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FPGA DESIGN BASED AUTOMATED ELECTRICITY PREPAID BILLING SYSTEM

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Abstract- Electric energy meters, the direct billing interface between utilities and consumers for long, have undergone several advancements in the last decade. The conventional electromechanical meters are being replaced by new electronic meters to improve accuracy in meter reading. Still, the Indian power sector faces a serious problem of lean revenue collection for the actual electric energy supplied owing to energy thefts and network losses. One of the prime reasons is the traditional billing system which is inaccurate, slow, costly, and lack in flexibility as well as reliability.
Therefore, attempts are being made to automate the billing systems. Even though more accurate and faster meter readings have seen the light of day, bill payment is still based on an old procedure. They require an individual/agent to personally come down to customer place and note the meter readings and report the amount one has to pay to the household/office. But the demand for computing power at all levels of electronic systems is driving advancements in semiconductor chip technology.
A Prepaid Energy Meter enables power utilities to collect electricity bills from the consumers prior to its consumption. The prepaid meter is not only limited to Automated Meter Reading [AMR] but is also attributed with prepaid recharging ability and information exchange with the utilities pertaining to customer's consumption details. The idea of prepaid metering will be very important for the new research fields of Micro-grid and Smart Grid and is an inevitable step in making any grid smarter than it is now. The use of electronic token prepayment metering has been widely used in the coming days to avoid the payments losses. So in this project we are implementing the prepaid electricity bill meter.

Index Terms- AMR, FPGA, RTL, PLD

I. INTRODUCTION

Electric energy meters, the direct billing interface between utilities and consumers for long, have undergone several advancements in the last decade. The conventional electromechanical meters are being replaced by new electronic meters to improve accuracy in meter reading. Still, the Indian power sector faces a serious problem of lean revenue collection for the actual electric energy supplied owing to energy thefts and network losses. One of the prime reasons is the traditional billing system which is inaccurate, slow, costly, and lack in flexibility as well as reliability.
The present practice of electricity billing is manual method only. With this, the total billing is a time-consuming process and it requires more manpower. The collection of billing is late procedure and so many consumers may not pay in time. Disconnecting of unpaid connections is also manual. Due to all these drawbacks, we cannot have proper auditing. To overcome these drawbacks, we are implementing this project. If this system comes in our day-to-day life, it will be useful for both the Government and the public.
The objective of the project is to make the user comfortable to plan his usage of power on the beforehand as we can determine the difference between the actual power consumed and sold power easily. When system is on, it starts counting the number of units and reduces the available balance simultaneously. On completion of amount, it checks whether the backup is available or not. If it is available, it again starts counting the units. Otherwise, it disconnects the line automatically with an alarm prior to that unless the system is recharged again.
In this project documentation, we have initially put the definition and objective of the project as well as the analysis and design of the project which is followed by the implementation and result phases. Finally, the project has been concluded successfully and also the future enhancements of the project were given in the documentation.

II. EXISTING WORK OR LITERATURE SURVEY

The present system of energy billing is error prone and also time and labor consuming. Errors get introduced at every stage of energy billing like errors with electro-mechanical meters, human errors while noting down the meter reading, and errors while

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processing the paid bills and the due bills. There are many cases where the bill is paid and then is shown as a due amount in the next bill. There is no proper way to know the consumers maximum demand, usage details, losses in the lines, and power theft.

The major drawback of a postpaid system is that there is no control of usage from the consumer's side. There is a lot of wastage of power due to the consumer's lack of planning of electrical consumption in an efficient way. Since the supply of power is limited, as a responsible citizen, there is a need to utilize electricity in a better and efficient way. The distribution company has to receive huge amounts in the form of pending bills, which results insubstantial revenue losses and also hurdles to modernization because of lack of funds. The remedy for this drawback is prepaid energy billing, which could be titled "Pay first and then use". There are clear results from many countries where a prepaid system has reduced the usage (wastage) by a large amount. Another advantage of the prepaid system is that the human errors made reading meters and processing bills can be reduced to a large extent.

The billing system is minimally able to detect power theft and even when it does it is at the end of the month. Also, the distribution company is facing many problems in terms of losses. The distribution company is unable to keep track of the changing maximum demand for domestic consumers. The consumer is facing problems like receiving due bills for bills that have already been paid as well as poor reliability of electricity supply and quality even if bills are paid regularly.

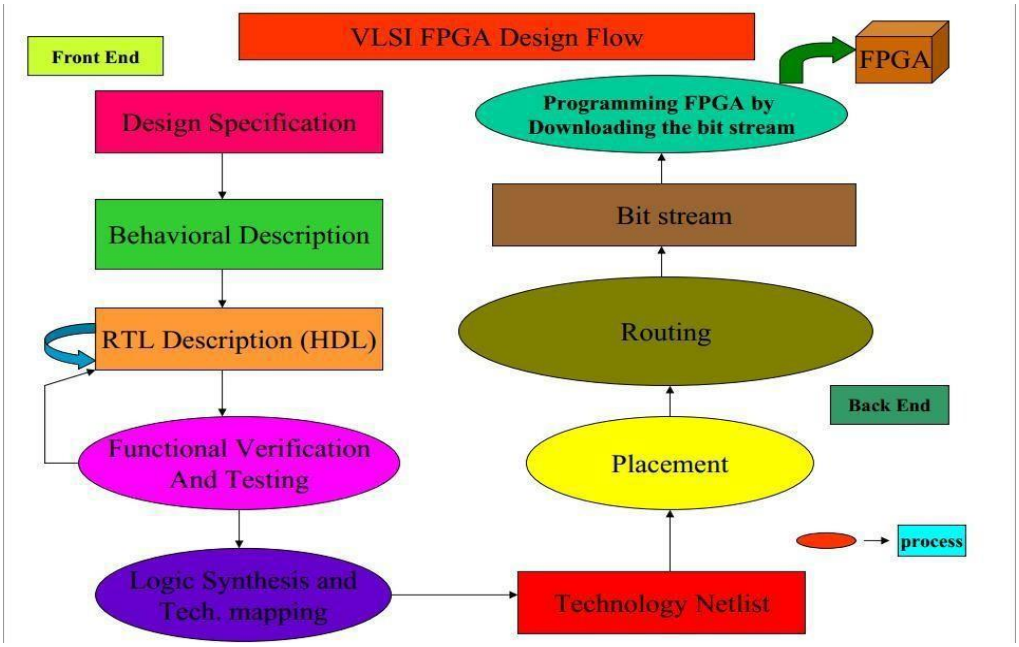
The remedy for all these problems is to keep track of the consumers load on a timely basis, which will help assure accurate billing, track Maximum demand, and detect online theft. These are all the features to be taken into account for designing an efficient energy billing system. The present project Prepaid energy meter for India incorporates these features to address the problems faced by both the consumers and the distribution companies.

Thus, a Prepaid Energy Meter was introduced for embedded applications which enables power utilities to collect electricity bills from the consumers prior to its consumption came into existence in which a micro controller is interfaced with an energy metering circuit, keypad and a display to display total units and balance amount, a contactor to make or break power line, and a buzzer indicator. At the sub-station end, a PC is connected with all energy meters using any communication channel. This prepaid meter is not only limited to Automated Meter Reading [AMR] but is also attributed with prepaid recharging ability and information exchange with the utilities pertaining to customer's consumption details.

Still advancements took place and efforts are being made to implement a vlsi based prepaid electricity billing system which has the following advantages.

III. WRITE DOWN YOUR STUDIES AND FINDINGS(PROPOSED WORK)

FPGA Design Flow:



Applications of FPGAs

Application areas of FPGAs are quite diverse and wide ranging. Broadly speaking, major application areas of FPGAs are: Digital Signal Processing (DSP), video processing, software defined radio, control systems engineering, bioinformatics, aerospace and

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defense systems, computer vision, speech recognition and processing, medical imaging, computer hardware emulation, ASIC prototyping, reconfigurable computing and radio astronomy etc.

Traditionally, FPGAs are utilized in applications where the volume of production is small and development resources and expenses required for creating an ASIC for that low-volume application are prohibitively high.

With advancement in FPGA technology the areas of application of FPGAs are growing day by day. FPGAs are particularly suitable in applications or implementation of algorithms where parallel processing offered by the architecture of FPGA may be utilized to deliver high performance.

ALGORITHM

1. Checks whether this project (prepaid electricity billing system) should be installed in commercial (industrial) or residential area.
2. If it is residential area, say tariff1 is taken into account while billing is done.

3. If it is commercial area, say tariff2 is taken into account.

4. After tariff is set, it verifies whether the password entered to the system is correct or not.

5. Then, it checks the balance. If balance is available, it starts counting the units and balance deduction is done simultaneously.
6. In case, if there is no balance available in the system, it checks for the availability of backup. If backup is available, then backup is assigned to the balance for further deduction.
7. If even there is no backup available, then it asks whether to switch off the system or not.

8. If we wish to stop the process, we can switch off the system.

FLOW CHART

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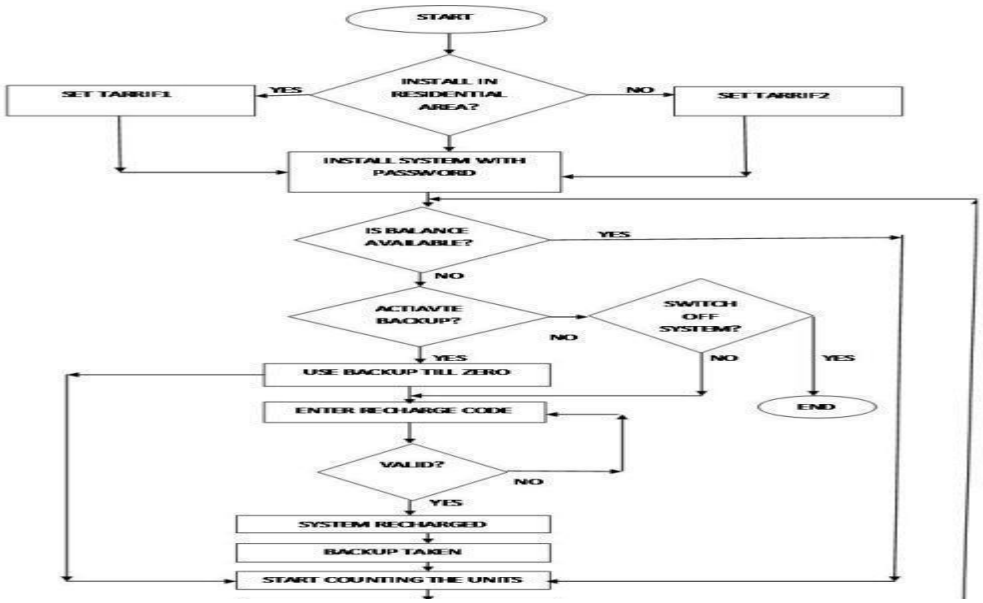
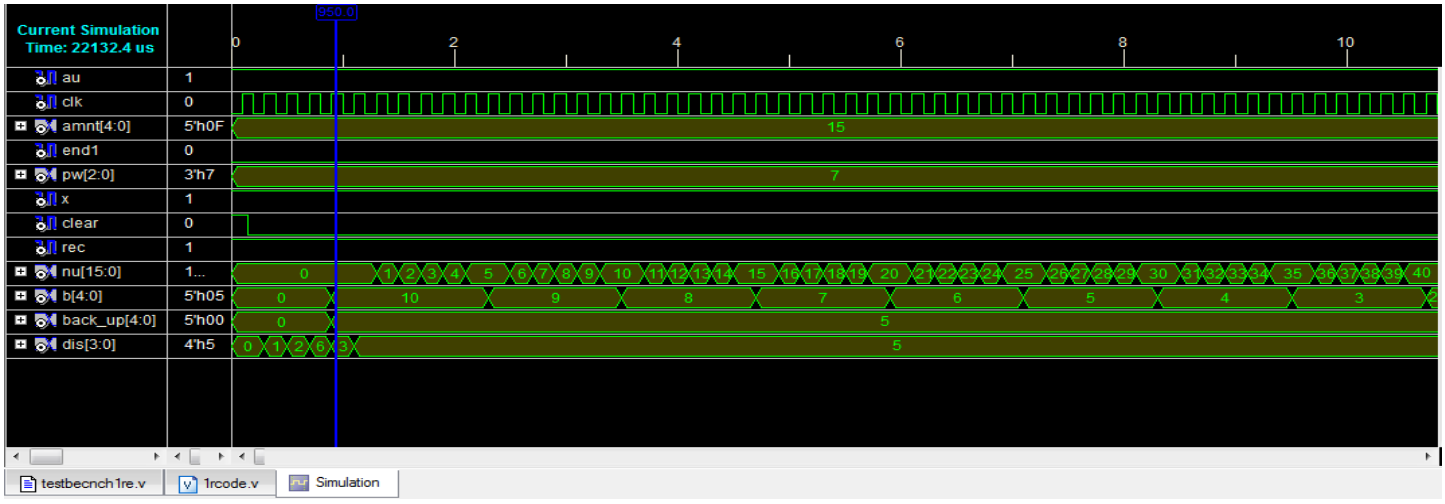


IV. RESULTS AND DISCUSSION(IF ANY)

Specification for which this code is written is units should increment by 1 at a time whereas the balance deduction of 1 rupee takes place for every 5units.

SIMULATED WAVEFORM



Design Utilization Summary

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Device Utilization Summary			
Logic Utilization	**Used**	**Available**	**Utilization**
Total Number Slice Registers	28	9,312	1%
Number used as Flip Flops	7		
Number used as Latches	21		
Number of 4 input LUTs	7,433	9,312	79%
Logic Distribution			
Number of occupied Slices	3,876	4,656	83%
Number of Slices containing only related logic	3,876	3,876	100%
Number of Slices containing unrelated logic	0	3,876	0%
Total Number of 4 input LUTs	7,438	9,312	79%
Number used as logic	7,433		
Number used as a route-thru	5		
Number of bonded IOBs	18	232	7%
IOB Latches	2		
Number of GCLKs	2	24	8%
Total equivalent gate count for design	45,735		
Additional JTAG gate count for IOBs	864		

V CONCLUSION

It is estimated that approximately 9% to 18% of the power being generated in the India is stolen. Other than the loss of revenue to the distribution unit, power theft also has adverse effects on consumers and society. One effect to consumers is the increase in the fees paid by consumers who pay for power; consumer may be billed for power based upon the amount of power consumed. The other important advantage of using this system is that a tampered energy meter can be quickly detected, and power pilferage can be minimized.

The energy meter is adaptable to power tariff. Thus when there is a change in power tariff there is no need to change the meter code. The operator at the substation will calculate the number of units based on the existing tariff and recharge the meters in terms of KWh. Since the energy billing is pre-paid, the consumers will now use electricity in a better planned manner thereby reducing wastage.

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