B.M.S. COLLEGE OF ENGINEERING
Bengaluru – 560019
Autonomous College Affiliated to Visvesvaraya
Technological University, Belgaum

A Report on Internship

"A Value Added Course on VLSI by SkillDzire "

Submitted in partial fulfilment of the requirement for the award of the degree
Bachelor of Engineering in Electronics and Communication Engineering

SEMINAR ON INTERNSHIP [22EC6SRIN2]
Submitted by

Nandan P Kashyap 1BM21EC082

Academic Year

2023-24

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BMS College of Engineering
Bull Temple Road, Basavanagudi, Bengaluru-560019

ACKNOWLEDGEMENT

I would like to extend my heartfelt gratitude to SkillDzire Private Limited for offering me the opportunity to enroll in their esteemed organization's Value Added Course on VLSI This experience has significantly enriched my knowledge and skills in the field.

Additionally, I am thankful to our college, B.M.S. College of Engineering, and the Department of Electronics and Communication Engineering for consistently encouraging internships and facilitating creative projects, which have been instrumental in shaping my academic and professional journey. These opportunities have not only broadened my horizons but also prepared me to face the challenges of the industry with confidence and competence.

BMS COLLEGE OF ENGINEERING

ABSTRACT

The VLSI course offered by SkillDzire, a prominent real-time learning platform in India, provided a comprehensive educational experience approved by the All India Council for Technical Education (AICTE) for internships. I was introduced to VLSI, starting from the basics and advancing to more complex topics. Testing and simulation of the processor were conducted using a comprehensive testbench in Verilog, verifying the correct execution of instruction sequences and the interaction between different modules. The results demonstrate the processor's capability to execute a range of instructions reliably and accurately, adhering to the principles of multi-cycle execution. A live project was also presented, allowing participants to apply their knowledge in a practical, real-world context. This thorough training equipped me with the necessary skills to effectively address real-world data science challenges, bolstered by the credibility of AICTE approval.

Moreover, the course fostered a collaborative learning environment where I engaged with industry-standard tools, enhancing my proficiency in VLSI problem solving and also the technical skills. The practical insights gained from the live project not only reinforced theoretical learning but also developed my problem-solving abilities and project management skills. As a result, I am well-prepared to contribute meaningfully to real-world initiatives and pursue further advancements in the dynamic field of VLSI.

BMS COLLEGE OF ENGINEERING

DECLARATION

I, **Nandan P Kashyap, with USN 1BM21EC082**, student of sixth semester B.E in Electronics and Communication Engineering, BMS College of Engineering, Bangalore, hereby declare that the internship, titled, "**A Value Added Course on VLSI** " was carried out by me for a duration of **5** weeks at **SkillDzire**. This report describes the work done by me in internship and the report is uniquely prepared by me.

I also declare that to the best of my knowledge and belief, this work is original and has not been presented elsewhere as an internship report or for any other purpose.

Place: Bangalore
Date: 19-06-2024   Signature of the Student

BMS COLLEGE OF ENGINEERING

INTERNSHIP COMPLETION CERTIFICATE

BMS COLLEGE OF ENGINEERING

BMS College of Engineering

Department of Electronics and Communication Engineering, Bangalore
Bull Temple Road, Basavanagudi, Bangalore-560019
(Autonomous college affiliated to Visvesvaraya Technological University, Belgaum)

CERTIFICATE

This is to certify that the Internship report on "VLSI" submitted by Nandan P Kashyap (USN: 1BM21EC082) is work done by her/him at SkillDzire and submitted during 2023 – 2024 academic year, in partial fulfilment of the requirements for the award of the degree of Bachelor of Engineering in Electronics and Communication engineering.

Internship Coordinator   HoD   Principal
Dept. Of ECE   Dept. Of ECE   BMS College of Engineering

        Signatures

   1. Examiner 1 :   ---------------------

   2. Examiner 2:   ---------------------

TABLE OF CONTENTS

BMS COLLEGE OF ENGINEERING

COMPANY PROFILE:

Background of the company:

SkillDzire is an educational platform in India focused on providing real-time, job-oriented courses. It caters to fields such as engineering, management, and pharmaceuticals, offering training by industry experts. The platform emphasizes practical learning with live projects and has AICTE approval for internships. SkillDzire aims to enhance employability through certification, job placement support, and comprehensive training programs, integrating live and recorded sessions to ensure participants are industry-ready.

Products and Services of the Company:

Courses: SkillDzire provides a wide range of courses tailored to industry needs. These include:
- **Engineering Courses**: Electrical Design, Mechanical Design, Electric Vehicle Technology, Civil Design, Embedded Systems with Python, Data Science, Full Stack Development, and Cybersecurity,VLSI.
- **Management Courses**: Business Analytics, Strategic HR Management, Sales & Marketing Communications, Finance & Accounting, Finance Modelling & IFRS, Investment Banking, Digital Marketing, and Gaming, Multimedia & Animation.
- **Pharmaceutical Courses**: Clinical Research and Medical Terminology.

Training and Certification: The platform emphasizes practical, real-world training through live projects, industry visits, and interactions with industry experts. Certification is provided upon course completion, enhancing employability and credibility in the job market.

Placement Support: SkillDzire offers lifetime placement support, including grooming sessions, mock interviews, and technical tests to prepare students for job opportunities. The platform has connections with over 450 companies that actively hire SkillDzire learners.

Flexible Learning Options: Courses are available in both live and recorded formats, ensuring accessibility and flexibility. The platform also offers easy monthly installments and pay-later options to make education financially accessible.
SkillDzire aims to bridge the gap between academic learning and industry requirements by providing comprehensive training programs designed to make participants job-ready.

Role and Responsibility of the intern:

As an intern, my responsibilities encompassed engaging with instructional videos, completing designated assignments, and participating in regular assessments to solidify my understanding of VLSI (Very Large Scale Integration) concepts. This involved attentively watching videos to grasp theoretical principles and practical applications specific to VLSI design, followed by diligently completing related assignments to demonstrate my comprehension.
Participating in assessments at regular intervals allowed me to evaluate my knowledge retention and apply learned concepts effectively in the context of VLSI. Effective time management was crucial to meet deadlines for submissions while ensuring the quality and accuracy of my work. Additionally, I engaged in self-study to reinforce learning, sought

feedback to enhance my performance, and maintained communication with instructors to clarify doubts and discuss course content.

Adhering to course guidelines and ethical standards was essential to ensure integrity in my academic endeavors. This structured approach contributed to a productive learning experience aimed at achieving personal and professional growth in VLSI design and technology. My proactive efforts in managing time, seeking clarification, and applying feedback were instrumental in maximizing the benefits of the internship and advancing my expertise in the field of VLSI.

LITERATURE SURVEY:

The field of Very Large Scale Integration (VLSI) system design is a cornerstone of modern electronics, encompassing a wide range of methodologies and challenges from front-end to back-end design flows. At the architectural level, VLSI design begins with the conceptualization of complex digital systems, translating high-level requirements into functional specifications. This involves combinational logic design, where logic gates and truth tables form the basis of digital circuits. Techniques such as Karnaugh maps and the Quine-McCluskey method are employed to simplify these circuits, optimizing them for efficiency and performance. Moving into sequential logic design, memory elements like flip-flops and latches play a crucial role. Here, designers address timing constraints and synchronization issues through the implementation of synchronous and asynchronous logic designs, ensuring reliable operation under various conditions.

As the design process progresses, state reduction techniques become vital in managing the complexity of sequential circuits. Flip-flops, including D, JK, and T types, are fundamental components in these designs, serving as the building blocks for more complex memory elements and state machines. Programmable Logic Devices (PLDs) such as Complex Programmable Logic Devices (CPLDs), Programmable Logic Arrays (PLAs), Programmable Array Logic (PALs), and Programmable Read-Only Memory (PROMs) are utilized to implement customized logic functions efficiently. Advanced topics in VLSI design delve into the intricacies of digital design and memory devices, including Random Access Memory (RAM), Read-Only Memory (ROM), Static RAM (SRAM), and Dynamic RAM (DRAM). These memory elements are essential for storing data and instructions, with each type offering unique advantages and trade-offs in terms of speed, density, and power consumption.

The practical application of VLSI design principles is greatly enhanced by Hardware Description Languages (HDLs), with Verilog being a prominent example. Verilog facilitates the modeling, simulation, and synthesis of digital circuits, providing a robust framework for developing and verifying designs. Key constructs in Verilog include modules, ports, and wires, which serve as the foundational building blocks for creating complex digital systems. Behavioral modeling, random stimulus generation, and verification methodologies are employed to ensure the accuracy and reliability of designs. Understanding flip-flop parameters, designing Mealy machine state diagrams, and implementing communication protocols such as Universal Asynchronous Receiver-Transmitter (UART) are integral aspects of VLSI design. The development of arithmetic logic units (ALUs) and the creation of module implementations and testbenches in Verilog culminate in a comprehensive design and verification process. This literature survey from SkillDzire encapsulates the breadth and depth of VLSI design, highlighting the continuous learning journey in mastering both foundational and advanced concepts in this dynamic field.

WORK ASSIGNED:

During my internship at SkillDzire, I undertook a variety of tasks focused on enhancing my proficiency in Verilog, critical language used for designing and simulating digital systems. Below is a summary of my assigned work:

Role: Intern in Digital Design and Development

Responsibilities and Tasks

1. **Learning Verilog:**

   ○ **Objective:** Gain a comprehensive understanding of Verilog for complex digital designs.
   ○ **Tasks:**
      ■ Explored Verilog syntax, data types, and procedural blocks.
      ■ Implemented combinational and sequential circuits, such a s multiplexers, counters, and shift registers.
      ■ Wrote testbenches to simulate Verilog designs and validate functionality.

2. **Sequence Detector Design:**

   ○ **Objective:** Apply Verilog knowledge to develop a Inter Integrated Circuit.
   ○ **Tasks:**
      ■ Designed a I2C and test its functionality.
      ■ Implemented the detector using Verilog.
      ■ Verified the design through simulation.

3. **Documentation and Reporting:**

   ○ **Objective:** Maintain detailed documentation of the projects and learning outcomes.
   ○ **Tasks:**
      ■ Created detailed reports on each project, outlining design approaches, implementation details, and simulation results.
      ■ Compiled a comprehensive technical report summarising the internship experience and key learnings.

BMS COLLEGE OF ENGINEERING

TECHNICAL TASKS ACCOMPLISHED

During my internship at SkillDzire., I worked on several technical tasks that deepened my understanding Verilog. The projects I undertook included the design and implementation of a Inter-Integrated Control protocol. Below, I provide a detailed discussion of each task, including the objectives, methodologies, and outcomes.

Inter-Integrated Control:

Objective:

Successfully able to transmit 8 bit binary 10101010 using the I2C communication protocol executed in Verilog and confirm the waveform of the out-put waveform with expected outcome.

Methodology:

- **Inter-Integrated Control (I2C) Design:**
  The sequence detector was based on an FSM, which changes its state based on the input bits and the sequence being detected. I defined states corresponding to each position in the sequence.
- Implementation in Verilog:
  Defined a similar FSM using 'always' blocks sensitive to clock edges.
  Utilised 'case' statements for state transitions.
  Created a testbench for simulation to ensure the sequence was detected accurately.

Outcome:

- Successfully designed and simulated the sequence detector.
- Gained a thorough understanding of FSM implementation in Verilog.
- Learned how to verify FSM designs through simulation.

Code:

```verilog
module i2c_controller_tb;

        // Inputs
        reg clk;
        reg rst;
        reg [6:0] addr;
        reg [7:0] data_in;
        reg enable;
        reg rw;

        // Outputs
        wire [7:0] data_out;
        wire ready;
```

```verilog
    // Bidirs
    wire i2c_sda;
    wire i2c_scl;

    // Instantiate the Unit Under Test (UUT)
    i2c_controller master (
            .clk(clk),
            .rst(rst),
            .addr(addr),
            .data_in(data_in),
            .enable(enable),
            .rw(rw),
            .data_out(data_out),
            .ready(ready),
            .i2c_sda(i2c_sda),
            .i2c_scl(i2c_scl)
    );


    i2c_slave_controller slave (
.sda(i2c_sda),
.scl(i2c_scl)
);

    initial begin
            clk = 0;
            forever begin
                    clk = #1 ~clk;
            end
    end

    initial begin
            // Initialize Inputs
            clk = 0;
            rst = 1;

            // Wait 100 ns for global reset to finish
            #100;

            // Add stimulus here
            rst = 0;
            addr = 7'b0101010;
            data_in = 8'b10101010;
            rw = 0;
            enable = 1;
            #10;
            enable = 0;
```
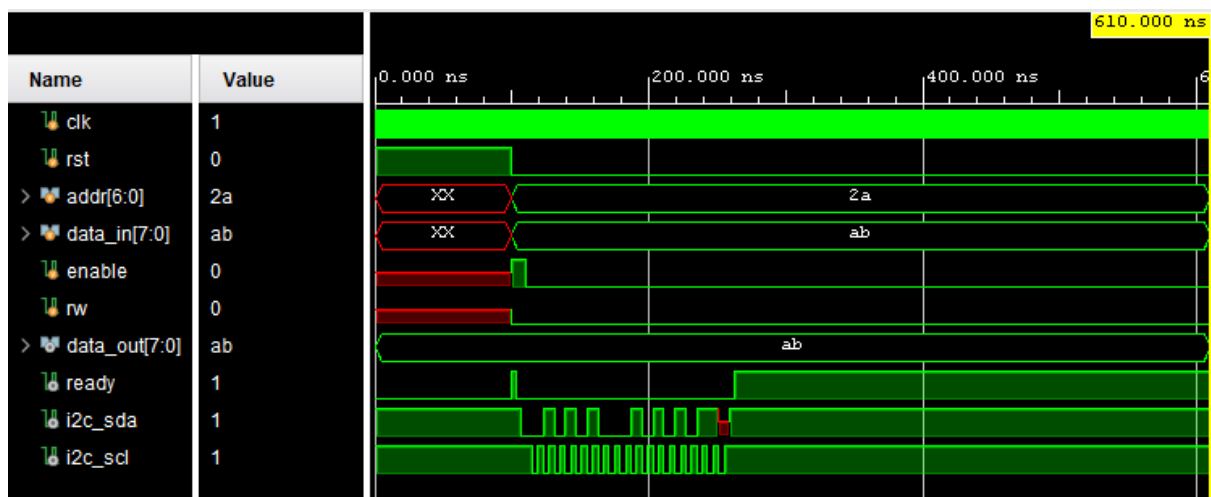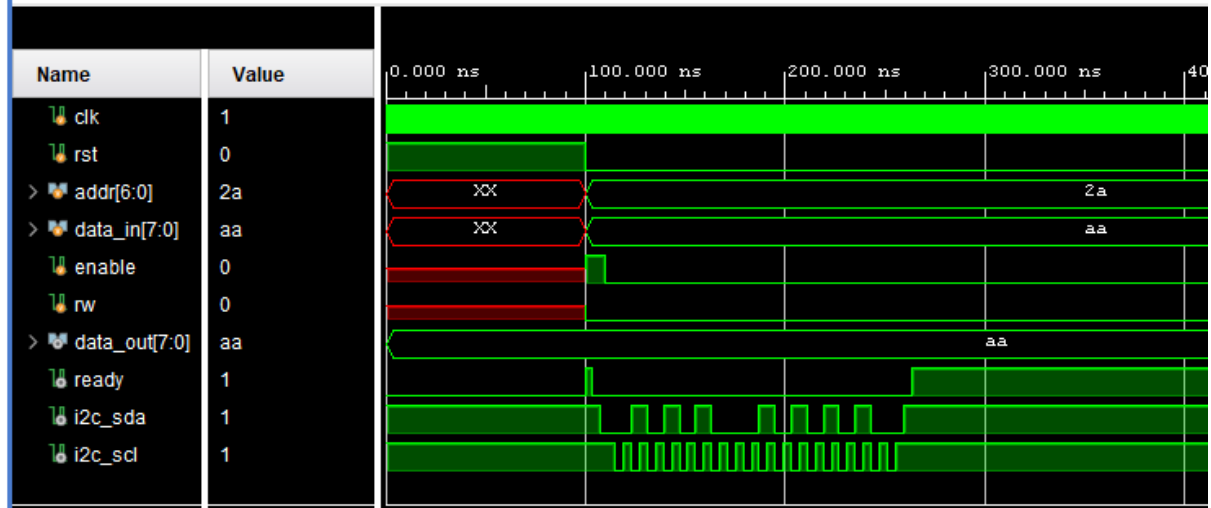
```
        #500
        $finish;


    end
endmodule
```

Output

BMS COLLEGE OF ENGINEERING

SKILLS ACQUIRED BEYOND CIRRICULUM:

1. **In-depth Understanding of VLSI Significance**: Gained advanced knowledge on the critical role of VLSI in modern electronics, understanding its importance in developing complex, high-performance electronic systems.
2. **Advanced Design Methodologies and Challenges**: Developed proficiency in modern VLSI design methodologies and an ability to navigate and address the challenges faced during the design and implementation phases.
3. **Comprehensive Design Flow Knowledge**: Mastered both front-end and back-end design flows, encompassing architectural design to physical implementation, with detailed knowledge of the tasks and processes involved at each stage.
4. **Digital and Analog Systems Proficiency**: Acquired the ability to differentiate between digital and analog systems, understanding their specific applications and characteristics within VLSI design.
5. **Expertise in Combinational Logic Design**: Enhanced skills in designing combinational logic circuits, utilizing logic gates and truth tables, and applying optimization principles to improve design efficiency.
6. **Advanced Sequential Logic Design Skills**: Gained expertise in designing sequential logic circuits, including working with flip-flops, latches, and registers, and integrating memory elements effectively.
7. **Synchronous Logic Design Mastery**: Developed advanced skills in synchronous logic design, including managing timing constraints, clock signals, and clock domain distribution techniques.
8. **Combinational Circuit Simplification Techniques**: Mastered techniques for simplifying combinational circuits using Karnaugh maps.
9. **Practical Design Application**: Enhanced practical skills by applying theoretical concepts to real-world design exercises, bridging the gap between theory and practice.
10. **Advanced Memory Device Design**: Developed expertise in designing and operating advanced memory devices, including RAM, ROM, SRAM, and DRAM.
11. **Verilog Mastery**: Mastered Verilog for VLSI design, including syntax, data types, statements, hierarchical design, and instantiation techniques.
12. **Behavioral Modeling in Verilog**: Enhanced skills in behavioral modeling using Verilog, focusing on procedural blocks, assignments, and control structures.
13. **UART Communication Protocol**: Developed skills in designing UART communication protocols, focusing on transmitter and receiver operation and timing diagrams.
14. **Verilog Testbench Development**: Enhanced expertise in developing testbenches in Verilog, including stimulus generation, assertion checking, and coverage analysis.

BMS COLLEGE OF ENGINEERING

APPLICATIONS:

The skills and experiences gained from my internship in VLSI have practical applications across various professional contexts:

1. **Fundamentals of VLSI System Design**: Mastery of VLSI principles is crucial for developing efficient, high-performance microchips used in modern electronic devices and systems.
2. **Front End & Back End Design Flow**: Expertise in VLSI design flows is essential for transforming architectural designs into physically implemented, manufacturable integrated circuits.
3. **Digital & Analog Systems**: Understanding the distinction and applications of digital and analog systems is vital for designing versatile VLSI circuits that cater to various electronic applications.
4. **Combinational Logic Design**: Proficiency in designing and optimizing combinational logic circuits is key to developing efficient computational hardware for processors and digital systems.
5. **Sequential Logic Design**: Knowledge of sequential logic design, including flip-flops and latches, is fundamental for creating memory elements and control units in integrated circuits.
6. **Synchronous and Asynchronous Logic Design**: Competence in both synchronous and asynchronous logic designs ensures robust, reliable circuit operation under varying timing conditions and protocols.
7. **Advanced Digital Design - Memory Devices**: Skills in designing memory devices like RAM and ROM are critical for developing storage solutions in computers and other electronic systems.
8. **Introduction to HDL and Verilog**: Familiarity with HDL and Verilog is essential for modeling, simulating, and synthesizing complex VLSI designs, enabling efficient development and verification of integrated circuits.

CONCLUSION:

The completion of the VLSI course with SkillDzire has equipped me with a comprehensive skill set essential for success in the field. From understanding front-end to back-end design flows, including architectural design, logic optimization, and timing considerations, to mastering Verilog for effective modeling and simulation, the course covered diverse aspects of VLSI system design. Through practical exercises and exposure to advanced topics like memory devices and communication protocols, I've gained practical insights and problem-solving abilities. This internship has deepened my understanding and prepared me to tackle real-world challenges in VLSI design with confidence and proficiency.

BMS COLLEGE OF ENGINEERING

REFERENCES:

[1] A. Morini, "VHDL-2019: Enhancing VHDL for Modern FPGA and ASIC Design," in
IEEE Access, vol. 7, pp. 92045-92056, 2019.

[2] J. Seidel and P. Herrmann, *VHDL-2019 Quick Reference*, 1st ed., Springer, 2020.

[3] C. Spear and G. Tumbush, *SystemVerilog for Verification: A Guide to Learning the Testbench Language Features*, 3rd ed., Springer, 2020.

[4] J. Bergeron et al., *Verification Methodology Manual for SystemVerilog*, 2nd ed., Springer, 2021.

[5] R. Velusamy et al., "FPGA-Based Implementation of Sequence Detector Using VHDL," in *Journal of Advanced Research in Dynamical and Control Systems*, vol. 12, no. 4, pp. 2107-2113, 2020.

[6] A. S. Bhat and A. Khan, "Design and Verification of Sequence Detector using Verilog HDL," in *International Journal of Electronics and Communication Engineering*, vol. 8, no. 3,
pp. 151-156, 2021.

[7] J. Lim et al., "Design of Intelligent Traffic Light Controller Using FPGA," in *IEEE Transactions on Intelligent Transportation Systems*, vol. 21, no. 6, pp. 2590-2601, 2020.

[8] M. K. Islam et al., "FPGA-Based Smart Traffic Light Controller for Efficient Traffic Management," in *Microprocessors and Microsystems*, vol. 78, pp. 103212, 2022.

BMS COLLEGE OF ENGINEERING

PLAGIARISM REPORT:

BMS COLLEGE OF ENGINEERING

BMS COLLEGE OF ENGINEERING