Residential Electrical Energy Management System

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Abstract: Here we are going to interconnect various types of sources such as solar, hydel, stored energy and EB common house-bus. System operation, Battery gets charge from the Solar Panel. By that time service main supplies, the load. After battery gets charged nearly 90%, then the solar panel supplies power to the load and EB supply gets cut-off. When solar and EB powers are not readily available then, storage source(battery) supplies the power to the load.
Mini-hydel work as second renewable source which charges the battery during availability of fuel (water flows from terrace to harvesting tank). In this proposed system NodeMcu-Esp8266 for controlling and transferring the data in source circuit and Raspberry pi Pico and Bluetooth are used in load control circuit. Household loads are controlled with a help of electric sensors like light and fan are control with help of Ultrasonic sensor and exhauster controlled by Gas sensor module.

I. INTRODUCTION:

Residential electrical energy management is a technique used to reduce their energy costs and environmental impact by improving energy efficiency and reducing waste. By analysing energy usage data and identifying areas where energy is being wasted or used inefficiently, homeowners can implement targeted strategies to reduce energy consumption and lower costs. A REMS can also help homeowners comply with environmental regulations and improve their sustainability performance. need to establish a baseline of energy usage, set energy reduction targets, and develop a plan for achieving those targets. They may also need to invest in new equipment or technologies, such as smart thermostats, energy-efficient lighting, or home energy management systems. Home automation systems can also be integrated into a REMS, allowing homeowners to control and optimize their energy usage remotely. For example, smart thermostats can be programmed to adjust the temperature of a home based on the time of day, reducing energy consumption when the home is unoccupied. Lighting systems can also be automated to turn off when rooms are unoccupied, reducing unnecessary energy consumption.

II. PROPOSED SYSTEM

The proposed system has two microcontrollers for controlling load and source circuits. NodeMCU microcontroller used to control source using Local Host web server. The source like solar, Battery (stored energy), Micro hydel and main supply from electricity board is switching by electromechanically relay. And loads like light, fan, exhauster was controlled with a help of ultrasonic sensor and gas sensor. Using Bluetooth module to control the load remotely.

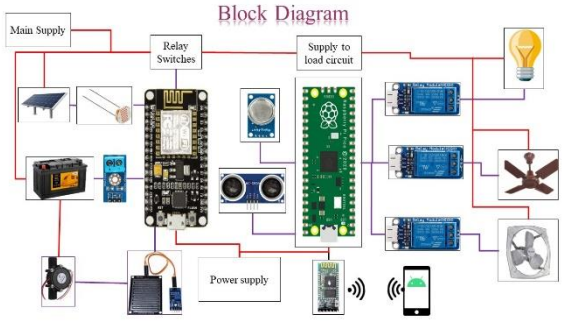

Figure: Proposed system block diagram

III.SOURCES CONTROL

The source control circuit has battery as stored energy source for monitoring and control purpose voltage sensor is used. Voltage sensor positive and negative connector outlet connected to battery positive and negative respectively. 5 voltage input given to Vin and GND connected to common ground. And then signal pin connected to NodeMCU A0 (analog Pin) this voltage sensor works on the principle of voltage division. The variation in signal pin measured by analogRead command and using algorithm analog values from the A0 converted into required voltage and percentage. This percentage values are transmitted to mobile phone using local host server. Local host

server means a wireless network connection made with Wi-Fi and hotspot.

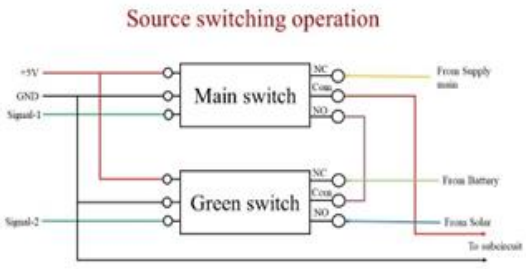

Figure: source switching operation in relay

IV. LOAD CONTROL CIRCUIT

For load control circuit Raspberry pi Pico microcontroller used which is 16-bit micro controller. It has proficiency to control entire sub circuit. With help of several sensors loads are control automatically and using Bluetooth communication the loads are controlled remotely.

V. FLOW CHART

The algorithm starts with initializing the source by getting response from the respective sensors. Greenon command given by the user through server then two conditions are checked to turnon solar or battery using LDR input and Main_switch and Green_switch. Similarly various process are feds in this loop function to turnoff green mode, enabled the battery mode, to enable the solar mode, and notify the consumer whether hydro power generator generate power or not. And make visible the exact battery status to the consumer via android application. After the loop finished then continue from first line in that function. So that the process in the loop continuous invariant to time. axes only with units.

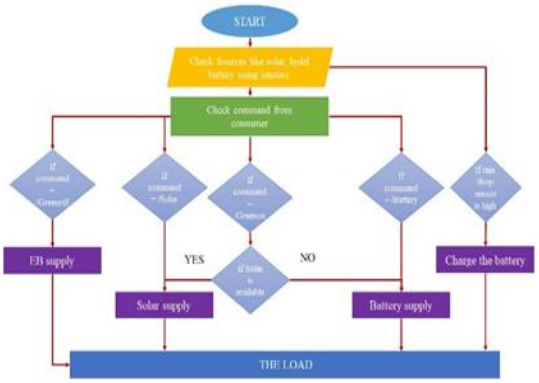

Figure: Source control flow chart

Loads are initialized and there are two modes of control one is remote control mode and automatic control mode. As previously mentioned, that Bluetooth used for wireless remote if command was transmitted from mobile for turnon or turnoff fan, light, and exhauster. In automatic control mode ultrasonic sensor is high then light and fan otherwise both are turnoff. Gas sensor is equal to high exhauster otherwise exhauster turnoff.

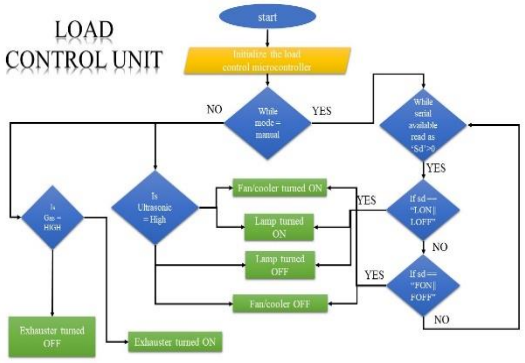

Figure: Load control flow chart

VI RESULT

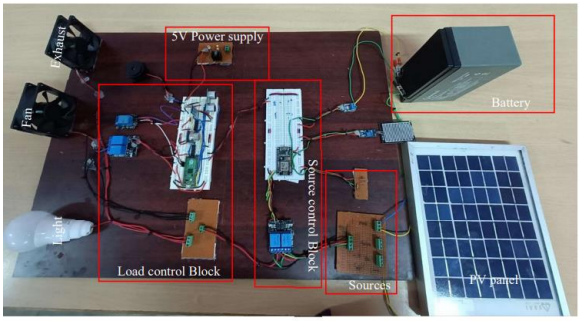

Figure: prototype of proposed system

The figure shows the hardware model of proposed system. it consists of two different microcontrollers used to control source as well as load. This prototype model has 5 blocks namely source incoming, power supply block, source control microcontroller with switches, load control microcontroller block and source control input block. This prototype model is DC based. For practical conditions an inverter plays crucial role in incoming block. The incoming block has rectified 12v ac as input from supply main, 12v regulated dc from solar panel and 12 regulated dc from battery source. Negative terminal of all sources is jointed and make ground bus. Then each positive of terminal of sources are connected to switch separately. Microcontroller and switches require 5V

dc so that it should be powered by external DC sources or from regulating 12v dc to 5v dc with a help of 7805IC. Then output from this block connected to breadboard with help of jumper cables. In source switching block consist of NodeMCU and electromechanical relay 2 input are connected to microcontroller according to command the relay turnon and turnoff. One relay act as green switch and another relay act as main switch where solar, battery and main supply's positive terminals are connected. In load control block consist of Raspberry pi pico which is connected with sensors and actuators. To control the loads like light, fan exhauster. Bluetooth used for remote control.

VII. CONCLUSION

Residential electrical energy management is a system of future electrical utilization at consumer side. All unused wasted energy were converted into useful electrical energy at economically.

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