where it will report the problems to the monitoring station. Below is Fig.4, an illustration figure for the output of the system:

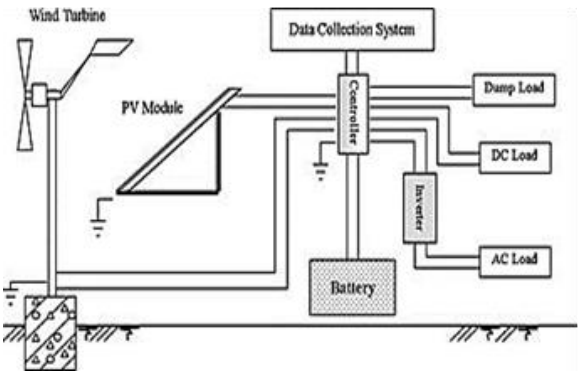

Fig.3. Schematic used for hybrid power generation system

Moreover, the other sensors will be used for the troubleshooting purpose. For example, the system will be able to identify problem in the wind turbine or the solar panel. Such as when the wind speed and the light intensity sensors reading do not match with the input power given to the system that is read by the voltage and current sensors. Furthermore, the fuel level sensor will sense the diesel engine is running out of fuel. This data of identified problems in the system will be sent to the wireless (Xbee) block where it will report the problems to the monitoring station. Below is Fig.4, an illustration figure for the output of the system:

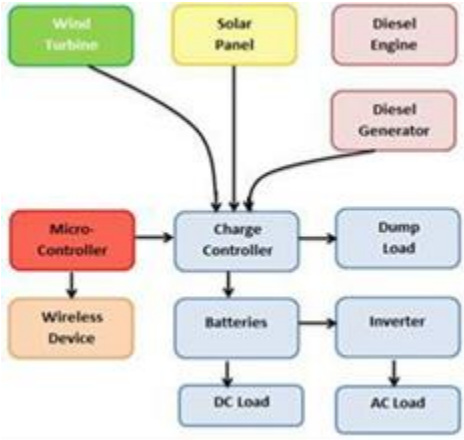

Fig. 4. Hardware Block Diagram used in this research

IV. FEASIBILITY STUDY

The Practicality examine was directed at Kuwait in two unique areas, Massila and Mishref. The two areas has distinctive environment, Massila is Shoreline zone with a Scope of 29.261243 and Longitude of 48.09042 while Mishref is local location with scope of 29.269329 and longitude of 48.068104. Kuwait has height of 55 meters. Absolutely, the breeze turbine and sun powered board will require an open region to keep away from shades or high building that hinders the breeze.

Additionally, to check that the winds speed of the locations and the starting speed needed for the wind turbine. Moreover, the sun light peak hours over the year and solar radiation needed to be checked. Therefore, Kuwait weather annual report was checked and below is the statics. The wind data as wind speed helps to locate a suitable site for wind turbine since the

energy in the wind increases with the cube of the wind speed.

For the PV module, if the light intensity sensor reading does not match the amount of power produced by the PV module, the controller will send a command to the disconnect the PV module from the charge controller. In both cases there might be mechanical or/and electrical problems which require the maintenance team to troubleshoot these devices. The charge controller will direct the power to the battery or the dump load battery based on battery voltage input

Table I : Wind Data Near Kuwait Airport

Month of year	Dominant direction	Wind probability = 4 Beaufort (%)	Average wind speed (kts)
January		34	9
February		47	11
March		43	11
April		48	11
May		45	11
June		69	14
July		54	12
August		50	11
September		45	11
October		37	10
November		28	9
December		33	9
SUM		45	10

There are certain basic requirements to follow regarding choosing the best location for wind placed such as high elevations has better wind speed and lower turbulence, avoid areas where there is woodlands or buildings and less altitude is better for performance.

For solar panels, there basic requirements regarding site selection such as solar radiation in the location. Based on Kuwait International Airport weather station findings, it was reported that Kuwait has an average solar intake of 9-11 hours per day. Fig. 5 illustrates the reported measured solar radiation (MJ/m2) in Kuwait.

This figure clearly states that solar panels will work efficiently in most periods of the year.

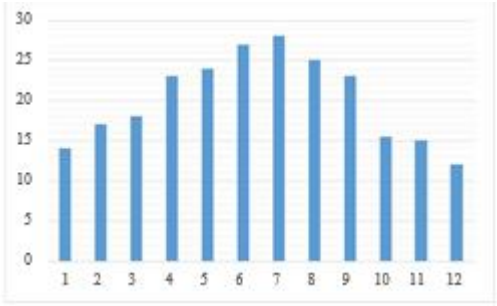

Fig. 5 Monthly Solar radiation (MJ/m2) in Kuwait.

The second parameter is the sunlight based board tilt edge, the ideal sun oriented point should be utilized as a part of request to substitute for missing the sun based tracker framework. In this manner, Sun based Electric Handbook mini-computer was utilized to get the edges required. This adding machine depends on the distinction in the sun tallness on step by step premise. As a delineation, the sun is at its most elevated at sun oriented twelve every day and this adding machine demonstrates the point around then of day with the goal that the irradiance from the sun is the most noteworthy, consequently most power produced.

TABLE II : Optimum Tilt Of Solar Panels (In Degrees) By Month In Sabah As Salim

month	1	2	3	4	5	6	7	8	9	10	11	12
tilt angle	45	53	62	69	77	84	77	79	61	63	45	38

V. FRAMEWORK CALCULATIONS

There are two calculations put away in the microcontroller; control calculation and investigating calculations. The control calculation which controls the power stream among the parts of the half breed framework is as per the following:

(a) Check the heap status; for stack case hop to (c). For no heap case, the battery is associated with charge the controller and the charging procedure begins when there is an excess of vitality created by the sustainable power source assets.

(b)When the battery is completely charged, the additional vitality is coordinated to the landfill stack.

(c)For stack case, there are three conceivable condition of charges (SOC) for the battery that can be chosen by the yield of the voltage sensor at the battery terminals. The three modes are: Full, Deplete, and Standard, when the battery terminal voltage is ≥ 98%, <20%, and between 21%-97%, individually.

(d)In Full SOC, the stupid load is exchanged on till the battery achieves its standard SOC%.

(e)In Deplete SOC, the battery is associated with the charge controller where the vitality is provided from sustainable power source assets when they are accessible, generally the diesel generator set turned on.

(f) In Standard SOC, the charger controller is providing vitality to the battery from the sustainable power source as it were.

Case#5, the fuel level for the diesel engine is running out of the storage tank; Case#6. When the light intensity readings do not match with the voltage and current readings for the solar panel, and when the wind speed readings do not match the voltage and current sensor readings for the wind turbine, and when the fuel level for the diesel engine is running out of the storage tank. The system will be able to identify problem in the wind turbine or the solar panel. Such as when the wind speed and the light intensity sensors reading do not match with the input power given to the system that is read by the voltage and current sensors

Likewise, for each situation the framework will respond in an unexpected way, as in case#1, the microcontroller will change sources. Additionally, in case#5 the framework will report the absence of fuel at 10%. Toward the end, case#6, the framework will turn off. The following is Fig. 6, which unmistakably shows the dataflow graph of the program introduced in the microcontroller.

VI. MODEL ESTIMATING

A model of half and half framework was intended to check the task of the proposed technique for the control and screen calculation. The power rating of every segment is figured to fulfill the heap prerequisite as indicated by the accessible vitality source.

A. Framework Load

The heap comprises of air conditioning and DC stack. The Air conditioner stack is spoken to by four light each 100W/110VAC, while the DC stack is spoken to by one water pump of 120 W/12VDC. The aggregate load control is 520 W. Accepting that the air conditioner stack and the DC stack laboring for 3 hours every day, the vitality devoured of the air conditioner and DC stack are 1200Wh/day and 360 WH/day, separately. Appropriately, the aggregate vitality devoured by the aggregate load every day is 1560 WH/day, i.e. 569.4 KWH/year

B. Framework Vitality Sources

The framework vitality sources in the proposed framework comprises of Sun oriented boards, wind turbine, and diesel motor generator. The sun based boards measuring relies upon the daylight of the site where they will be introduced. Table III demonstrates the daylight information in Kuwait, where Fiery debris is Normal Daylight hours/day, ADH is Normal Sunshine Hour and minutes/Day, and SDH is Sun height at sunlight based twelve on the 21st day (o). The Powder demonstrates that the Fiery remains differs in the vicinity of 7 and 11 hours/day. The yearly normal daylight is 9 hours/day. Since the misfortunes in wire and association is around 25%, along these lines, the aggregate sun oriented influence after rectification factor is 1560 x 1.25 = 1950 WH/day. Sun oriented exhibit estimate in the wake of figuring sun hour is 1950/9 = 216.67

TABLE III Sun Light Data In Kuwait

Month	ASH	ADH	SDH
Jan.	8:00	10:28	40.8
Feb.	8:55	11:06	50.1
Mar.	9:00	11:56	61
Apr.	8:00	12:50	72.7
May	10:00	13:35	80.9
June	10:00	13:57	84.2
July	10:00	13:47	81.1

Aug.	11:00	13:09	72.9
Sep.	10:00	12:17	61.4
Oct.	10:00	11:23	49.9
Nov.	9:00	10:38	40.8
Dec.	7:00	10:17	37.4
Annual	9:00	12:00	61.1

The yield of a breeze turbine depends upon the turbine's size and the breeze's speed through the rotor. The traverse of the breeze turbine you require depends upon the application. Little turbines stretch out in measure from 20 watts to 100 kilowatts (kW). Littler scale turbines stretch out in measure under 500 W are used as a piece of an arrangement of employments, for instance, charging batteries for recreational vehicles. The maximal achievable extraction of bend control by a breeze turbine is 59% of the total theoretical breeze control (Betz Law). The turbine control is (around) with respect to the third vitality of speed stays as a result of rotor edge disintegration and drag, gearbox setbacks, generator and converter mishaps, reduce the impact passed on by a breeze turbine.

For rotor measure, a turbine can catch enough vitality from the breeze when the turbine edges are long. As a rule the yield vitality is specifically corresponding to the twofold of the rotor diameterr. Table IV demonstrates the rotor measure and the most extreme power yield, where D and P are the rotor breadth and the power yield, individually.

TABLE IV The Rotor Size & Max. Power Output

D (meters)	10	17	28	33	40	44	48
P (kW)	25	100	250	300	550	600	750

To determine the appropriate size of wind turbine to use, divide monthly electricity consumption in kilowatt-hours (kWh) by 12. Then, compare this total to estimates of the power production for different wind turbines. To get a preliminary estimate of the performance of a particular wind turbine, use the following formula: = 1.64 2 3

Where, is Annual energy output (KWH/year), D is rotor diameter (m), and is the annual average wind speed (m/s). The power of wind turbines in watts (P) depends on the wind speed in m/s (V) according the relation.

Where, is the air thickness in Kg/m3 (around 1.225 kg/m3 adrift level, less higher up), is the effectiveness of the windmill (when all is said in done under 40%), and is the cleared rotor region (m2).

Betz' law says that you can just change over under 59% of the motor vitality in the breeze to mechanical vitality utilizing a breeze turbine. The mechanical effectiveness of the turbine is biggest (around 44 %) at a breeze speed around nearly 9 m/s. This is a think decision by the architects who planned the turbine.

The essentialness of the pile is 569.4 KWH/year, and the typical breeze speed in Kuwait is 10 Cluster which is indistinguishable to 11 mph. Properly, the SEW_1000 wind turbine which has a 2KW assessed control, 12VDC, 41A evaluated present, 82A short out present, 2.5m/s starting speed, and 13m/s assessed speed.

Wind turbine is expected to be under a store while working. If a breeze turbine works under no store in high breeze conditions, it can act normally destruct. Consequently, a dumb load should be use to guarantee the breeze turbine. Since a 12VDC battery is used as a piece of the proposed system, and the most outrageous current of the turbine is 82A, by then the best vitality of the breeze turbine to be dumbed is 82* 14 = 1148W (14V is used as the voltage of the battery when it is totally charged).C. Batteries

It is essential to choose the correct rating for the batteries to guarantee that the heaps are sufficiently provided food by the battery for the timeframe for which it is composed. The heap as ascertained is 1560WH/day for 3 hours every day. To ascertain the ampere-hour (AH) of a 12V battery required to run the heap the entire day

The factor 1.1 is utilized to make up for misfortunes. In this framework, control sonic 12V/145AH fixed lead corrosive battery is utilized.

VII. TESTING AND CHECK

A model is worked by the arrangement system cleared up in past fragments. Fig. 6 shows the schematic blueprint for the general affiliation. Also, the sun fueled board and the breeze turbine were totally isolated from the controller to have the ability to test its execution. In addition, there are a couple of security measures, for instance, to totally isolate the daylight based board/bend turbine from the charge controller before ousting the battery from the charge controller, and to dependably interface the battery initially to the charge controller.

The microcontroller is the supervisor of all activities in the half breed framework since it controls the power stream among all components and send all data of the framework utilizing the information got by Xbee. The task of every part and sensor associated with the microcontroller was tried.

The charge controller was tried to check its activity in various cases. Amid the test, the battery was purposefully not completely charged to stay away from any harm to the battery when there is a short out. The breeze sensor was perused by interfacing it to Arduino through Simple to Advanced Converter (ADC). The fuel sensor was utilized to check the level of the fuel in the diesel motor. When testing any part associating with the diesel motor it was turned off before interfacing the heap.

For Xbee arrange, terminal programming was utilized to design the Xbee modules; the Xbee module was associated with Xbee adventurer and associated with the PC. A serial port arrangement was settled to distinguish the Xbee port to the Terminal programming.

From Fig. 7, the Xbee module parameters were perused by terminal programming, it demonstrates the Channel, ID and the organizer. Both Xbee modules were settled to have a similar variant, ID and channel, while one of them is set to be the facilitator. In this manner, when the diesel comes up short on fuel, the heap will close down coming about to loss of 33% of the heap utilize. Since the heap is basic, 33% loss of energy for each day isn't adequate in any way; in this manner nonstop observing is required.

The loss of this association will lead the diesel to keep up a battery charging mode until the point when the association is settled.

On the off chance that there was no investigating program, it will devour the fuel in the diesel tank for a drawn out stretch of time until the point when support gathers. Thus, since the heap will devour the fuel quicker in the diesel motor, the framework will require more support. However, keeping up the association in the task, will prompt an adequate working framework, without the need of constant upkeep.

VIII. CONCLUSION

Half breed influence age framework is thought to be essential for Center East to practice environmental safety with clean vitality exceptionally that the zone is rich with sustainable power sources. The proposed crossover framework is an extraordinary framework in outline, development, investigating with numerous points of interest, for example, high level of exactness and minimal effort. The loss of this connection will lead the diesel to maintain a battery charging mode until the connection is fixed.

In case there was no troubleshooting program, it will consume the fuel in the diesel tank for a long period of time until maintenance accrues. Hence, since the load will consume the fuel faster in the diesel engine, the system will require more maintenance. But maintaining the connection in the project, will lead to a sufficient working system, without the need of continuous maintenance.

The present work gives a half and half framework and technique for creating power off network. The proposed half and half framework is proficient to consolidate the sun based power, wind vitality and diesel motor to furnish remote territory with power.

Additionally, all information from sensors in the framework are gathered by Xbee are utilized to find blame area to enable blame to analyze by the upkeep investigating program transferred in the microcontroller. The support investigating program was intended to keep up a power supply hotspot for a basic load.

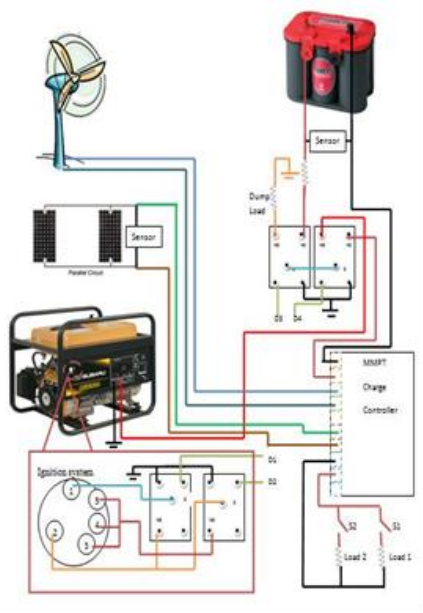

Fig.6 the prototype overall schematic diagram

The charge controller was tested to check its operation in different cases. During the test, the battery was intentionally not fully charged to avoid any damage to the battery when there is a short circuit. The wind sensor was read by connecting it to Arduino through Analog to Digital Converter (ADC). The fuel sensor was used to check the level of the fuel in the diesel engine.

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