AN INTELLIGNET DEMAND SIDE MANAGEMENT WITH RENEWABLE ENERGY INTEGRATION FOR SMART HOMES BASED ON TIME OF USE (TOU)

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Abstract—

Global energy demand is increasing rapidly in comparison to the steady growth of energy generation and transmission setups, thereby widening the demand-supply gap. In traditional grids, utilities cater this situation by increasing the total generation capacity as a function of peak demand. However, the resulted system by a large part is unutilized. Price based load management system consider flattening demand fluctuations as an objective. Both the customer and the utility will get the benefits. It encourages the customer to encourage peak demand in response to the incentives. The model is simulated in TOU pricing environment for three cases: (i) Traditional homes, (ii) Smart homes & (iii) Smart homes with RES. Simulation results shows that the proposed model optimally schedules the appliances resulting in electricity bill and peaks reductions, Real Time Pricing combined.

Keywords— TOU (Time Of Use), RES (Renewable Energy Sources), RTP (Real Time Pricing), EMS (Energy Management System).

I. INTRODUCTION

Renewable energy is the present and future source of energy. This project deals with hybrid energy which is a combination of solar and EB Grid. In this paper, we present a cost-efficient appliance scheduling model for residential users. Our appliance scheduling model aims at optimizing the operation time of electrical appliances. Results validate that the proposed model performs well in scheduling the household electrical appliances and provides benefits to the users by significantly reducing their electricity bills.

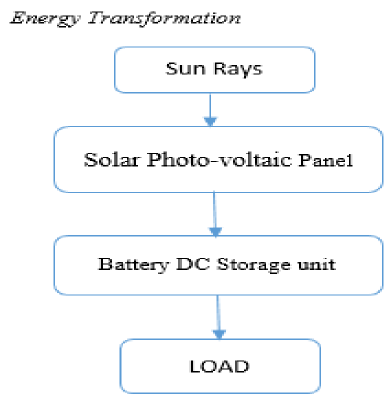
II. PRINCIPLE AND WORKING

A. *Principle*

The principle depends on the switching operation of the MOSFET. This automatically switches the source from solar to EB grid depending on the total power consumed by the load.

B. *Working*

When a stream of photons (i.e. light) falls on the photo-voltaic plate, it dislodges a few electrons that produces a current in its connected eternal circuit. This is used to supply the load initially.



As the load increases, the total power consumed increases because of which the solar panel might not be able to sustain the load. At this time, the Microcontroller automatically notices the increase in power consumed and sends the signal to the MOSFET which switches the supply from the solar panel to the EB grid.

III. SYSTEM DESIGN

The system design characteristics specify the existing and the proposed systems. The drawbacks of the existing system are also specified.

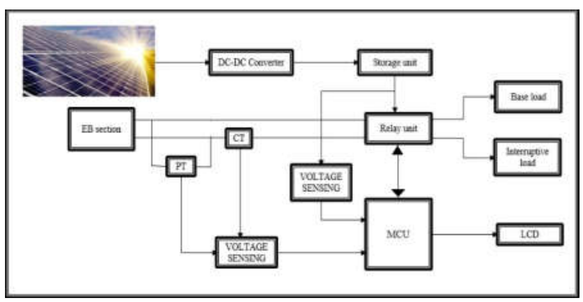


Fig. 1: The general Block Diagram.

A. *Existing System*

In existing system, EMS includes advanced metering infrastructure, smart meters, home gateway, energy management controller, home appliances and in-home display devices. The advance metering infrastructure is like the nervous system of the EMS architecture which communicates in both ways between utility and smart meter. An optimization approach based on the inclining block rate pricing scheme is used for power consumption of all the automatically operated appliances in home.

B. *Proposed System*

In our proposed system, an optimal approach for scheduling the power usage of smart appliances in a home is proposed based on the TOU pricing scheme. It consists of an integrated power and renewable energy utility that is interested in serving in all types of residential or commercial loads. The respective power grid and on-site RES acts as a single node. The optimization program dispatches power to residential loads and storage systems that could be utilized during high demanding hours. The energy demand of residential load is directly fulfilled by using grid energy, direct renewable energy or storage systems depending on the electricity price in particular hours. However,the on-site renewable energy source and storage system acts as a first choice for delivering energy to residential loads, thus reducing energy obtained from utility. The microcontroller schedules usage based on the TOU and the C.T. and P.T. acts as smart meter which transfers energy information to microcontroller and the relay unit will select the source according to the necessary requirements. the on-site renewable energy source and storage system acts as a first choice for delivering energy to residential loads, thusreducing energy obtained from utility. The microcontroller schedules usage based on the TOU andthe C.T. and P.T. acts as smart meter which transfers energy information to microcontroller and the relay unit will select the source according to the necessary requirements.

IV. SIMULATION

The MATLAB Simulink Software is used to show the simulated results of the entire project. The Simulation diagram consists of a simplified version with blocks to represent the sources and the loads. These sources and Loads are explained below in detail.

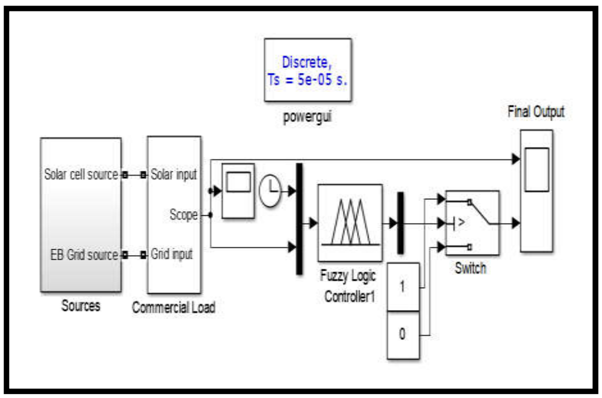


Fig.2 : Simulation diagram in MATLAB Simulink Software.

A. Sources:

A DC source is specified to signify the solar panel which is represented as an RPS for the experiment. These sources alternate based upon the necessity of the consumer's load.

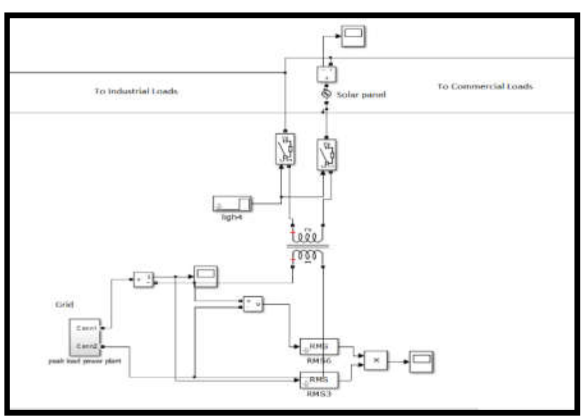


Fig. 3 : Solar and EB grid sources used in MATLAB Simulink.

B. Commercial Loads:

The commercial loads are given as:

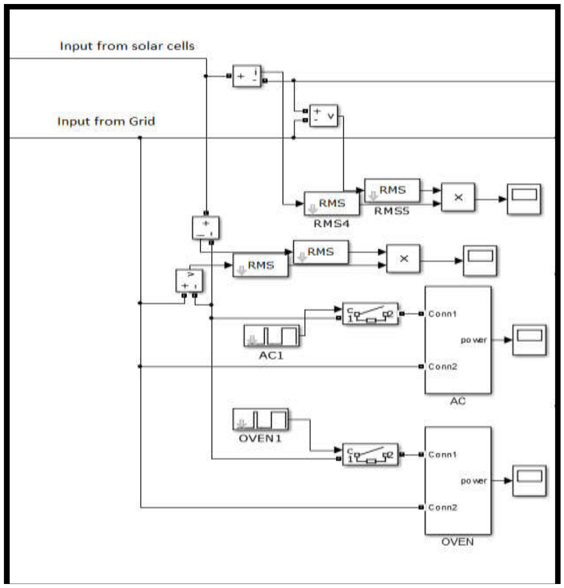


Fig. 4 : Commercial Loads simulated in MATLAB Simulink.

Further loads used in commercial homes includes:

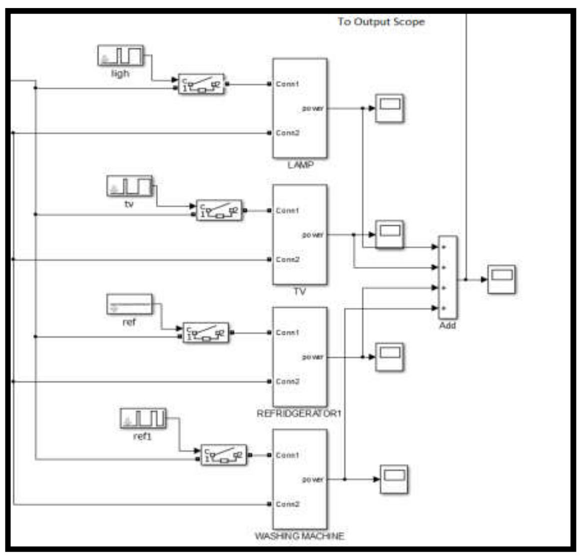


Fig. 5 : Other commercial Loads shown in MATLAB Simulink.

These commercial loads are simulated based on the real time values of resistances and power consumed by generally seen loads of this caliber.

V. FUZZY LOGIC

The Fuzzy Logic rules are given as follows.

TABLE I. FUZZY LOGIC RULES

S.NO.	Fuzzy Rules
1.	If (TIME is MORNING) and (RES_LOAD is LOW) then (RESIDENTAL is ON)
2.	If (TIME is DAY) and (RES_LOAD is MED) then (RESIDENTAL is ON)
3.	If (TIME is NIGHT) and (RES_LOAD is HIGH) then (RESIDENTAL is OFF)

TABLE II. FUZZIFICATION TABLE

Time	Residential Load		
	Low	*Medium*	*High*
Morning	ON	OFF	OFF
Day	ON	ON	ON
Night	ON	ON	OFF

VI. FUZZY LOGIC PARAMETRES

A. Time Parametres

TABLE III. TIME PARAMETRES

Time	Range		
	Min	*Peak*	*Max*
Morning	0	0.04	0.08476
Day	0.08	0.12	0.1724
Night	0.1679	0.205	0.24

B. Load Parametres

TABLE IV. LOAD PARAMETRES

Load	Range		
	Min	*Peak*	*Max*
Low	0	205	416.7
Medium	400.5	525	684
High	670.6	800	1000

VII. SIMULATION RESULT

The below figure displays the continuous varying load characteristics and the change in the source. That is, the switching of the source from the DC panel to the EB grid. The simulation result is a model output for the actual operation. When the total power consumed crosses 750W, the source switches from the solar to the grid source. As the total power consumed goes below the specified range, the source automatically switches back to solar power alone. The specified range can be varied as required and according to the output obtained from the solar panels which varies according to the number of panels used. This is shown in the graph that follows:

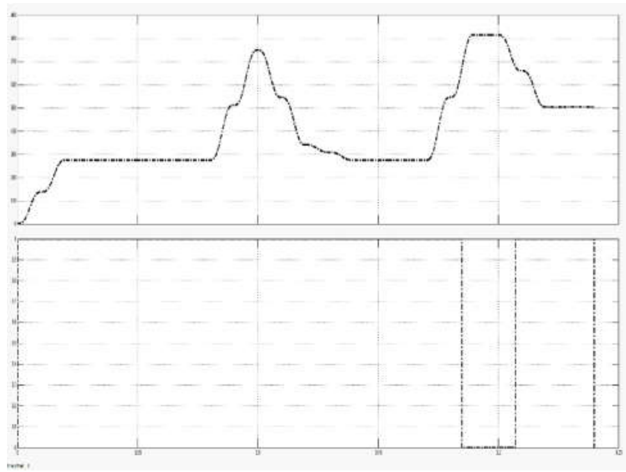


Fig. 6 : Simulation Results showing the switching operation between the solar and EB sources.

A. Top Half

The top half of the graph shows the varying load with respect to time. The residential loads vary constantly depending on the time of use. This is taken into consideration. As each variation is considered by the Fuzzy logic controller the actions are taken.

B. Bottom Half

The bottom half of the graph shows the switching operation of the source from the Solar panel to the EB grid and then back to the Solar panel as the load drawn again drops back into the acceptable range for that period of time.

VIII. CONCLUSION

The Demand side management has potential to provide many benefits to the entire smart grid, particularly at the distribution network level. This project presents a demand side management strategy that can be employed in the future smart grid. A heuristic based evolutionary algorithm is developed for solving the problem.

Simulations were carried out on a smart grid which contains two different kinds of customer's areas. The simulation outcomes show the proposed algorithm is able to handle a large number of controllable devices of several types, and achieve substantial savings while reducing the peak load demand of the smart grid.

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