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Efficient Energy Management to Reduce Billing in Smart Home and Also Control

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ABSTRACT: A smart home represents also a home that satisfies its needs in an intelligent and flexible ways, responding to the needs and comfort of its dwellers, enabling them to control and manage consumption of their own green energy sources. The main purpose of this paper is to provide continuous power supply to a battery bank and load, by selecting the supply from any of the three sources namely solar, mains and Piezo automatically in case if one the source is absent. The need of electricity is increasing day by day and the frequent power cuts of electricity are causing many problems in different areas like banks, colleges/schools, hospitals, houses and industries. Thus, there is requirement for an alternate arrangement of power supply. When a source, say mains fails, the supply automatically shifts to next priority source. If the solar also fails it switches over to the next available source and so on. As it is not feasible to provide all 3 different sources of supply, one source with alternate switches are provided to get the same function. The project can be further enhanced by using other sources like Inverter also and then taking into consideration for using the best possible power whose tariff remains lowest at that moment. We are updating all information on IOT cloud using NodeMCU module. If excess energy is generated then it is supplied to the grid.

KEYWORDS: Internet of Things (IoT), Renewable Energy Sources, Smart Home, CO2 Emissions, Electricity Cost.

I. INTRODUCTION

Greenhouse gas emissions are an emerging issue that poses a serious environmental problem and threat the entire world. Electricity production process is considered among the principal CO2 emitters since it relies heavily on non-renewable sources like coal and natural gas. However, switching to green electricity generation as hydro or wind is not yet evident because they represent intermittent sources that are highly weather dependent and can meet now at maximum 14% of electricity generation needs. Moreover, green electricity is often more expensive than non-green ones. As governments and utilities worldwide seek to reduce carbon footprints and conserve energy, they are interested to use further wireless Internet of

Things (IoT) technologies to transform traditional energy infrastructure into interconnected smart grid.

Smart meters are an essential element and usually the first milestone in smart grid implementations. In this context, we propose an optimization model embedded in these IoT devices (i.e. smart meters) to intelligently schedule energy consumption from renewable & nonrenewable electricity providers and an energy storage system (battery) to meet smart buildings electricity requirements. The proposed optimization model takes into consideration several constraints, namely the availability as well as the electricity price of each source. The goal of this model is to find the best proportion of using

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each source in order to reduce CO2 emissions but also taking into account the minimization of consumer's billing cost. Simulation results prove the efficiency of our model either with or without using carbon emissions tax to penalize using nongreen energies.

II. LITERATURE SURVEY

This paper aims in finding the best proportion of using each source (i.e. renewable, nonrenewable sources or battery) in order to reduce CO2 emissions and also taking into account the minimization of consumer's billing cost. Simulation results prove the efficiency of this model either with or without using carbon emissions tax to penalize using non-green energies. [1]

The aim of this article is to present a cost-effective energy management system design and implementation suitable for frugal smart cities and smart villages. This paper focuses on proposing a solution of continuous monitoring system constituted by connected energy metering and control devices based on Arduino and Raspberry Pi and remotely controlled, via Wi-Fi, current and voltage smart meters/switches.
The outcome of this paper includes improved operating conditions of the electricity market, especially in the interest of consumers. [2]

This paper presents an idea or a concept for smart home using mobile application.
It focuses on flexible, cost friendly wireless smart home system, which would be based on an Android. The proposed project is designed for reading Electrical energy in units and view in Mobile Application to the customer's mobile. This project uses only simple components and is more reliable. Less power consuming microcontroller is used and moreover it does not use any costly ICs or circuits. By installing this project in commercial households, people can get an idea of how much energy they are consuming in real time. [3]

III. OBJECTIVES

- To present cost effective smart home architecture for smart energy control and to promote low cost
- IoT solutions for smart home energy management and hence to reduce billing in smart homes.

- To use renewable sources and battery in order to minimize the consumer's bill with respect to CO2 reduction.

- To utilize naturally available energy resources. We are making a circuit based on freely available power resources. (Solar, Wind and Piezo Devices)

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IV. CIRCUIT DIAGRAM

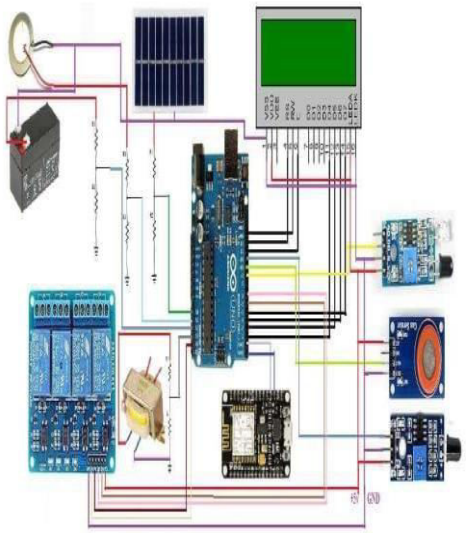

Fig A. Circuit Diagram

The operation of this system can be explained in different cases:

Case1: In this case when both solar power and wind power is less, or not available then automatically power will be drawn from main supply and delivered to battery. Additional power will be provided by batteries charged from Piezo Devices. Case2: In this case when solar power and wind power are both available then, we preferably go with solar power, since it is higher than wind power. And the power from Solar is delivered to battery, along with power generated by Piezo Devices.

Each time when renewable sources are opted then the energy is stored in battery, which can be later used for specific applications.

V. SYSTEM COMPONENTS

A. ARDUINO

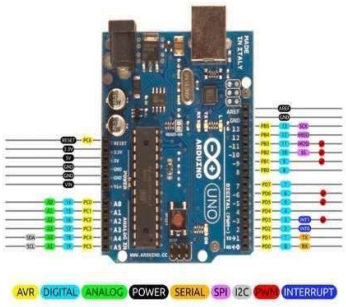

Fig 1: Arduino UNO

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Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analogue inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC to DC adapter or battery to get started.

B. ENERGY METER

Fig 2: Energy Meter

Watt hour meter or energy meter is an instrument which measures amount of electrical energy used by the consumers. Most interesting type are used as prepaid electricity meters. Basic unit of power is watts.
One thousand watts is one kilowatt. If we use one kilowatt in one hour, it is considered as one unit of energy consumed. These meters measure the instantaneous voltage and currents, calculate its product and gives instantaneous power. This power is integrated over a period which gives the energy utilized over that time period.

C. IR SENSOR

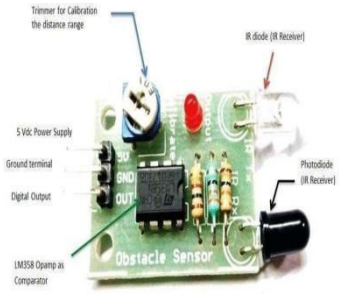

Fig 3: IR Sensor

IR Sensor Module Features:

1. 5VDC Operating voltage
2. I/O pins are 5V and 3.3V compliant
3. Range: Up to 20cm
4. Adjustable Sensing range
5. Built-in Ambient Light Sensor
6. 20mA supply current
7. Mounting hole

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D. GAS SENSOR

Fig 4: Gas Sensor

Applications of Gas Sensor:

1. Gas level over-limit alarm
2. Breathalyzer
3. Portable alcohol detector
4. Stand-alone/background sensing device
5. Environmental monitoring equipment

E. SOLAR PANEL

Fig 5: Solar Panel

A Solar panel, or photo-voltaic module, is an assembly of photo-voltaic cells mounted in a framework for installation. Solar panels use sunlight as a source of energy and generate direct current electricity. Most solar panels are made up using crystalline silicon solar cells. Installation of solar panels in homes helps in combating the harmful emissions of greenhouse gases and thus helps reduce global warming.

F. WI-FI MODULE

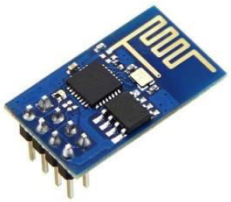

Fig 6: Wi-Fi Module

Wi-Fi Module is used for development of IoT (Internet of Things) embedded applications. The Wi-Fi Module is a selfcontained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to our WiFi network.

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G. PIEZOELECTRIC SENSOR

Fig 7: Piezoelectric Sensor

A piezoelectric sensor is a device that uses the piezoelectric effect to measure changes in pressure, acceleration, temperature, strain, or force by converting them to an electrical charge.
The piezoelectric effect results from linear electromechanical interaction between the mechanical and electrical states in crystalline materials.

VI. PROPOSED SYSTEM

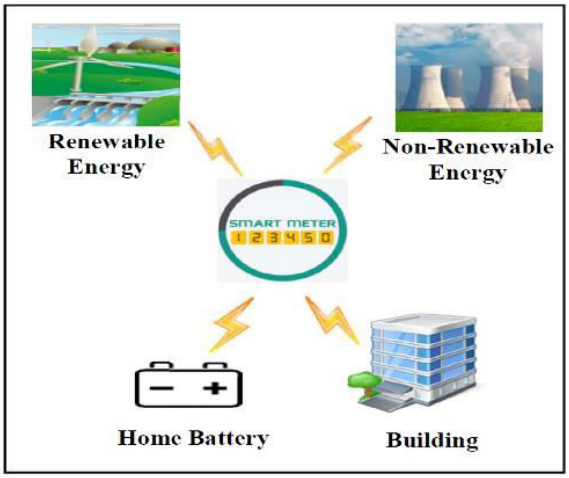

Fig B. represents the proposed model architecture of the project. The system is modelled to function in the following ways:

i. If the generated voltage from the Solar Panel as well as Piezoelectric devices sums up to 10 volts, then the devices connected are run by green energy.
ii. If the total generated voltage from the Solar Panel and Piezoelectric devices are less than 10 volts, then the circuit automatically receives power from the main supply. iii. Whenever the circuit draws power from the main supply, the units that are being consumed are being sent to the user through a mobile application. iv. Also, if there is excess amount of energy generated from the Renewable sources, the unnecessary power is sent to the main grid, hence making it profitable to the user.

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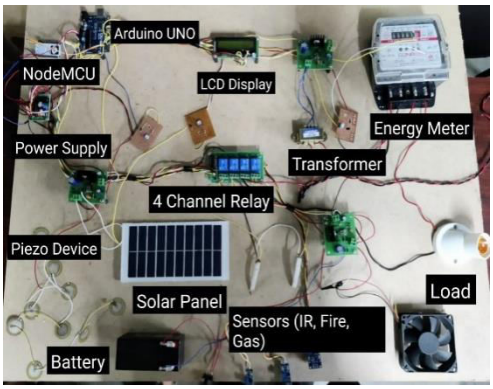
VII. RESULTS



In order to simplify our model, only Solar and piezo are considered in the optimization problem. Due to this both carbon emission and billing is reduced.

VIII. CONCLUSION

The necessity of proposed guaranteed power supply system creation for responsible consumers is proved.
In this case under responsible consumers is considered the electrical installations, which define the robustness and continuity of different technological processes. During researches, the structure and methodology of key parameters choosing of proposed guaranteed power supply system of responsible consumers with use of emergency power supply sources and uninterruptable power supply is developed. The emergency power supply functions on the base of the alternative and renewed energy sources, such as piezo, solar with DC to DC power station, which works on the following oil gas. Each of these sources allows avoiding occurrence of emergencies and infringement of technological process continuity. The main stages of choosing structure, main parameters and content of proposed guaranteed power supply system are presented.

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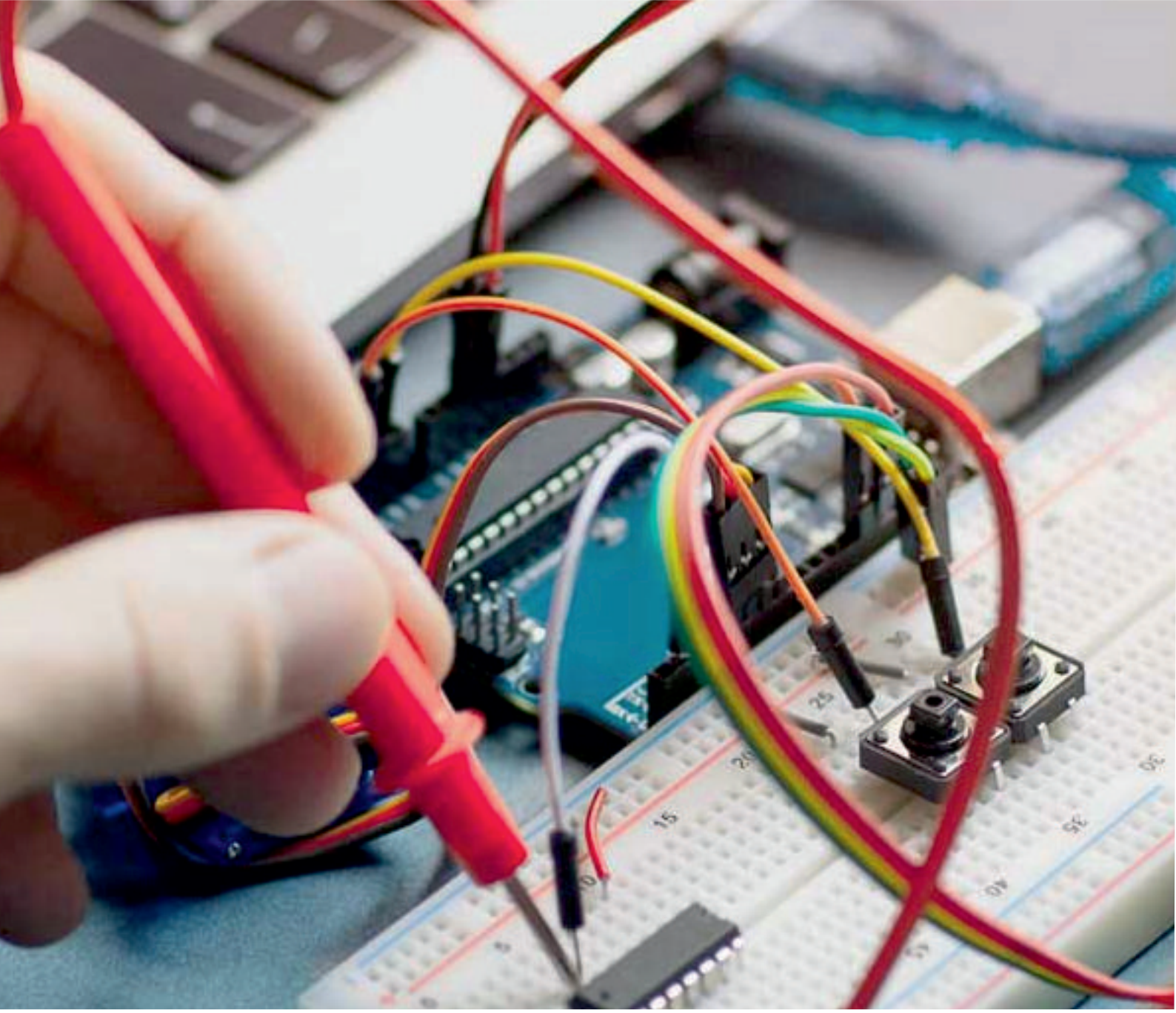

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