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Abstract – This paper advocates the use of free and open source interactive computerized design tool "Cedar Logic" for the design of combinational and sequential logic circuits. This tool provides a modern approach to fill the gap in the currently available computer based teaching software, with the purpose of providing alternative-mode subject delivery. The Cedar Logic is used to show the link between Boolean algebra and combinatorial and sequential circuits. Each circuit introduces new concepts and produces the complete design of a stand-alone apparatus that is fun and interesting to use.

Keywords- digital circuit; cedar logic; simulation study

I. INTRODUCTION

Traditionally digital circuit-design for beginners follows a three-stage sequence from introductory logic to combinatorial circuits and then to

sequential circuits. A Digital circuit is a representation of signals by discrete bands of analog

levels, rather than by a continuous range .Generally digital circuits are of two types a. Combinational b. Sequential. A combinational circuit consists of logic gates whose outputs at any time are determined from the present combination of inputs. A combinational circuit performs an operation that can be specified logically by a set of Boolean functions. The sequential circuit consists of a combinational circuit to which storage elements are connected to form a feedback path. The storage elements are the devices capable of storing binary information[1].

Understanding of the digital circuits becomes progressively complex when we move from Logic gates to combinational circuits and then to sequential circuits. Thus use of cedar logic for implementation of digital circuits helps to realize the basic functionality and operation of each circuits.

II. CEDAR LOGIC

CEDAR Logic Simulator[4] is a software application which allows to design logic systems in digital mode, by providing some low-level logic objects and register-level functions. One can also use it while teaching courses of computer architecture. It has a very user friendly interface and is easily comprehensible.

The interface of the program is plain and easy to work with. From the left side of the window, we can insert objects into the sheet by using the 'drag and drop' method. These items are mainly based on basic gates, inversions and connections, decorations, muxing and decoding, additions and

comparisons, flip flips, registers, RAM and ROM, along with chips. The main application window includes 10 different pages, so that we can work on multiple digital designs at the same time and seamlessly navigate back and forth between them.In addition, we can use the copy, paste, undo and redo functions, as well as export the project to a monochrome or color Bitmap file. On top of that, you may view an oscope, hide the grid lines and wire connection points, zoom in and out, as well as lock the current state.

Cedar Logic Graphical User Interface

III. DIGITAL CIRCUIT IMPLEMENTATION

Combinational circuit implementation:-The design of combinational circuits starts from the specification of the design objective and culminate in a logic circuit diagram or a set of Boolean functions on which the logic diagram can be obtained.

The procedure involves the following steps:

1. From the specifications of the circuit, determine the number of inputs and outputs and assign a symbol to each.
2. Derive the truth table that defines the required relationship between inputs and outputs.
3. Obtain the simplified Boolean functions for each output as a function of the input variables.

4 Draw the logic diagram and verify the correctness of the design (manually or by simulation).

Below some combinational circuits are shown which are designed in CEDAR LOGIC.

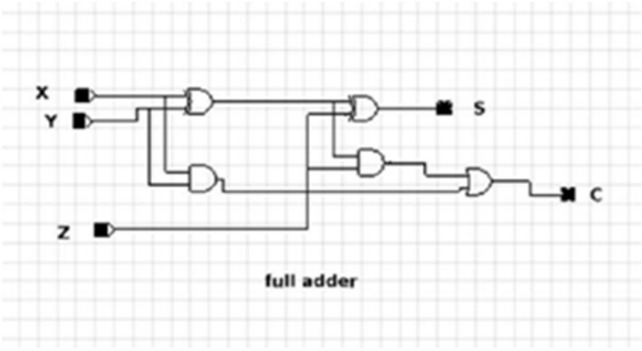

Figure 2. Full Adder Implementation using Cedar Logic

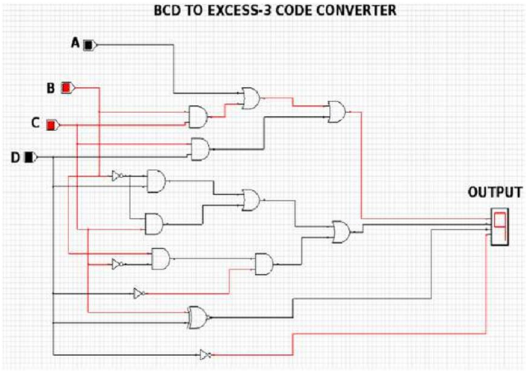

Figure 4. BCD to Excess-3 code Converter simulation

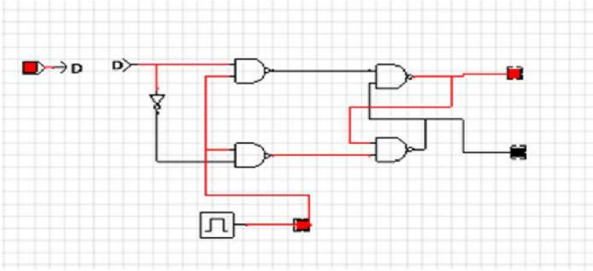

Figure 4. BCD to Excess-3 code Converter simulation

Sequential circuit implementation:-There are two main types of sequential circuits, and their classification is a function of the timing of their signals. A synchronous sequential circuit is a system whose behaviour can be defined from the knowledge of its signals at discrete instants of time.

The behaviour of an asynchronous sequential circuit depends upon the input signals at any instant of time and the order in which the inputs change. The storage elements commonly used in a synchronous sequential circuits are time-delay devices.

In asynchronous systems, the storage elements consist of logic gates whose propagation delay provides the required storage. Thus, an asynchronous sequential circuit may be regarded as a combinational circuit with feedback.

Because of the feedback among logic gates, an asynchronous sequential circuit may become unstable at time.

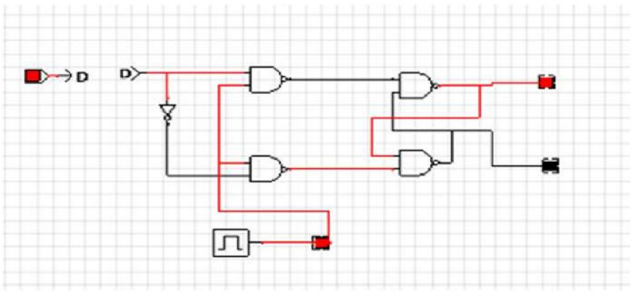

Figure 5. D-Flip Flop Implementation using Cedar Logic

Figure 6. D-Flip Flop Simulation view using O-scope of Cedar Logic

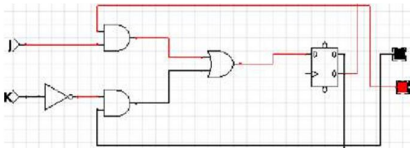

Figure 7. JK flip-flop Implementation using Cedar Logic

IV. CONCLUSION

This paper presented the design and simulation of digital circuits in an easy to use environment using Cedar Logic. The design process is simple and less time consuming. It provides detailed analysis of circuits using the oscope for visualising output waveform for variations with respect to the input. We verified different combinational circuits such as full adder, Multiplexer , BCD to Excess-3 Code converter and sequential circuits such as D-flip-flop, J-K flip-flop. Many such circuits can be designed and simulated for easy understanding and analysis.

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