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Bidirectional Smart Net-Meter

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Abstract: Now a day's the gap between energy generation and demand is increasing. To overcome this problem, the use of generation of energy from renewable sources will satisfy the consumers need. This system also helps to reduce monthly energy bill and also generate error free bill. In this paper, we are using energy which is generated by renewable energy sources and whatever surplus energy is export to the grid. This will reduce the monthly energy bill of consumer by crediting the exported energy charges. The proposed bidirectional smart net metering consists of voltage and current measurement circuit. This measures the instantaneous voltage and current respectively. Then aurdino calculates the net energy by using measured values of voltage and current also the net output energy displayed through LCD. This is interfaced with aurdino at regular interval. Experimental result shows the accuracy in calculating the net energy of system.
Keywords: Aurdino; Net Metering; Net Energy; Renewable Energy Source, AMI, AMR

I. INTRODUCTION

Energy is considered to be an important commodity for development of any country. The world's economic growth is placing enormous demand on its energy resources. The energy gap between generation and demand has to be balanced by incorporating renewable power generation to an existing conventional power generation. The technological innovation and environmental incentives are changing the face of electricity generation and transmission. Renewable power generation has become an ultimatum in recent years. In recent times many energy experts, scientist, engineers and activists actively promotes a 100% renewable energy vision.[1] Net metering is novel concept where an instrument which has a special metering and billing agreement between utilities and their customer facilitates the connection of small renewable Energy generating system to the power grid. In this system, The renewable energy sources like solar PV panel wind energy, tidal from this energy generation is possible. The solar PV generation is becoming more important as renewable energy source. Since, it offers many advantages, such as no fuel costs, no noise, no pollution and less maintenance.Net energy metering requires the meter to measure two quantities 1) imported energy 2) exported energy.[1] net meter values can be sent to the utility using communication technology[2].In this paper Bidirectional net meter is accumulate to compute energy delivered by the electric distribution company to consumer and energy delivered by the consumer to distribution company and generation from renewable energy sources.

II. BACKGROUND OF BILLING SYSTEM

A. Charges for electricity supplied by the MSEDCL-

1) The MSEDCL is authorized to recover charges for the electricity supplied by the MSEDCL to the consumer which shall be in accordance with the tariff determined by the commission time to time.
2) The MSEDCL also authorized to recover such sub charges and charges for wheeling as may be specified under the provision of subsection 2. And subsection 3. Of section 42 of the act and such additional subcharges as may be specified under the provision of subsection 4. Of section 42 of the act.
3) Unless otherwise specified all HT and LT charges refer to one point of supply and each separate establishment shall be given separate point of supply.
4) The charges for electricity supplied may include fixed charge in addition to charge for actual electricity supplied in accordance with terms and conditions of tariff as may be specified.
5) In addition to the charges fixed by the commission, the consumer shall be required to pay to the MSEDCL all taxes, duties and other statutory charges as may be required under any law for time being in force.

When power supply to a consumer is released in the middle of a month then in the first billing month after release of power supply, the" fixed charges /Demand charges" or any other similar fixed charge shall be levied on pro-rata basis, only for such no. of days for which the power supply is given during the said billing month . similarly the energy consumption during the first billing month shall also be charged On pro-rata basis under various blocks/slab of tariff.

B. Measurement of actual energy consumed in KWH for particular month-

TABLE I Energy Consumption in Units

Meter No.	Current Reading	Previous Reading	MF	Unit	Adj. Unit	Total
74712444	81	0	01	-19	200	181

Now a day's we using the electronic digital meter for measuring the electricity consumed for particular month. Digital energy meter gives accurate measurement of electricity consumed for the particular month. But this energy meter does not give the net value of energy consumed of specific period like 30 days. For measuring net value of energy consumed we need to do some mathematical calculations as follows:

C. Unit consumed in particular month = Running unit –previous month reading

By doing this calculation we can got the actual value of energy consumed for their particular month .

D. Standard tariff structure make by MERL for LT consumer

TABLE III Tariff Structure

Consumption Slab (kWh)	Fixed /Demand Charge	Energy Charge(Rs./kWh)
0-100 Units	Single Phase :Rs.40 Per month Three Phase:Rs.130 Per month	3.36
101-300 Units		6.05
301-500Units		7.92
501-1000 Units		8.78
Above 1000 Units (Balance unit)		9.50

1) *Fixed charges/demand charges-* Fixed charges are those charges, who added in every electricity bill to overcome the cost of capital investment, labour. Fixed charges are vary with connected load. when your demand is more then , fixed charges also increases with proportion to it and this charges added in your total electricity bill.
2) *Final billing process-*

TABLE IIIII Final Billing to LT Consumer

	Rs. Ps.
Fixed Charges	60.00
Energy Charges	845.13
Electricity Duty	179.57
Wheeling Charges	219.01
F.A.C.	-1.85
Additional Supply Charges	0.00
Tax on Sale	0.00
Previous Bill Credit	0.00
Current Interest	0.00
Capacitor Penalty	0.00
Other Charges	0.00
Total	**1,301.86**

Net Arrears	7.37
Adjustments	-2.44
Interest Arrears	0.00
Total Arrears	4.93
Net Bill Amount	1,306.79
Rounded Bill	**1,310.00**
Last Receipt Date	**04-MAR-18**
Last Receipt Amount	**280.00**

Here we can see the different types of charges present in the total billing process. Energy charges depends upon total energy consumed by consumer in different range of units. Fixed charges are added in every electricity bill. Fixed charges depend upon the total demanding kilowatt.

If demand is more then fixed charges also more. the taxes are applied on electricity bill is as per the rule of government ,the percentage of tax is fixed. By adding all these changes final electricity bill is generated.
(**Note:** Above billing system is only applicable for Maharashtra state according to MSEDCL.)

III. ADVANCED NET METERING INFRASTRUCTURE

Net meter is a policy proposed to promote the generation of power from small renewable system. Under net metering a system owner receives retail credit for all the electricity they generate when they produce more electricity than they consume during any given billing period.[4] Advanced net meter is not limited to electricity distribution. The infrastructure includes smart meter at consumer end, communication network at different levels of the infrastructure hierarchy to connect to two ends. Under the net metering program a smart meter is installed which allows a two way communication therefore , communication or issuance of command or price signals from the utility provider to the meter or load controlling devices are also possible.[3]Net meter electronically tracks how much electricity is used and when it is used. Smart meter track the energy use in home on an hourly basis. It also sends this information automatically to the local distribution company. [4]

Some net metering (NEM) programs are given :

1) *Standard NEM*- This is a solar and wind energy program for residential and small commercial rate customers whose generator size is 30kw or less.
2) *Expanded NEM*-This is a solar and wind energy program for agriculture and demand rate customer whose generator is of any size and for residential and small commercial rate customers whose generator capacity is over 30kw.
3) *NEMVNMA*-This is a solar energy program only for customer living in low income multifamily affordable housing.
4) *NEMBIO*-This program is only for customers with generators fuelled from an eligible biogas digester.
5) *NEMFE*-This program is only for customers with eligible fuel cell generators [4]

IV. HARDWARE ARCHITECTURE

Net meter is used to measure the net energy between the grid to load. And excess energy from any renewable energy source that fed to the grid.[1] The proposed system consist of voltage and current measurement circuit, power supply unit , aurdino, GSM module, LCD, Relay module ,solar as a renewable energy source. The voltage and current measuring circuit feeds the corresponding instantaneous value of voltage and current as an input to aurdino. Aurdino calculates the net energy by using instantaneous values of voltage and current. And the net output energy is displayed through LCD which is interfaced with aurdino.[1]

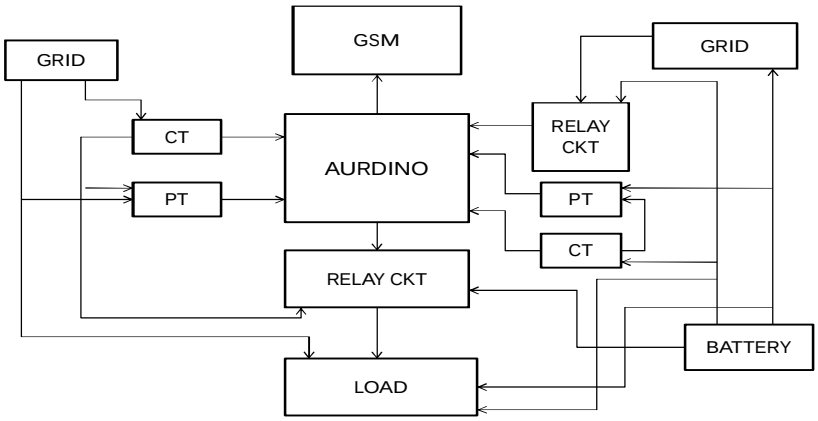

Fig1. Block diagram of proposed bidirectional smart net meter

1) *Potential transformer*- The voltage measuring circuit measures voltage value and gives input to aurdino.
2) *Current transformer*- The current measuring circuit measures current value and gives input to aurdino.
3) *Power supply circuit*- The 230 volt AC supply is given to the center tapped step down transformer. The step down transformer converts 230 volt AC to 15 volt AC. The bridge rectifier circuit converts Ac to DC . The output from bridge rectifier is given to the voltage regulator to get 12 volt respectively.
4) *LCD*- A 16*2 LCD is interfaced with aurdino and display the output from aurdino.

5) *Processing unit* – The aurdino is an interactive system that through the use of hardware and software can interact with its environment. The proposed system uses aurdino (type of ATmega328) as processing unit. The input to the aurdino is fed from CT and PT which process the input data and calculates the net output energy by using appropriate software coding.[1]

TABLE IVV Aurdino Specifications *(ATmega328)*

Microcontroller	ATmega328
Operating voltage	5 volt
Input voltage (recommended)	5 volt
Input voltage (limits)	7-12 volt
Digital I/O pins	6-20 volt
Analog Input Pins	14(of which 6 provide PWM output)
DC current per I/O pin	40 mamp
DC current for 3.3 volt pin	50mamp
Flash memory	32KB(ATmega328)of which 2KB used by boot loader
SRAM	2KB (ATmega328)
EEPROM	1 KB(ATmega328)
Clock speed	16 MHz

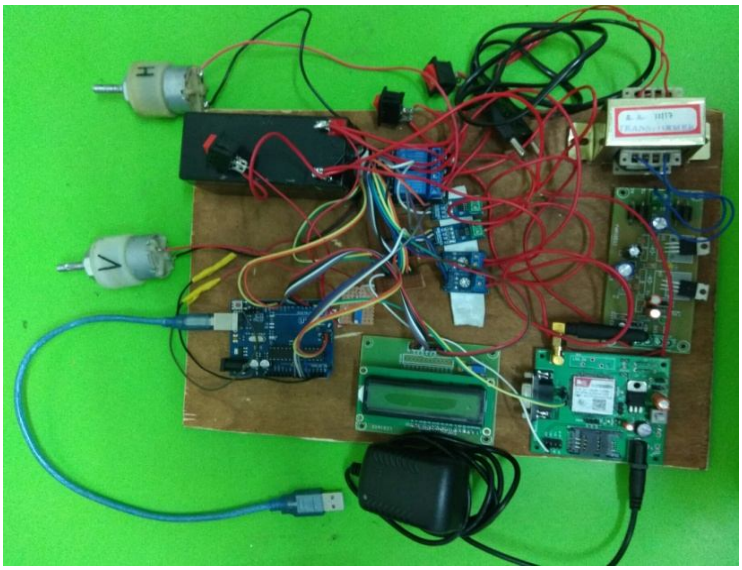

Fig 2 Proto Type for Net meter

V. CONCLUSION

In this paper we successfully implemented the hardware configuration of bidirectional smart net meter which calculate the energy gain from grid and send to grid and generate net energy charges. This module is simply designed for domestic consumer with efficient energy charges.

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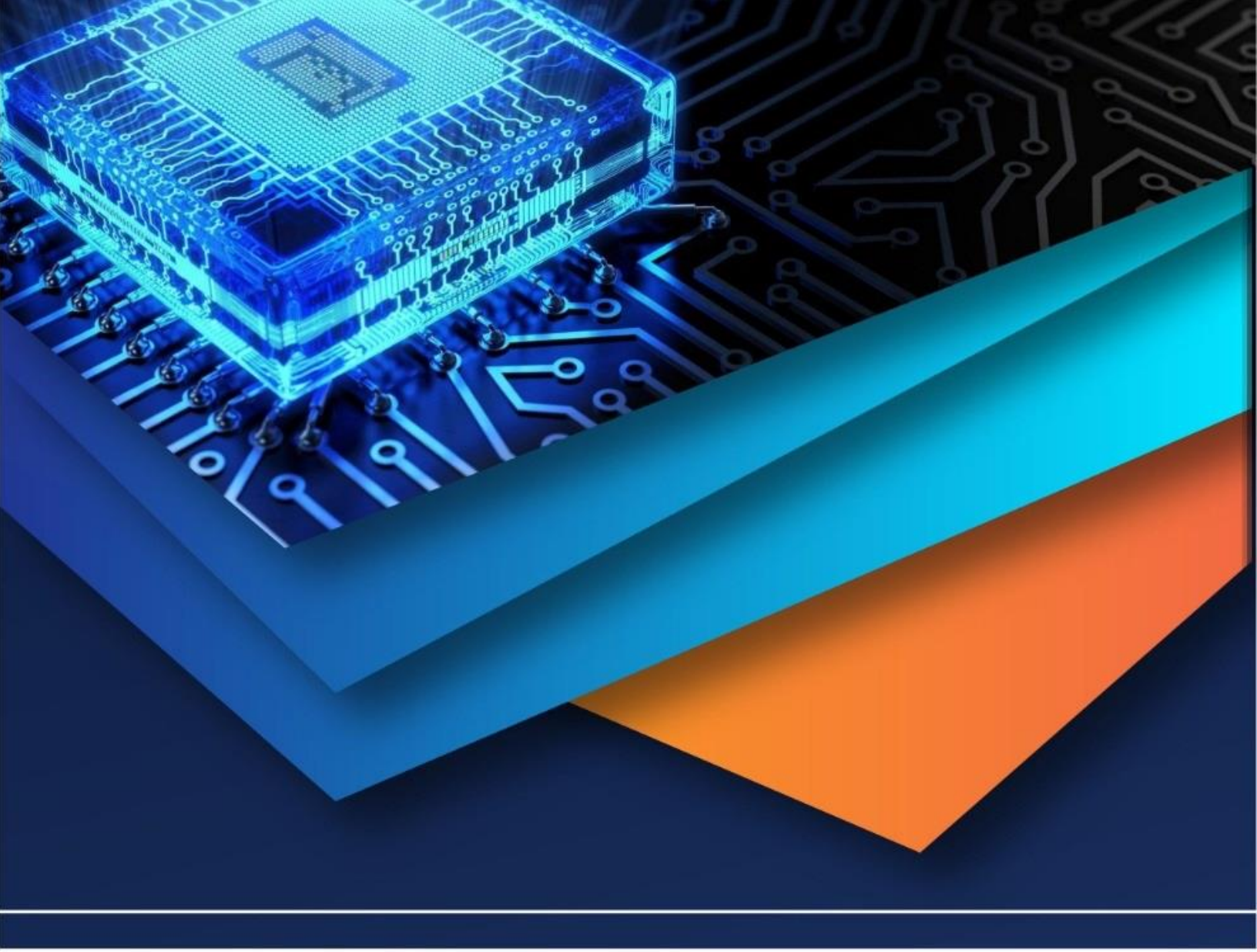
REFERENCS

[1] Maharaja, K., et al. "Development of bidirectional net meter in grid connected solar PV system for domestic consumers."Energy Efficient Technologies for Sustainability (ICEETS), 2016 International Conference on. IEEE, 2016.
[2] Tony, Tania, P. Sivraj, and K. K. Sasi. "Net energy meter with appliance control and bi-directional communication capability."Advances in Computing, Communications and Informatics (ICACCI), 2016 International Conference on. IEEE, 2016.
[3] Mohassel, Ramyar Rashed, et al. "Application of Advanced Metering Infrastructure in Smart Grids." Control and Automation (MED), 2014 22nd Mediterranean Conference of. IEEE, 2014..
[4] Hossain, Md Shakhawat, and M. Tariq Iqbal. "Grid connected energy storage system to profit from net-metering and variable rate electricity." Electrical and Computer Engineering (CCECE), 2014 IEEE 27th Canadian Conference on. IEEE, 2014.
[5] Thakur, Jagruti, and Basab Chakraborty. "Smart net metering models for smart grid in India." Renewable Energy Research and Applications (ICRERA), 2015 International Conference on. IEEE, 2015.
[6] Deskar, Vinayaka R., et al. "Design of net meter using FPGA." Recent Trends in Electronics, Information & Communication Technology (RTEICT), IEEE International Conference on. IEEE, 2016.
[7] Chakraborty, Ajoy Kumar, and Navonita Sharma. "Advanced metering infrastructure: Technology and challenges."Transmission and Distribution Conference and Exposition (T&D), 2016 IEEE/PES. IEEE, 2016.
[8] Ahmad, Adnan, et al. "An Optimized Home Energy Management System with Integrated Renewable Energy and Storage Resources." Energies 10.4 (2017): 549.
[9] Matanza, Javier, Sadot Alexandres, and Carlos Rodríguez-Morcillo. "Advanced metering infrastructure performance using European low-voltage power line communication networks." Iet Communications 8.7 (2014): 1041-1047.
[10] Khan, M. F., Jain, A., Arunachalam, V., & Paventhan, A. (2014, July). Roadmap for smart metering deployment for Indian smart grid. In PES General Meeting| Conference & Exposition, 2014 IEEE (pp. 1-5). IEEE.
[11] Pravin S Phutane Rahul A Gorde, Swapnil V Shinde, Vishal S Deshmukh "Demand Side Management (DSM) Through (V2H) Vehicle to Home and (H2V) Home to Vehicle System" International Journal of Emerging Technologies and Innovative Research volume 5, issue 4, (April 2018): 2349-5162
[12] Zagade, A. S., Sadagar, R. P., Naiknaware, S. J., & Phutane, P. S. Review on Micro-generation of Electricity Using Rooftop Turbine Ventilator (RTV).



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