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Covid- 19 Drugs Interactions Database System Implementation Using VHDL

[1]Wedad Abdul Khuder Naser, [2]Hind Jumaa Sartep, [3]Safana Hyder Abbas
Computer Science Dept, Collage of Education, Mustansiriyah University Baghdad , Iraq

Abstract— Many drug suggestions are presented to improve the success of Covid -19 treatment. As a result, detecting covid -19 drugs interactions in treatments would be important for patients' health. In this paper , a covid-19 drug interactions database, referred to as CDID, is part of the drug interaction solution designed to support physicians in making their decisions when evaluating drug interactions between drug pairs and drug safety.

The covid-19 drugs – interaction framework is suggested as a hardware implementation. VHDL is used to characterize the built architecture (Very High speed integrated circuit hardware Description Language). Using the Xilinix ISE 9.2i program, the simulation result was obtained. The timing diagram that depicts how the device operates has been obtained. The VHDL coding is used to generate the system's schematic block diagram. A chip implementation is proposed, with low memory costs and a fast processing rate.

Keywords— Drugs Interaction , Covid-19 drugs interaction , Database , Xilinix ISE 9.2i program , Very High speed integrated circuit hardware Description Language

I. INTRODUCTION

As of December 2019, a coronavirus species that can spread from person to person has been found in Wuhan, China1. The outbreak, later dubbed Covid-19, posed a threat of the World Health Organization (WHO) declaring it a pandemic in a short period of time[1]. It has been recognized that thousands of clinical trial reports and reviews have been written in order to provide treatment alternatives for the disorder. A major focus of these studies is on how current medications are used to treat Covid-19 and treatment options [2,3].

Many drug suggestions are presented to improve the success of Covid 19 treatment. Some attempts have been made to use a mixture of these drugs.. Patients can experience severe side effects if they take more than one drug at the same time. As a result, detecting drug interactions that used in the treatment of Covid 19 will be important. A database was created for this study that contains ten drugs used to treat covid 19 as well as the interactions that occur between them. It is aimed that the experimental results would make , it easier to choose safe drugs and improves the chances of Covid 19 treatment success for the intended patient.

A VHDL implementation is recommended to CDID; applying such a device is very useful on low-cost hardware, in several recent applications, FPGA has been the most widely used microelectronic technology. This is because of the FPGA's low cost and high capacity, as well as its short design time.

FPGAs preserve the characteristics of VLSI and ASIC devices while avoiding the high costs of development and the inability to make design changes after launch [7].

II. OVERVIEW OF VHDL

VHDL is a digital electronic device description language.. A component's description in VHDL is made up of two parts: an interface specification and an architectural specification. The input-output ports of the component are defined in the interface explanation, which begins with the keyword ENTITY. After ENTITY keyword, the component's name is followed by IS, which is also a VHDL keyword. The architecture body of an entity is a definition of the entity's internal implementation. An interface to an object can have a variety of different architecture bodies that correspond to different implementations of the similar function [4].

FPGA stands for Field Programmable Gate Array, and it is a logic chip that can be fully reconfigured. Millions of logic blocks (CLBs) make up this logic chip, which can be connected to form complex digital logic implementations. A network of wires and programmable switches connects the different devices. By specifying the basic logic function for each logic block, the user's design is realized. Behavioral design, functional simulation, verification, positioning, and routing are all included in a standard computer assisted design (CAD) for an FPGA [5].

III. COVID -19 DRUGS INTERACTION DATABASE (CDID)

Covid 19 – Drug Interactions Databases (CDID) are often used in clinical practice to detect possible drug interactions between drug pairs in order to provide Covid 19 patients with safe, beneficial, and successful treatment.

CDID's advantage include:

1- Data collection, retrieval, modification, and deletion, as well as other data-processing operations, are made simpler with CDIDs.

2-CDID allows adding, and creating new Covid-19 drug interactions

3- CDID enables physicians to decide which drug combinations should be avoided by determining the interactions between drugs given at the same time. Figure 1 bellow shows the block diagram of the suggested CDID system.

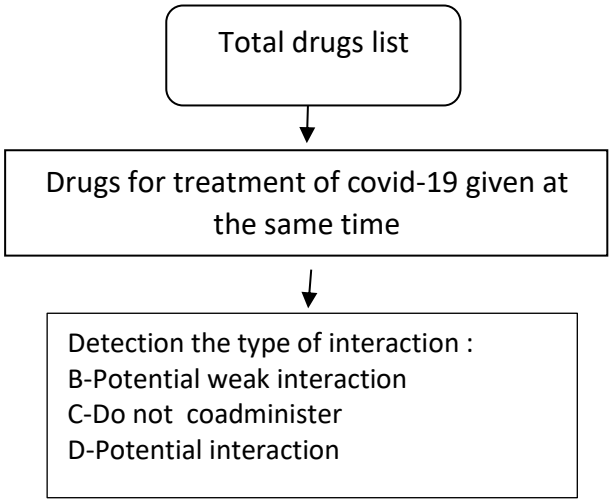


Figure 1. CDID architecture

IV. PROPOSED SYSTEM

In CDID, a database was built that contains ten drugs used to treat covid 19 and the interaction that occur between them. With the experimental results obtained, its aim is to make selecting safe drugs easier and increase the effectiveness of Covid 19 treatment.

CDID communicates with the user by receiving human questions about covid-19 drug interactions and presenting the results to the user in the form of a message indicating the type and severity of the drug interaction.

CDID contains the code for each of two covid -19 drugs that are given at the same time and also contains the code for the type of interaction between them. Table 1. show the drugs numbers that used in the data base.

Table 1. List of the used drugs.

No. of the drug	name of the covid-19 drug
1	Anokinra
2	Asperin
3	Azithromycin
4	Cloroquine
5	Colchicine
6	Acenocoumarol
7	Basiliximab
8	Pindolol
9	Acarbose
10	Pitavastation

The data stored in CDID should be given a binary code to facilitate its use in VHDL programming, as shown in the tables below. Table (2) shows that for two drugs that will be used at the same time, a code has been assigned.

Table 2. Drugs combination code.

Drug1	Drug2	Code of combination
1	6	000
1	7	001
2	6	010
3	6	011
3	8	100
4	8	101
4	9	110
5	10	111

In a table 2, the number of covid-19 drugs given at the same time is shown in the first and second columns The code for a combination of two drugs given at the same time is represented in the third column. For eg., the first row of the table means that we are using Ankara as drug 1 and Acenocoumarin as drug 2 at the same time, with the code (000) indicating their combination code.

Since there are eight different combinations (0-7) of drugs that are given at the same time, a 3-bit was used to denote the code.

The primary goal of CDID is to identify the type of interaction for the previously chosen covid-19 drugs.; there are approximately three types of interactions. Table 3 represent the code of interaction type as shown below.

Table 3. code of interaction type

Type of interaction	**code**
Potential weak interaction	00
Do not Coad minister ?	01
Potential interaction	10

Table 4 shows the relationship between the code of drug combination and the interaction type.

Table 4. The relationship between the system's inputs and outputs.

Combination Code	**Type of interaction**
000	00
001	01
010	11
011	11
100	11
101	11
110	11
111	11

The first row in the table 4 show the following :

(000): This code represents the combination of two drugs from table 2.

(00) : It's a two-bit number because there are three different types of interaction in table 3 , and this is the first type, which means potential weak interaction.

The first column represents the system's input, while the second column represents the system's outputs.

4.1 Implementation of VHDL

FPGAs are programmable logic devices that, like software, allow for design flexibility. with the capability of being reconfigured an infinite number of times after being produced FPGAs have historically been used by hardware designers as a prototyping method [6].

Xilinx ISE 9.2i was used to build the simulation environment. The simulation environment was Xilinx ISE 9.2i, and to simulate the relationship between the drug combination as an input and the interaction type as an output, a VHDL program was written.

Figure 2 show a timing diagram that illustrates how the system works. On the left side of the black screen, the following signals appeared:

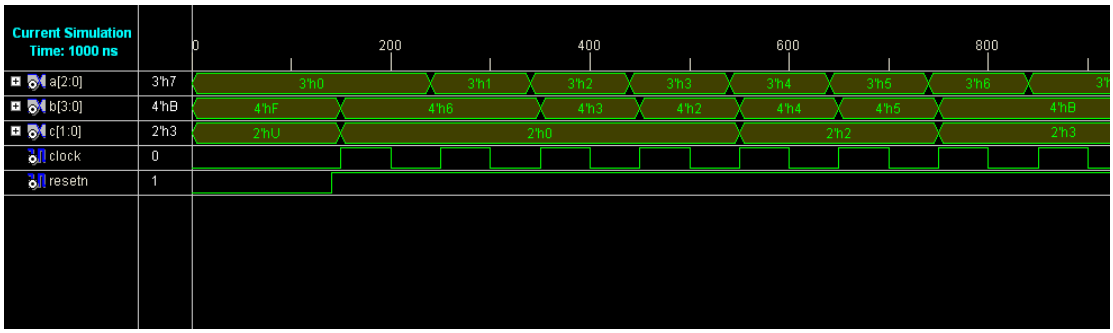


Figure 2. The system timing wave

The clock is a positive edge signal that is used to coordinate the system operation.

The resetn signal is used to put the system's service to a halt.

A. It is system input signal that represent code combination code

B . It is output signal refers to the type of interaction

As shown in the figure, when resetn is ON and a=(0)H, the outputs are b=(6)H, exactly as shown in the table 2.

The proposed system's schematic symbol is represented in Figure 3.

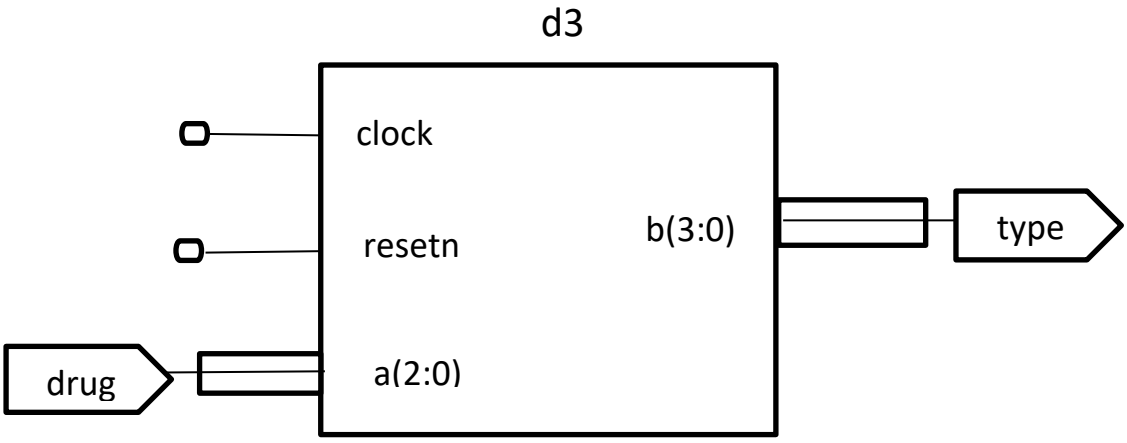


Figure 3. The schematic diagram.

The d3 is a system chip depicted in the previous figure as a black box, with a 3-bit input bus signal for the drug combination code and a 2-bit output bus signal for the form of interaction, both with a positive edge clock and 1-bit resetn signal.

The internal FPGA structure of the prior figure, which represents the gate level, is shown in Figure 4.

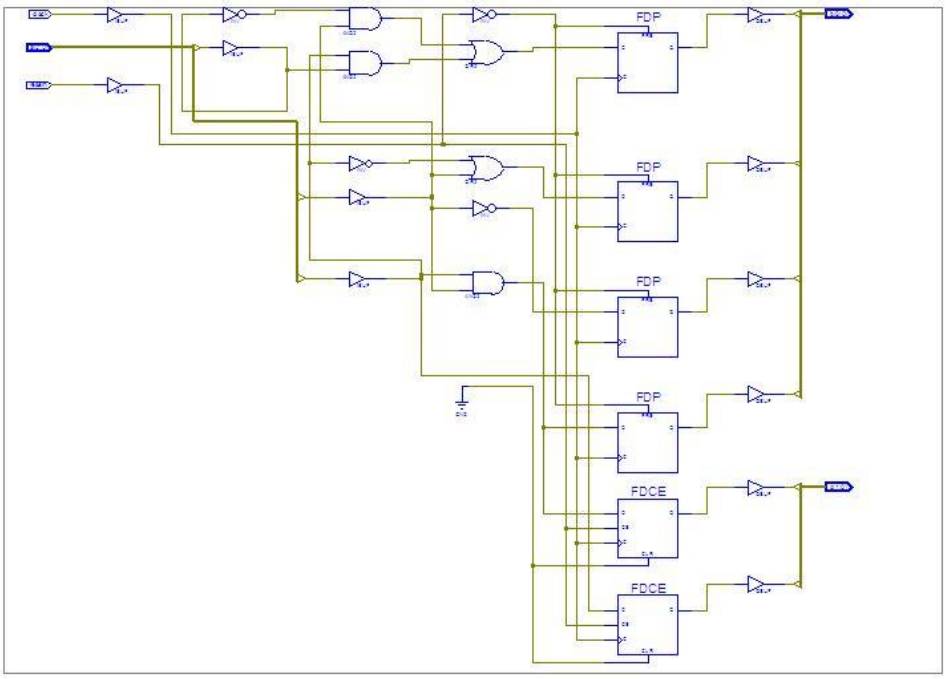
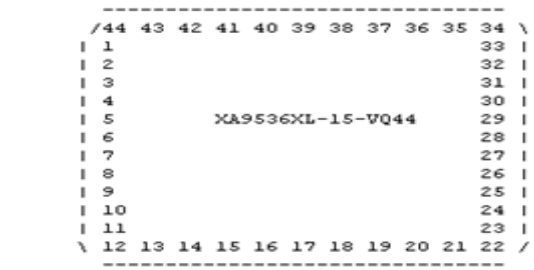


Figure 4: the gate level.

Figure 5. shows the chip's layout as well as a description of each pin:



Pin No.	Signal Name	Pin No.	Signal Name
1	KPR	23	KPR
2	KPR	24	TDO
3	KPR	25	GND
4	GND	26	VCC
5	b<2>	27	KPR
6	KPR	28	a<0>
7	KPR	29	a<1>
8	KPR	30	c<0>
9	TDI	31	a<2>
10	TMS	32	KPR
11	TCK	33	resetn
12	KPR	34	KPR
13	b<3>	35	VCC
14	KPR	36	KPR
15	VCC	37	KPR
16	KPR	38	b<0>
17	GND	39	KPR
18	KPR	40	KPR
19	KPR	41	b<1>
20	KPR	42	KPR
21	KPR	43	clock
22	c<1>	44	KPR

Figure 5. The list of chip pins.

In the overview report, the percentage of microcells, registers, and pins used in the Xilinix environment is shown in Figure 6. It also shows the types of signals that are needed.

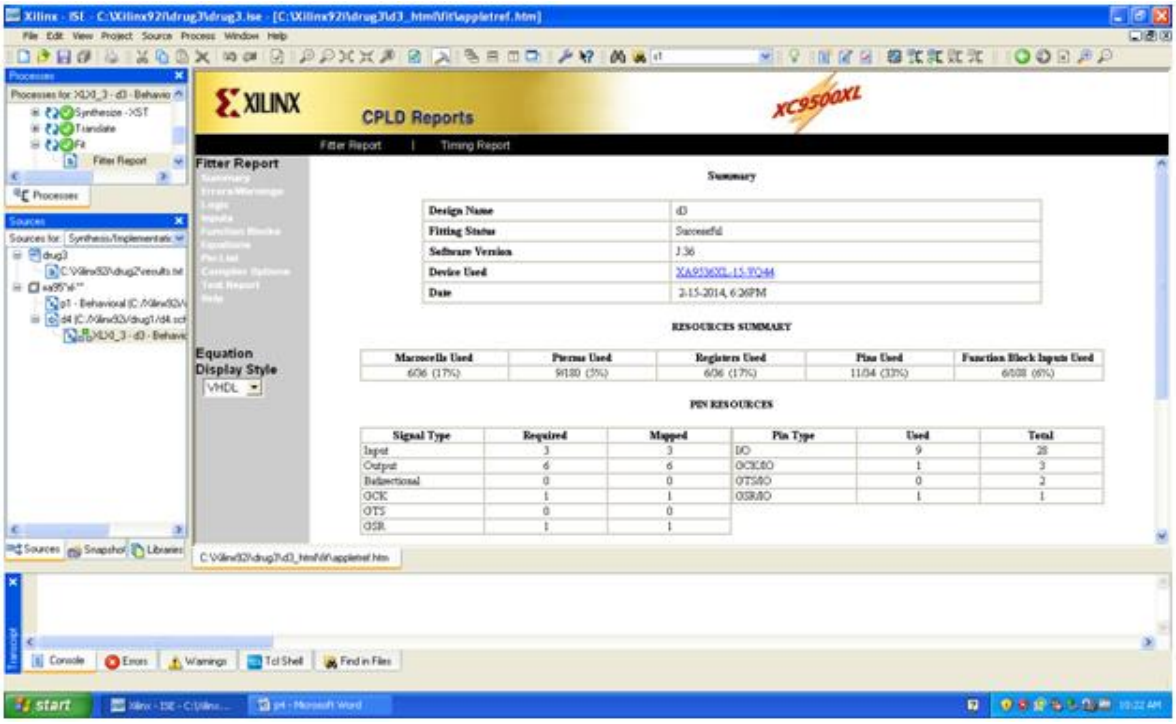


Figure 6 .The summary report.

V. CONCLUSION

This project effectively shows the hardware implementation of the Covid-19 Drug Interaction Database System. When dealing with complex systems, using hardware descriptions such as VHDL is a very practical option. In this paper:

1- The aim of CDID is to make it easier to choose safe drugs and improve the success of Covid 19 treatment. Since a CDID, is part of the drug interaction solution designed to support physicians in making their decisions when evaluating drug interactions between drug pairs and drug safety.

2- CDID are structured to facilitate the storage, retrieval, modification, and deletion of data

And allows creating new Covid-19 drug interactions

3- Using Xlinix 9.2i, a VHDL coding is created to test the device.

4- A timing diagram is created to demonstrate the relationship between the system's input and outputs as a function of time.

5- The hardware is represented schematically as a black box with associated inputs and outputs.

6- The RTL description is used to illustrate how the chip's gate level functions.

7- The chip layout is described, along with a explanation of each pin.

8- To obtain all of the chip data, a summary report is obtained.

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