

GROUP 6 - Electricity Billing System Using Verilog



FINAL REPORT

EC332 DIGITAL SYNTHESIS LAB

Botla Shrestha

21EEB0A17

Challa Abhinay

21EEB0A18

Chennupati Mahathy

21EEB0A19

Department of Electrical and Electronics Engineering

To

Prof. Ekta Goel

Assistant Professor

Department of Electronics & communication Engineering

NATIONAL INSTITUTE OF TECHNOLOGY

(An Institute of National Importance)

WARANGAL

TELANGANA, 506004

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Introduction:

In the current technological landscape, automation is significantly impacting society, with the realization of smart homes becoming increasingly plausible. There is a growing demand from users for fully automated electronic products that can monitor the environment, control electric appliances, and communicate with the outside world. This project focuses on the development of an automated Electricity Billing Machine (EBM), providing users with the ability to track their electricity consumption in terms of units and associated costs. The aim is to create a model that simplifies traditional energy meters, incorporating additional features such as displaying due dates, incurred fines, and other relevant information.

In today's rapidly advancing technological environment, the need for efficient and intelligent solutions in the electrical systems domain has never been more critical. With the global dependence on electricity on the rise, innovative and effective billing systems are essential. This project report delves into the conceptualization, design, and implementation of an Electrical Billing System using Verilog, a widely used hardware description language in digital design and electronic systems.

The primary goal of this project is to develop an advanced billing system that can precisely monitor and bill electricity consumption. Going beyond traditional billing methods, the proposed system integrates advanced features to improve accuracy, flexibility, and user-friendliness. Utilizing the capabilities of Verilog, a versatile hardware description language renowned for describing complex digital systems efficiently, our objective is to create a robust and adaptable solution seamlessly integrable into diverse electrical infrastructure environments.

Significance of the Project:

Automation and Efficiency: The use of Verilog in an electrical billing system automates and streamlines the billing process, enhancing overall efficiency. Verilog's capability in describing complex digital systems ensures a high degree of automation in monitoring and billing electrical consumption.

Real-time Monitoring: Verilog enables real-time monitoring of electrical usage, providing users with up-to-date information on their consumption patterns. This real-time data empowers consumers to make informed decisions about their electricity usage and helps in optimizing energy efficiency.

Precision and Accuracy: Verilog-based electrical billing systems offer a high level of precision and accuracy in tracking electricity consumption. This ensures that users are billed accurately, reducing discrepancies and promoting transparency in the billing process.

Flexibility in System Design: Verilog's versatility allows for flexible system design, accommodating various functionalities and features in the billing system. This flexibility ensures that the system can be tailored to meet specific requirements and adapt to different scales of electrical networks.

Integration with Advanced Features: Verilog facilitates the integration of advanced features beyond basic billing, such as displaying due dates, fine calculations, and other relevant information. This adds value to the billing system, providing users with a comprehensive overview of their electricity usage and associated costs.

Seamless Integration: Verilog-based solutions can be seamlessly integrated into existing electrical infrastructure environments. This adaptability ensures that the electrical billing system can be implemented without significant disruptions to the existing setup, making it a practical and feasible solution.

Enhanced User Experience: The use of Verilog enhances the overall user experience by providing a reliable, user-friendly interface. This ensures that consumers can easily navigate and understand their electricity usage data, fostering better engagement with the billing system.

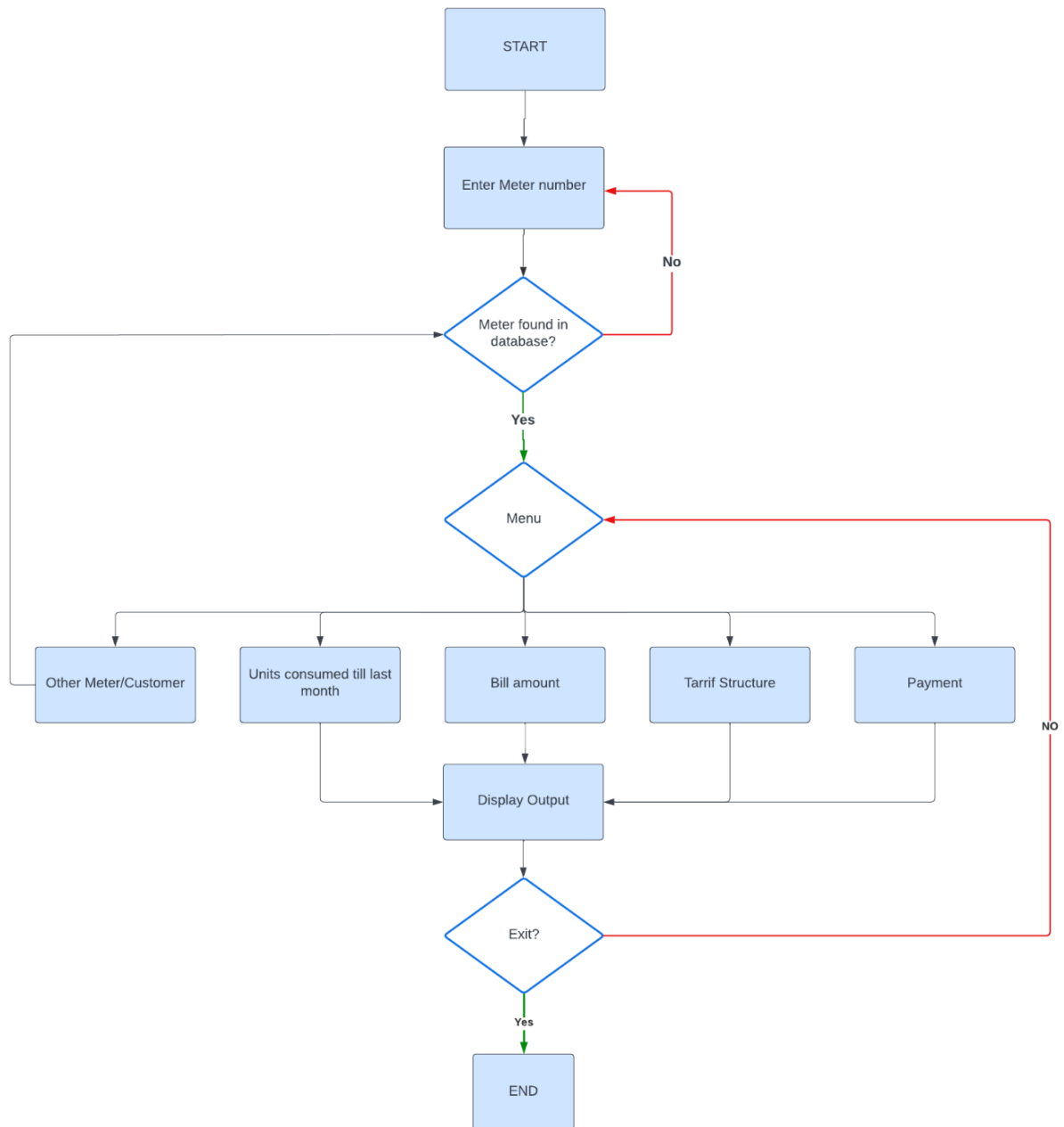
Technological Innovation: Implementing Verilog in electrical billing systems represents a technological innovation in the field of digital design and electronic systems. This innovation paves the way for future developments in smart billing solutions, aligning with the ongoing evolution of electrical infrastructure in the modern era.

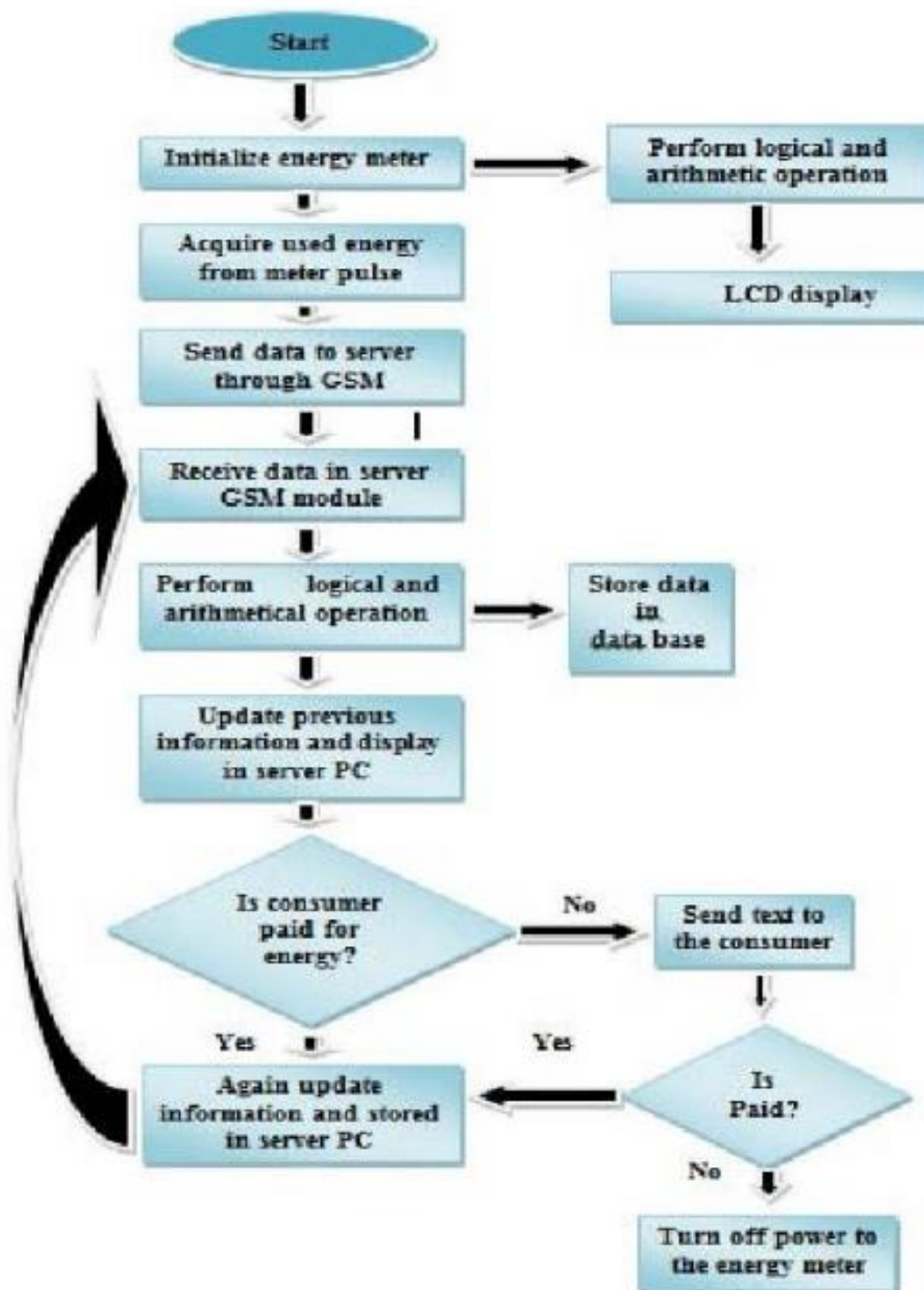
Objectives of the Project:

Behavioral Modeling: Implement a behavioral model of a digital voting machine in Verilog, emphasizing the design and simulation aspects.

Development of Automated Monitoring: Create a system capable of automatically monitoring and recording electricity consumption, providing real-time data for users to track usage patterns.

Block Diagram / Flow Chart:





Methodology:

Initially, the user has to enter his electricity meter number in the EBM to initialize it. If the entered meter is available in the database, EBM will display the number of units consumed by the user and the amount to be paid along with fine incurred due to late payment or any other reasons. If the user pays the amount, then it will be updated in the database and the EBM will be reset.

Use of Verilog: Verilog was chosen for its suitability in describing digital systems. It provides an efficient way to model the behaviour of the voting machine. Behavioural modelling in Verilog allows the focus on defining the functionality of the system rather than the specific hardware implementation.

Arrays for Meter numbers and watts consumed efficiently: Arrays were employed in database to store Meter numbers and watts consumed efficiently. Meter IDs are were stored to ensure accuracy in identifying the customer. The array allowed for quick and direct indexing based on the Meter ID.

Step-by-Step Explanation of billing Process:

Initialization: The Electrical billing machine starts in an initialized state. The system stores all data, including meter numbers, meter IDs, Last paid date, and some other information.

Identifying the particular meter/customer: Every meter is assigned with a particular index number with which it will be identified in the database. Once the meter number is entered the meter ID will be searched in the database and this unique index is stored as meter ID till the operations on that particular meter are completed. Every data related to a particular meter or customer can be accessed with this meter ID.

Displaying units consumed till last month: The units consumed by a particular user till the last time they paid the bill will be stored in the database and this can be viewed using the meter no/ID.

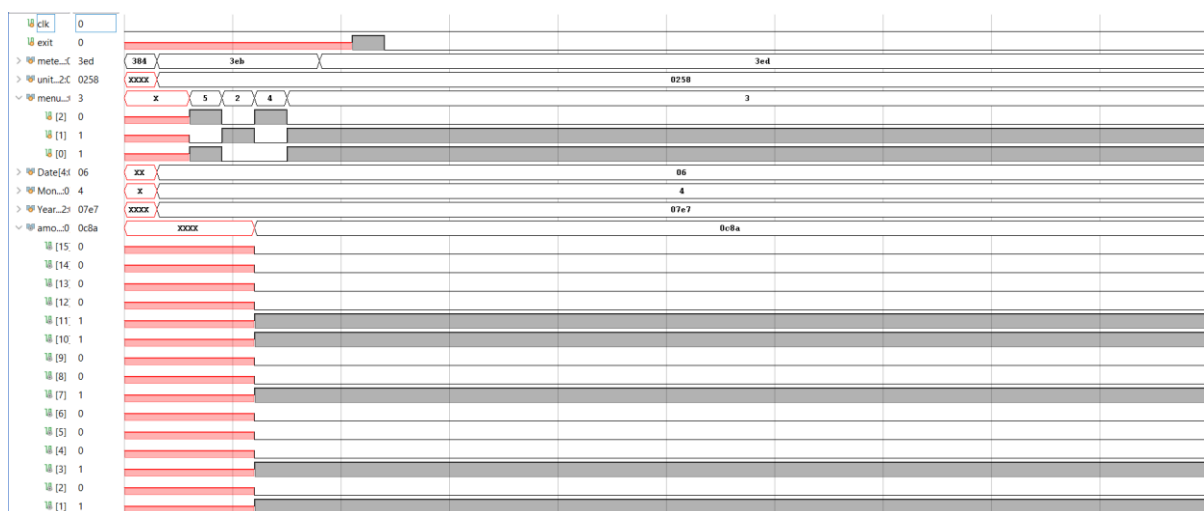
Bill amount: Based on the number of units consumed by the consumer in that particular period of time and the tariff structure, the consumer is levied an amount which can calculated and displayed.

Tariff Structure: Tariff is a dynamic thing which changes with change in demand-supply natures at a particular time.

Payment: Payment gateway can be chosen by the Electricity board. The consumer will be redirected to that particular gateway. Authentication will be done and payment can be made by the consumer.

Simulation and Testing: The Verilog code is tested using a comprehensive testbench. Test cases include scenarios with different voter IDs, votes, and reset conditions. Simulations are run to verify that the voting machine behaves as expected in various situations.

Output Waveform:



TCL Console:

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# run 1000ns
Meter number not found in database
Meter number found in database
Logged In.
Tariff amount to be paid for units below 100: Rs.0
Tariff amount to be paid for units below 200: Rs.4
Tariff amount to be paid for units below 300: Rs.5
Tariff amount to be paid for units above 300: Rs.6
Meter no: 1003
Units consumed till last month: 400
No of consumed this month: 200
Last Due Date: 27 - 4 - 2023
Total amount to be paid: 3210
You have paid the bill!
Next Due Date is: 6 - 5 - 2023
Meter number found in database
Exit

```

Result:

The above proposed project of Electricity Billing Machine is thus successfully implemented in Verilog HDL language. The EBM implemented in this project takes user's meter number as the input and the output is displayed in TCL console. We also checked for different type of cases of user credentials and inputs given in the testbench. The expected output was successfully obtained.

Challenges related to efficient array indexing has been successfully addressed. Careful design considerations and validation processes ensure the reliability of the system.

Conclusion:

The primary goal of this project was to develop an advanced billing system that can precisely monitor and bill electricity consumption. Going beyond traditional billing methods, the proposed system integrates advanced features to improve accuracy, flexibility, and user-friendliness. And this proposed project is successfully implemented. But the future scope of this project is that it can further developed in such a way that it can be synchronized with the energy meter as well and give the billing status dynamically with the time.