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Smart City with Bluetooth of Things using Solar-Wind Power Generation

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ABSTRACT

Now-a-days due to exponential rise in population, every city is facing problems for day to day requirements like street lights controlling, increasing global warming, water supply management and garbage management. In order to control all these applications from remote areas and to reduce the man power and increase automation, we are introducing BOT technique. In this paper we are going to manage street lights by using LDR sensor. Likewise, Garbage management, temperature indication and Water supply management at particular location are monitored thereby transforming normal city into a smart city. In this paper we supply power to the equipment of control unit from the solar-wind energy system. The electrical energy from solar-wind energy system is stored in battery bank. This energy is supplied to all the control requirements in the smart city besides managing all the equipments smartly. Then all the information from the different equipments is monitored in PC or in mobile using Bluetooth app.

Keywords: Bluetooth Module, High Speed Propeller Type Wind Turbine and Solar Panel.

1. INTRODUCTION

Energy is playing an important role in human and economic development. But this energy, which is primarily available in the form of coal, lignite, oil, natural gas, biomass, hydrates, water, etc., are rapidly depleting due to fast industrial growth and rapid growth in population. So there is a need for looking into alternate sources of energy. Research on renewable energies have been initiated first for wind power and then for solar power. In wind power generation, efficiency could be increased by 50% with beam tracking, beam focusing and wind direction adaptive motion methods. So by combining both solar and wind energy, a power plant can generate constant power at all times and helps to fill the energy gap at all times.

2. PROPOSED SYSTEM

The proposed system of wind-solar power generation system is in outline composed off our power sources: a wind power generation system, solar power generation system, and storage battery. The power obtained from two sources i.e. solar panel and wind turbine is stored in two different batteries and the two batteries are connected in series to produce maximum output voltage from both wind and solar.

The output voltage of is given to the microcontroller which converts it into 5v with the help of inbuilt voltage regulator because microcontroller operates on 5v only.

Then by programming the program into the microcontroller, it controls and operates the applications in a smart city like garbage management, temperature monitoring, automatic street lighting, and automatic watering to plants using ultrasonic sensor, temperature sensor (LM35), light depending resistor, and submersible pump respectively. All these applications are monitored using Bluetooth module.

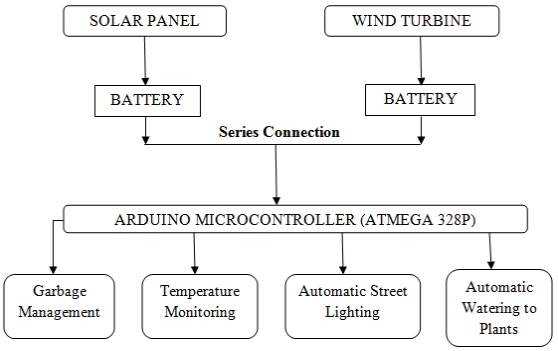


Fig.1: Block Diagram for Implementing the Proposed Method

3. HARDWARE IMPLEMENTATION

3.1 Solar Panel

A solar panel absorbs the sunlight as a source of energy to generate electricity or heat. It converts energy from the sun into electricity or heat. Solar (photovoltaic) panels convert energy in the form of light from the sun into electrical energy. Usually 4 and 22 percent of the energy falling on a panel is actually converted to usable electrical energy. The rest is reflected or turned into heat.

Solar energy refers to the utilization of the radiant energy from the Sun. Solar power is used interchangeably with solar energy, but refers more specifically to the conversion of sunlight into electricity by photovoltaic, concentrating on solar thermal devices, or by an experimental technology such as a solar chimney or solar pond.

Solar panels are Photovoltaic cells which gives voltage if you place them directly under sun light. Here if you change the position of panels the power output will vary. Means, direct sunrays on solar panel can give maximum output otherwise

there might be decrease in the value of their outputs. So we have to track the path where the maximum power will attain.

Solar panels are of two types that collect energy from the sun. One is solar photovoltaic modules which use solar cells to convert light from the sun into electricity and the other is solar thermal collector which collects the sun's energy and generates electricity by heating water.

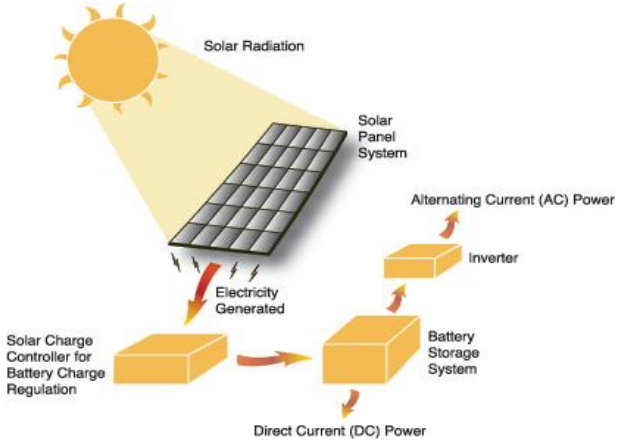


Fig.2: Operation of Solar Panel to Obtain the Output Voltage

3.2 High Speed Propeller Type Horizontal Axis Wind Turbine

This is the kind of wind turbine that is used most widely for the generation of electricity. Instead of working on the thrust force of the wind, as in the former cases, this turbine operates on the aerodynamic forces of the wind. It has been found that wind turbines that work on thrust forces operate at a lower efficiency than the ones which operate on aerodynamic forces. A schematic diagram of the high speed propeller to wind turbine is as shown in the figure

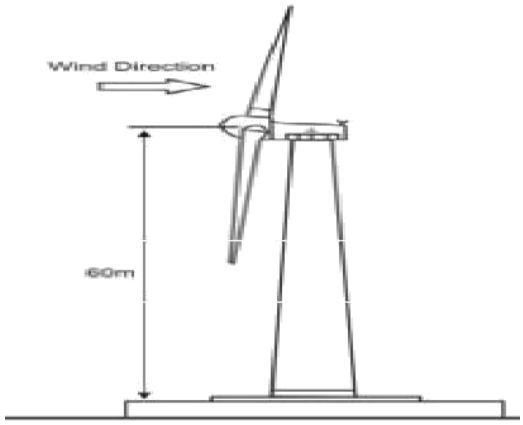


Fig.3: High Speed Propeller Type Wind Turbine

3.3 Battery

An electric battery is a device consisting of two or more electrochemical cells that convert stored chemical energy into electrical energy. Each cell has a positive terminal, or cathode, and a negative terminal, or anode. The terminal marked positive is at a higher electrical potential energy than the terminal marked negative. The terminal marked negative is the source of electrons that when connected to an external circuit will flow and deliver energy to an external device. When a battery is connected to external circuit electrolytes are moving as ions within, allowing the chemical reactions to be completed at the separate terminals and delivering energy to the external circuit. It is the movement of those ions within the battery which allows current to flow out of the battery to perform work.

3.4 Relay

A relay is an electrical switch that uses an electromagnet to move the switch from the off to on position instead of a person moving the switch. It takes a relatively small amount of power to turn on a relay but the relay can control something that draws much more power. Here we are using two relays for ON and OFF operation of electric bulb and submersible pump.

3.5 Arduino Microcontroller

Arduino is a single board microcontroller, intended to make the application of interactive objects or environments more accessible. An Arduino board consists of an Atmel 8-bit microcontroller with complementary components to facilitate programming and incorporation for other circuits. Official Arduino have used the mega AVR series of chips, specifically the ATmega8, ATmega168, ATmega328, ATmega1280, and ATmega2560. Most of the boards include a 5 volt linear regulator and a 16 MHz crystal oscillator or ceramic resonator in some variants. Here we are using ATMEGA 328P microcontroller.

3.6 DC Motor

Generally DC motor is a device which converts input electrical energy into output mechanical energy. But in this paper we are using that DC motor as DC generator by coupling the shaft of DC motor to wind turbine. So that the mechanical input to the motor by the wind turbine is converted into electrical energy (DC power). We are using 1000r.p.m Brushed DC motor so that it can operate for the variations in the input mechanical energy due to wind.

3.7 Temperature Sensor (LM35)

In general, a temperature sensor is a device which is designed specifically to measure the hotness or coldness of an object .LM35 is a precision IC temperature sensor with its output proportional to the temperature (in °C).With LM35, the temperature can be measured more accurately than with a thermistor. It also posses low self-heating and does not cause more than 0.1 °C temperature rise in still air.

The operating temperature range is from -55°C to 150°C.The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It has found its applications on power supplies, battery management, appliances, etc.

The analog voltage output pin of LM35 is connected to the analog pin (A0) of the microcontroller then microcontroller converts the analog output voltage of LM35 to the temperature in centigrade's and displays the value. Thus we can monitor the surrounding temperature of the smart city in different locations.

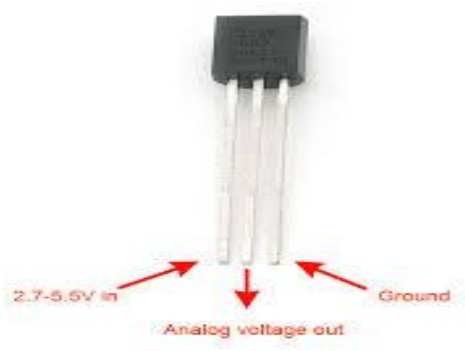


Fig.4: Pin Description of Temperature Sensor

3.8 Ultrasonic Sensor

Ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back. By recording the elapsed time between the sound wave being generated and the sound wave bouncing back, it is possible to calculate the distance between the sonic sensor and the object.

The operation of ultrasonic sensor is mainly depending on trigger pin and echo pin. The trigger pin sends the sound waves at a specified frequency and the sound waves are reflected back when they strike an object which are received by echo pin. Thus the garbage level is monitored.

Fig 5: Ultrasonic Sensor

3.9 Light Depending Resistor

The light dependent resistors also known as a LDR is a resistor whose resistance increases or decreases depending on the amount of light intensity. LDRs are a very useful tool in a light/dark circuits. LDRs can have a variety of resistance and functions.

Fig 6: Light Depending Resistor Sensor

They are generally made of semiconductor material consists of free electrons which are enclosed in a crystal lattice so that the free electrons are unable to move. But when sunlight falls on the sensor the free electrons gains the energy and breaks the bond of crystal lattice which decrease the resistance of circuit and when there is no sunlight the resistance of circuit increases. Here we are using this sensor for automatic street lighting. When there is sunlight bulb is off and sunlight intensity reduces to a particular value then bulb is on.

3.10 Bluetooth Module

Bluetooth module consists of 6 pins i.e. V_{cc}, ground, state, enable, RXD (Receive Data), and TXD (Transmit Data). In this paper Bluetooth module is used to transmit data from Bluetooth to Microcontroller. For that transmission of data, transmit pin of Bluetooth is connected to receiver pin of microcontroller and transmit pin of microcontroller is connected to receiver pin of Bluetooth. In this paper we are monitoring all the applications in the smart city like automatic water pumping to plants, garbage level detection, temperature around surroundings and automatic street lighting using Bluetooth module.

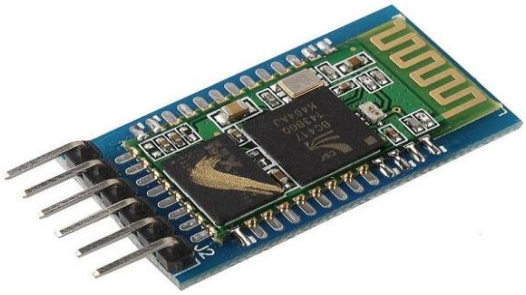


Fig 7: Bluetooth Module

3.11 Submersible Pump

A submersible pump is a device which has a hermetically sealed motor close-coupled to the pump body. When supply is given to the submersible pump the motor in the pump rotates which in turn rotates the impeller which is attached to the shaft of motor. Due to this rotation of impeller a suction force is created around the blades of impeller which sucks the fluid and due to centrifugal action it sucks out the fluid at a certain head. The whole assembly is submerged in the fluid to be pumped. We are using this pump for automatic watering of Plants.

Table 1: Specifications of Components Used

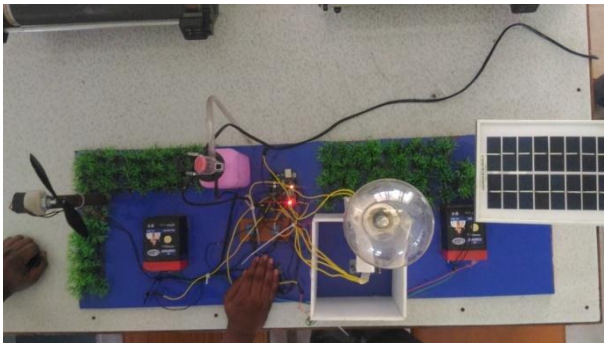
Component	Specification
Solar panel	V_{oc}=10V, I_{sc}=0.37A, 3 Watts
DC motor	Shunt motor, 1000 r.p.m, 6V
Battery	6V, 5Ah
Submersible Pump	5-12V, 130-220mA, 40-110mm lift
Relay	230V A.C/12V D.C, 7A
Temperature Sensor	4-30V, −55°C to 150°C
Ultrasonic Sensor	5V D.C, 1”inch to 13 ‘feet
Bluetooth Module	3.3-6V, 10-30 mA

The main advantage of this type of pump is that it prevents pump cavitations, a problem associated with a high elevation difference between pump and the fluid surface.

Submersible pumps push fluid to the surface as opposed to jet pumps having to pull fluids. Submersibles are more efficient than jet pumps.

Fig 8: Submersible Pump

4. RESULTS



Garbage management is done by using of an Ultrasonic sensor which senses the level of waste present in that particular bin and indicates the level in the user interfacing devices. The values identified are given in the table below.

Table 2: Garbage Management

Garbage Level Filled	Value Indicated By Ultrasonic Sensor
Empty	22cm
One-fourth filled	19cm
Half filled	14cm
Three-fourth filled	10cm
Fully filled	6cm

The following table indicates the automatic street lighting depending on the light intensity absorbed by the light depending resistor.

Table 3: Automatic Street Light Control

LDR Sensor Value	Condition of Street Light
Greater than 400 Lux	OFF
Less than 400 Lux	ON

Temperature in the smart city is monitored using Temperature sensor (LM35) analog value as shown in the following table

Table 4: Temperature Monitoring

Analog Value Across Temperature Sensor	Temperature Indicated
49.11	23.93^{o}C
55.009	26.86^{o}C
61.99	30.27^{o}C
62.99	30.76^{o}C
66.99	32.71^{o}C

5. CONCLUSION

The use of non-renewable sources of energy will affect the green house by increasing pollution. Therefore, use of renewable sources like wind and solar will be eco-friendly and can be used for preventing global warming.

Solar-Wind systems being the most promising application in today's world are of great importance. Grids are an emerging technology which can eliminate the hazardous effect of emitted gases from combustion of fuels which have been used for generating power since its invention. Now a days, systems are being implemented in various fields such as automation, domestic usage etc. This approach of using models would not only help in village electrification but it will also be more significant as its implementation is a smarter approach towards conservation of our environment ultimately making power grid smarter.

By this paper continuous power supply is obtained using solar-wind energy system eliminating all the problems of standalone renewable energy systems. The power obtained from this energy system is utilized to operate different control applications in a city like street lights, temperature sensing, water management, Garbage management.

And also these applications are monitored and controlled from remote areas using "BLUETOOTH OF THINGS" technique. Thus a normal city is being transformed into a smart city with an uninterrupted power supply.

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