Ethical Analysis of final project

LIS

Abstract

In this work, it will be analyzed and evaluated the ethical impact of the implemented design. The problem to solve was the coordination of traffic lights in a cruise. The traffic lights were controlled for cars, bikes and pedestrians. The design was done through the sequential and combinational circuits. In addition, it was taking into account that the place of the cruise is located in the city of Puebla.

Introduction

The task was to make a digital system that could successfully control the traffic lights in the following cruise.

Figure 1: Model of the cruise to control

This cruise includes traffic lights for cars, bikes and pedestrians. The planted problem was simple, but the solution required a lot of analysis and understanding of the relation between the cars, bikes and pedestrians, so that there would be a good flow in the intersection and no accidents.

The objectives of the design were to control the lights and make a regressive counter for the pedestrians so that they would notice how much time left they have as they cross the street.

The focus in this paper is how the decisions taken in the design phase of the project were justified in the ethical sector and that the decisions taken were informed, so that it was measured the impact of engineering solutions in global, economic, environmental, and societal contexts.

The design of a cruise falls within the field of urban design and as such, in the words of Professor Meyer Wolfe, has the following characteristics.

- It addresses how people perceive and behave in their environment.
- Considers the implications of shaping actions (including environmental and ecological consequences) at a variety of scales (sometimes from individual to regional).
- Pursue multiple objectives for multiple clients (including affected members of the public), and it is carried out through an explicit decision-making process that offers the public the opportunity to participate in a meaningful way, identifies goals and objectives, analyzes existing conditions, explores alternative concepts and solutions, evaluates options with respect to project goals, project and public values, selects preferred alternatives or combines preferred elements into a synthesized concept, and includes an implementation strategy.[1]

Lying here lies the importance of thinking through all aspects when creating the design, to assess its impact and to assess its efficiency, which corresponds to the degree of how well the task was completed.

Design and the ethical considerations

The first step in the design was to identify the number of traffic lights and subdivided between cars, bikes,

pedestrians and the number of lights needed for each type.

The results were:

- 4 pedestrian traffic lights (2 LEDs red and green)
- 3 bikes traffic lights (2 LEDs red and green)
- 3 cars traffic lights (4 LEDs red, green, yellow and white for the turn)

This decision was made considering the design of any city cruise of Mexico. It should be noted that in Mexico, it is rare for bicycle lanes to be considered on cruises of this type. However, it was followed the same logic to add it.

Figure 2: Street example

The second step was to establish the relation between the traffic lights. For that it was created a table of restriction. In other words, for each of the 13 traffic lights, it was marked the ones that must necessarily be red to avoid accidents.

Pedestrians				Cars						Bikes		
P1-1-3	P2-1-3	P1-2-4	P2-2-4	C1-1	C2-1	C1-2	C3-2	C1-4	C2-4	B1-1	B1-2	B1-4
1						0	0	0			0	0
	1				0	0		0	0		0	0
		1		0			0		0	0		
			1	0	0					0		
		0	0	1		0		0			0	0
	0		0		1					0	0	
0	0			0		1				0		
0		0					1	0				0
0	0			0			0	1		0		
	0	0							1	0		0
		0	0		0	0		0	0	1	0	0
0	0			0	0					0	1	
0	0			0			0		0	0		1

Figure 3: Table of restrictions

The one meant that there is flux on that street, and the zero that there must not be flux (otherwise it would generate and accidents). The empty space means no relation, and through that it will be made combinations of the workflow. The considerations taken in these relationships were:

- Pedestrians can cross in both directions on the sidewalk.
- Bicycles and cars only cross in the designated direction.
- There are intersections between the cars. A car can turn is independent of whether it can go straight.

The next step was to select the combinations of the workflow, those were considered by prioritizing the flow on the cars. This decision was based on logistic and economic concerns because there are more cars than bikes or pedestrians. Traffic jams and traffic in general are constantly factors that influence the emotional state of people, so decisions were made that benefit the majority. However, it is aware that when making this decision the environmental aspect is ignored, since pedestrians and bicycles are left in second place. It is not encouraged citizens to use these types of transports, which are the most pleasant for the environment and that benefit citizens in the physical health sector.

The next Figure shows fie combinations of states. The first exemplify the case when all the pedestrians can pass, but it was not selected as the pedestrians are not the priority.

Pedestrians				Cars						Bikes		
P1-1-3	P2-1-3	P1-2-4	P2-2-4	C1-1	C2-1	C1-2	C3-2	C1-4	C2-4	B1-1	B1-2	B1-4
1	1	1	1	0	0	0	0	0	0	0	0	0
0	0	1	0	0	1	1	0	1	0	0	0	1
1	0	0	0	1	1	0	0	0	1	0	0	0
0	0	0	1	0	0	1	1	0	1	0	1	0
0	1	0	0	1	0	0	1	0	0	1	0	0

Figure 4: Table of chosen combinations

The next four combinations were the selected, it were four because is the minimum number of states, so that all the traffic lights are on at some point at the time.

The next step of the design was the creation of the 2 and 4 LEDs traffic light. The 2 LED design was easy because it has a direct relation with the restriction table and the combination from one input there is two out (its relation is the negation). The 4 LED one is more complex because from two inputs one that is the state and other the turn and four outputs, the turn one has a direct relation but to have a yellow LED the times have to be subdivided.

However, creating the design of this part structurally has the drawback that the red state always lasts longer. Because to avoid accidents, the section of the state of green is the one that must be subdivided into the time of green and yellow.

This aspect makes the flow of traffic inefficient; however, it is necessary for the code to have other benefits. Since when applying said structural design the 4 states can be changed from the design in a very simple way. And so the prioritization of the cars in the flow is something that can be changed quickly and easily if desired. Or, on the other hand, if you want to stop certain streets by modifying the restrictions and thus the combinations, you can do it by changing a minimum part of the code.

The last aspect to evaluate the design is the time, to do the tests and the simulation each state was done in 8 seconds, so in reality it is not a considerable interval for cars, bikes and pedestrians to pass. Considering that the cruisers of this type are wide and long due to the multiple existing signs, so it is something that needs to be changed if its implementation is considered.

Results and Analysis

The design was successfully programmed and established in VHDL and the FPGA.

The following figure shows the implementation of the FPGA code in the mockup.

Figure 5: Mockup 1

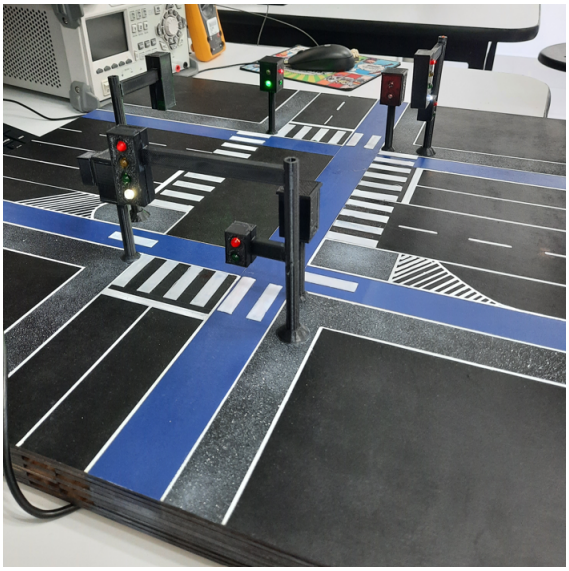

Figure 6: Mockup 2

Having identified the key parts of design that have an impact on society, it can be seen that design has the following repercussions.

Prioritization of cars over pedestrians and cyclists. Structure that can easily reorder the combinations allowing to modify the priorities. Safety for pedestrians as there is a countdown timer for the time the traffic light changes. The traffic light provides a sense of control and less waiting as there is a counter.

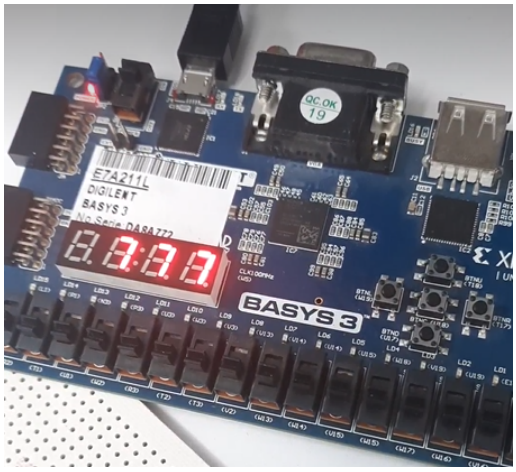

Figure 7: Evidence of the regression count down in a display

Conclusion

In conclusion, it can be seen that the priorities at the time of design focus on essential functionality and the

requirements of the society established at the time. That is to say, most of them are carts and as such the design focused on satisfying said flow in the first instance. And although the priority was not pedestrians and bicycles, they reside in the approach to the same task, since each one has its own lane and crossroads.

However, the design was done with the goodness that reordering priority or combinations isn't too much of a challenge. And such is a great advantage. Finally, the great impact that the design given to the intersection can have on society and specifically on passers-by is observed. Small changes that may seem insubstantial can considerably change the perception of society and even the state of mind of the occupants.

LBM

Introduction

Engineering's and computational system's bachelor's programs at Universidad de las Américas Puebla includes the subject called Diseño Digital (digital design), which implies "designing new digital hardware products and the circuitry to make them function" [3].

The purpose of this project was to design, build and demonstrate the correct functioning of a traffic light cruise where cars, bicycles and pedestrians could interact without any troublesome, which meant no accidents or confusions for users.

In the implemented design, individual traffic lights for cars, bicycles and pedestrians was used; for cars, some of them had an extra light for indicating a turn. Each bicycle and pedestrian traffic light had two LED lights: green and red, additionally, pedestrian traffic lights had a counter from 7 to 0 to indicate how much time the pedestrian had to cross the street.

The importance of traffic lights resides on a basic principle: allow the traffic to move on the correct direction. "In the absence of physical traffic police officers at intersections, the traffic lights do the job. It is every motoristâs duty to follow the lights. If a vehicle jumps a red light, there can be a chain reaction to that and it can lead to several accidents at different places" [4]
. Even is this project was a prototype and simulation, the importance of the correct functioning was exactly the same since it had to be coherent to the real application.

Process

The next elements were used in the elaboration of the final project:

- Red, yellow and green LED lights
- 3D printer
- Resistors for every LED lights
- Welding plate
- Welding kit
- Wooden planks
- UTP cables
- Laser cutter
- Spray paint and glue
- Basys 3 FPGA
- Vivado
- Eda Playground

Starting from the logic, 13 traffic lights were considered: 4 pedestrian lights, 3 for bikes and 6 for cars. The steps including defining when and which lights could be activated and which ones couldn't, creating a sort of truth table where strict '0' (red light) would be activated, this was obviously made to avoid accidents.

Pedestrians				Cars						Bikes		
P1-1-3	P2-1-3	P1-2-4	P2-2-4	C1-1	C2-1	C1-2	C3-2	C1-4	C2-4	B1-1	B1-2	B1-4
1						0	0	0			0	0
	1				0	0		0	0		0	0
		1		0			0		0	0		
			1	0	0					0		
		0	0	1		0		0			0	0
	0		0		1					0	0	
0	0			0		1				0		
0		0					1	0				0
0	0			0			0	1		0		
	0	0							1	0		0
		0	0		0	0		0	0	1	0	0
0	0			0	0					0	1	
0	0			0			0		0	0		1

Figure 8: Restrictions

Afterwards, states were defined, which described the combinations of the traffic lights, taking in consideration that cars had the top priority since **the city of Puebla was taken as a reference**, meaning

that there were more cars and, considering the efficiency of the traffic lights, it was more important to give them the priority to avoid traffic jam. Nevertheless, there was still time for pedestrians and bicycles to cross the street; for pedestrians specially, they had 7 seconds to cross, considering that a higher density of people can cross the street at the same time in 7 seconds instead of cars.

Pedestrians				Cars						Bikes		
P1-1-3	P2-1-3	P1-2-4	P2-2-4	C1-1	C2-1	C1-2	C3-2	C1-4	C2-4	B1-1	B1-2	B1-4
1	1	1	1	0	0	0	0	0	0	0	0	0
0	0	1	0	0	1	1	0	1	0	0	0	1
1	0	0	0	1	1	0	0	0	1	0	0	0
0	0	0	1	0	0	1	1	0	1	0	1	0
0	1	0	0	1	0	0	1	0	0	1	0	0

Figure 9: States

The code was elaborated firstly on EDA Playground using the structural mode, which meant a series of VHDL codes being called by one big one. Once we obtained the corresponding codes, Vivado was used to implement the desing on Basys 3. Once the correct functioning of the code was verified by using PMOD's on the side of the Basys 3, the counter was added, always considering a clock signal and two extra counters on the original design. Once this 7 to 0 counter was structured, it was implemented on the 7 segment display located on the left most center of the Basys 3.

Safe processes included the right management of the welding kit, such as being careful with the hot probes, working on an open space or with opened windows and doors at all times and having the plate on a clear space where errors could be detected. For 3D printing and laser cutting, by knowing the correct usage of the equipment was enough, since these machines are not specially dangerous, considering the 3D printer has a glass protector. When working with the FPGA, rectifying the correct connections was enough.

Results and discussion

After completing the process of programming, debug, implementation on the FPGA, making of the scale model of the street and testing the final design, it was concluded that the main objective, which was demonstrating the correct functioning of the traffic lights without compromising the correctness of the logic, was achieved.

The project took about one month to complete, taking as a priority the coding on VHDL. After checking that the signals on the wave simulation corresponded to the design stated on Excel spreadsheets, it was compared to the design of a real traffic light. Once the scale model was done, all of the outputs were connected to the corresponding LED light, resulting on the complete design. A mistake was made after planning how the scale model would look like: since the display counter stayed at the bottom of the wooden base, it was impossible to visualize it without lifting the whole physical design. This should be taken in consideration if any other person wants to recreate this project.

The structure and functioning of the lights can be easily modified by adding or taking out traffic lights from the restrictions table, then and then modifying the states table. Since the functioning of the traffic lights was designed apart, from other data, they can stay the same. Counters were defined to change depending on the number of states, so they must change. The introduced data on the code will change depending on the initial conditions, however, the structure and main components of the design must be the same.

As it was mentioned before, the priority of the green light was given to cars; considering that the design was thought as if it was going to be implemented on Puebla, the results were favorable. Every hypothetical user had enough time to get through the cruise, therefore the design could easily avoid traffic jams and any other fatal accident. The design could change depending on the location of it, nevertheless, it is accurate to what we had expected it to be.

References

[1]Owen, John. "The Importance of Urban Design for Your Community". MRSC empowering local government. 16 March 2020. Recovered from mrsc.org/Home/Stay-Informed/MRSC-Insight/March-2020/The-Importance-of-Urban-Design-for-Your-Community.aspx

[2]"China: un semáforo "castiga" a los peatones que cruzan en rojo". LA NACION. 24 April 2018. Recovered from www.lanacion.com.ar/sociedad/china-un-semaforo-castiga-a-los-peatones-que-cruzan-en-rojo-nid2128676/

[3]Ziprecuiter Marketplace Research Team. "What Is a Digital Design Engineer and How to Become One".Digital Design Engineer. https://www.ziprecruiter.com/Career/Digital-Design-Engineer/What-Is-How-to-Become

[4]HDFCERGO. "The Importance of Fully-Functional Traffic Lights".Digital Design Engineer. https://www.hdfcergo.com/blogs/car-insurance/the-importance-of-fully-functional-traffic-lights

Annex

- Github code with all the technical description of the project: Github code
- For further evidence: Video of test