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Design of High Efficient and Adaptive Traffic Control System Using Verilog HDL

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Abstract: **-- Our country is a developing country. For the growth and development of our country economically, each and every individual should work equally and they have to be punctualnot only for people and for the transportation of goods there is a need of efficient traffic controller. Normally we have traffic light controller system which works basically on the fixed time allocated for each road. There is another traffic controller system that works and allocates time to each road based on the density of traffic. This project works based on the second case by including two special features. The first feature is it gives priority to the emergency vehicles to pass first and the second feature is if any person crosses the red signal then camera will capture his or her images. That entire system is developed using Verilog code and software Xilinx 14.3.**

Keywords: Xilinx, traffic light controller system

I. INTRODUCTION

For the development of country economically different industries are established which provided employment to lot of people in cities and in towns in all over world. For employment and for goods transportation people need to travel from one place to another place through roads. If there is traffic jam then it will create loss to the country economically, indirectly it creates problems like loss of time, fuel and money.

Among all there is a major problem like loss of life which means if there is an emergency vehicle which is in traffic jam then it may lead to loss of life to avoid such problems there is need of efficient traffic control system.

Normally there is a possibility to develop and design a traffic control system using ASIC(Application Specific Integrated Circuits) and CPLD's (complex programmable logic devices). Whereas, this ASIC is used for a specific application only and that to it is very costlier. The CPLD's has lesser no of PLD's (Programmable Logic Devices) when compared with FPGA's (Field Programmable Gate Arrays). Due to more no of gates, lesser cost, more efficiency, high speed, reprogrammability and due to smaller size FPGA's are preferable to use.

II. SURVEY ON TRAFFIC LIGHT CONTROL SYSTEM

In many cities traffic light system is implemented by using microcontroller and microprocessor whereas, this functionality is fixed in nature which means it can't work according to the real time.

Due to fixed nature of microcontroller and microprocessors they can't be able to reprogrammable by the designer or by the user.

The traffic system with those componentsis programmed in such a way that the time allocated for each traffic signal is fixed. Then the problem arise with that system is the waiting time may increase. This means if there is no vehicle in one road and there is more number of vehicles in the other road then due to that programming there will be green signal in the first road for the fixed time. At the same time the vehicles which are in the second road must wait for a long time. This leads to loss of time, money and fuel. So we have to implement some advanced system for traffic controlling due to which the user can save their time.

If the traffic control system is implemented using Application Specific Integrated Circuit and it is used for a specific application only and this type of design takes more time and money for fabrication.

If the traffic control system is implemented using Complex Programmable Logic Devices then due to lack of memory devices there is a need of usage of lot of flip-flops takes place. This increases the complexity in design of system. Due to lack of gates capacity it is better to go through another component.

So that most of the traffic light control system is developed using field programmable gate arrays and these are the perfect replacement for CPLD. CPLD and FPGA's

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are having same features but when compared with the CPLD's FPGA's are having more number of gates ranges from 10 to 1000's of logic gates.

III. PROPOSED SYSTEM

The proposed system consists of six roads and named it as t1, t2, t3, t4, t5, t6 and each road consists of three IR sensors and a sound sensor and rc sensors the IR sensors are named as A, B, C, D, E, F.

The sound sensors are named as sos1, sos2, sos3, sos4, sos5, sos6.

The RC sensors are named as rc1, rc2, rc3, rc4, rc5, rc6 whereas rc1 for road one and two and rc2 for road three and four and rc3 for road five and six.

The main objective of this traffic control system is it gives priority to the emergency vehicles to pass first. And the finds out the person or captures the images of the person who crosses the red signal.

The six road traffic control system diagrammatic representation is shown below

In that representation the sound sensor is placed at the end of the road and it allocates maximum time for the green signal to be in the ON state.

And this system works in a way that there is a high density of traffic in one road and there is emergency vehicle or fire brigade in the other road at that time the green signal is activated in the road which is having the emergency vehicle.

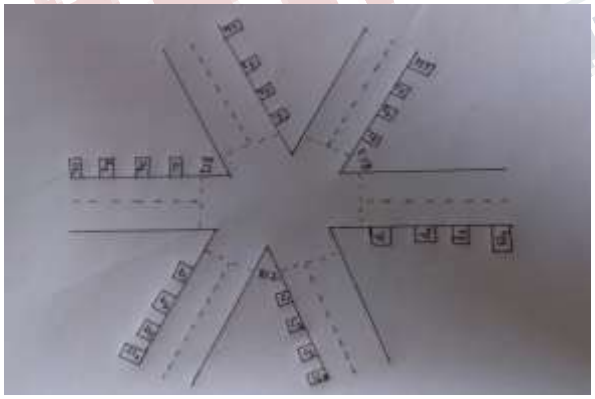

Fig .1 Six roads traffic control system

State table for the six road traffic control system is represented below

Name of the roads	States allocated to each road	Traffic signals	Sensors and there different mode of operation			Time [ns]
	S0	R	If sound sensor sensed state =s32, otherwise s1			
	S1	R	For A= s2, B= s3, C= s4, D= s5, E= s6, F= s7			
t1	S2	R1	A1	A2	A3	0 Sensor A is activated
	S8	G1	1	0	0	24
	S9		1	1	0	48
	S10		1	1	1	72
	S11	Y1	12			
t2	S3	R2	B1	B2	B3	0 Sensor B is activated
	S12	G2	1	0	0	24
	S13		1	1	0	48
	S14		1	1	1	72
	S15	Y2	12			
t3	S4	R3	C1	C2	C3	0 Sensor C is activated
	S16	G3	1	0	0	24
	S17		1	1	0	48
	S18		1	1	1	72
	S19	Y3	12			
t4	S5	R4	D1	D2	D3	0 Sensor D is activated
	S20	G4	1	0	0	24
	S21		1	1	0	48
	S22		1	1	1	72
	S23	Y4	12			
t5	S6	R5	E1	E2	E3	0 Sensor E is activated
	S24	G5	1	0	0	24
	S25		1	1	0	48
	S26		1	1	1	72
	S27	Y5	12			
t6	S7	R6	F1	F2	F3	0 Sensor F is activated

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	S28	G6	1	0	0	24
	S29		1	1	0	48
	S30		1	1	1	72
	S31	Y6	12			
	S32	R	Sound sensor is sensed			
t1	S33	R1	SS1			12
	S34	Y1				12
	S35	G1				64
t2	S36	R2	SS2			12
	S37	Y2				12
	S38	G2				64
t3	S39	R3	SS3			12
	S40	Y3				12
	S41	G3				64
t4	S42	R4	SS4			12
	S43	Y4				12
	S44	G4				64
t5	S45	R5	SS5			12
	S46	Y5				12
	S47	G5				64
t6	S48	R6	SS6			12
	S49	Y6				12
	S50	G6				64

State diagram for the proposed traffic control system

The state diagram shown below has states from so to s50.The state transitions happen by following the conditions. The state s0 checks for the two conditions. The first condition it checks is any of the sound sensor is in ON state or not because here the sound sensors are having highest priority.
The second condition it checks is any of the IR sensors are in ON state or not.

If any sound sensor is activated then the state transition occurs from s0 to s32.

If any IR sensor is activated then the state transition occurs from s0 to s1.

The states s1, s2, s3, s4, s5, s6, s7 are for red signal and this case becomes true when any of the IR sensor is equal to one.

The states s11, s15, s19, s23, s27, s31 are for yellow signal and this case becomes true when any of the IR sensor is equal to two and remaining states from s8 to s30 are for green signals.

Here it checks for distance covered by the traffic. The distance covered by the each sensor is of 15, 30 and 45 feet. The time is allocated based on the distance covered by the traffic.

When any of the sound sensor is activated the state transition happens from s32 to allocated states.

If there are two roads with emergency vehicles then it checks for the lowest density of traffic and that road is cleared first. And when the red signal is in ON condition it checks for the RC sensor whether it is activated or not if it is activated then the camera goes to ON condition for the allocated time after that it goes to OFF condition.

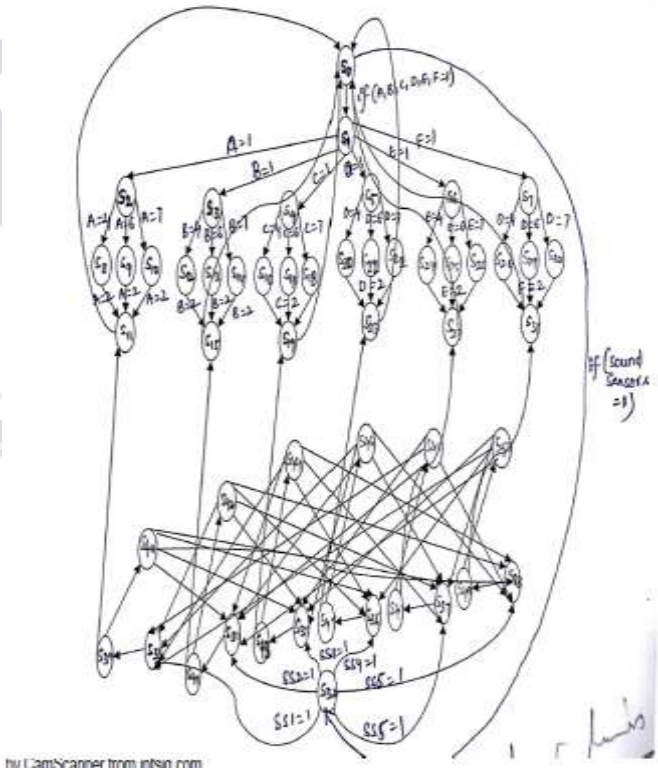

Fig.2. State diagram for the proposed traffic control system

IV. RESULTS AND DISCUSSION FOR THE PROPOSED SYSTEM:

A, B, C, D, E and F are the IR sensors of the roads t1, t2, t3, t4, t5, t6resm pectively.

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The red signal is in ON condition and the camera is in OFF condition

When the IR sensor 'A' of the road 't1' is one i.e., A=1 and rc1 is the RCsensor of the road 't1' is zero i.e., rc1=0

Fig3. Red signal ON state

The green signal is in ON condition and the camera is in OFF condition

There are three IR sensors for each road placed at a distance of 15, 30, 45 feet.

When the IR sensor 'A' of the road 't1' is four i.e., A=4.

The distance covered by sensor when A=4 is 15 feet and 24ns is the time allocated to clear the traffic

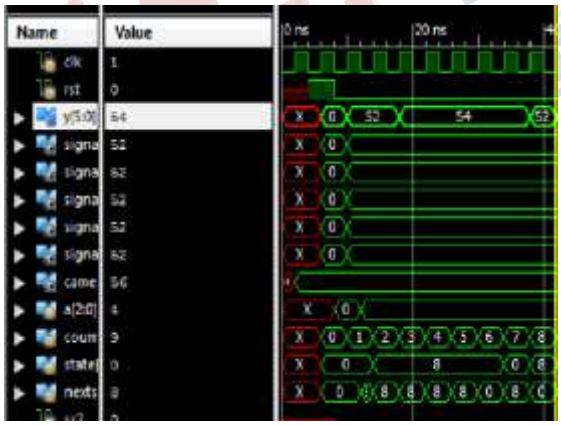

Fig4. Sensor A=4, green signal ON state

The green signal is in ON condition and the camera is in OFF condition

When the IR sensor 'A' of the road 't1' is six i.e., A=6.

The distance covered by sensor when A=6 is 30 feet and 48ns is the time allocated to clear the traffic

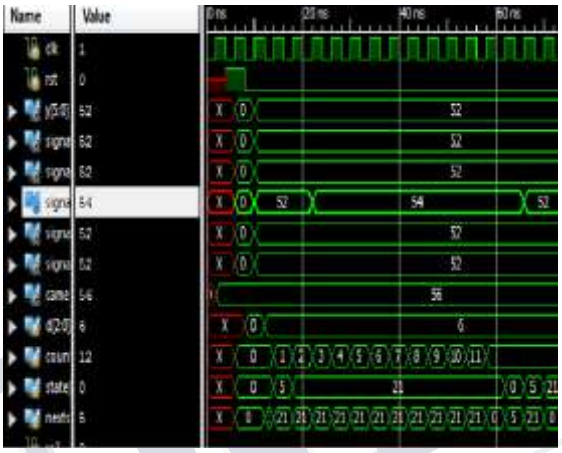

Fig5. Sensor d=6, green signal ON state

The green signal is in ON condition and the camera is in OFF condition

When the IR sensor 'A' of the road 't1' is seven i.e., A=7.

The distance covered by sensor when A=7 is 45 feet and 72ns is the time allocated to clear the traffic

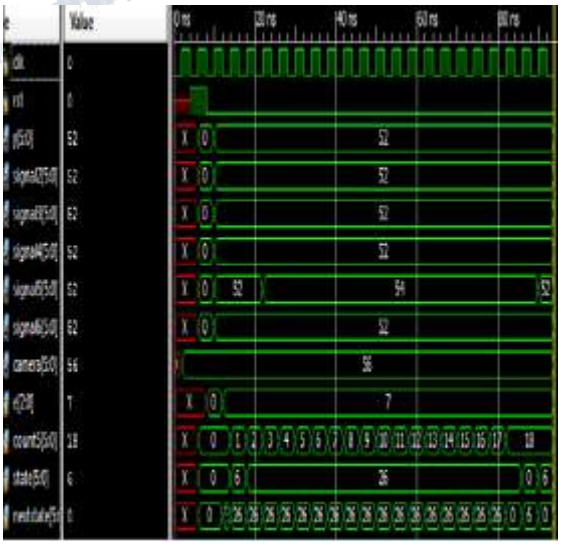

Fig6. Sensor A=7, green signal ON state

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When sound sensor of any road is activated
The red signal is in ON state for 12ns and count value is lesstan 3.

After count<3 the yellow signal is in ON state for 12ns and count value is lessthan 6.
After count<6 the green signal is in ON state for 64ns and count value is lessthan 16

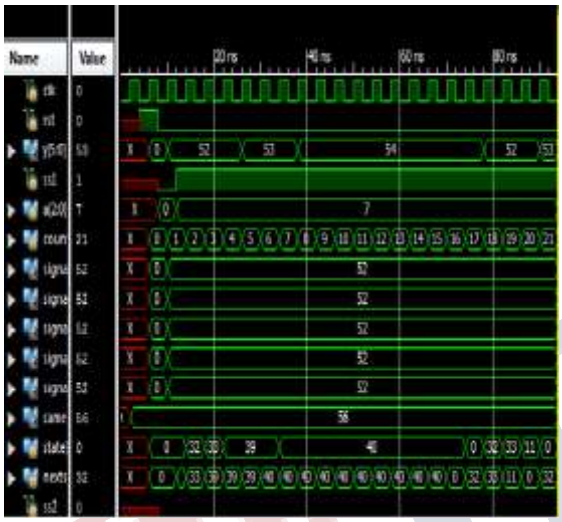

Fig7. Sound sensor ss1 ON state

The red signal is in ON state and the camera is in ON state.
The RC sensor is activated when the red signal of that road is in ON state.

This RC sensor activates the camera to the ON state.

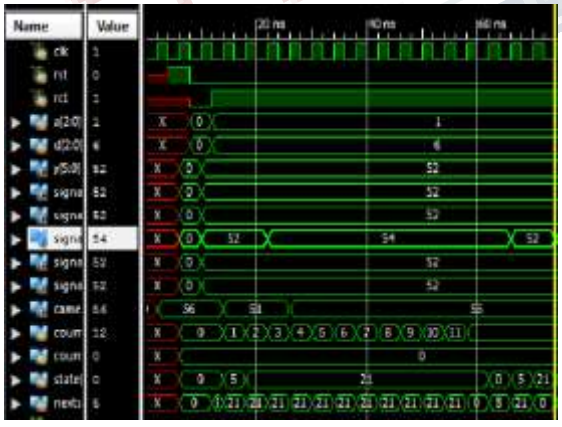

Fig8. Red signal and camera ON condition

The yellow signal is in ON state and camera is in OFF state.

When the IR sensor 'A' of the road 't1' is two i.e., A=2.

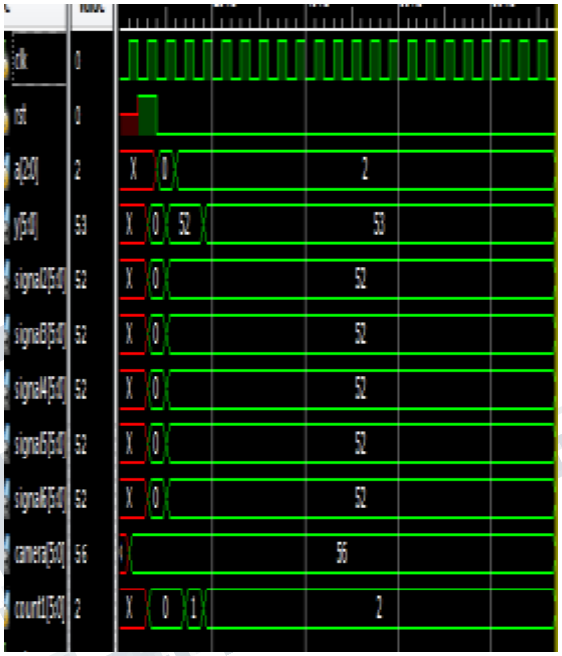

Fig9. sensor A=2 yellw signal ON state

For the condition C=4 and E=7 the green signal is in ON state for the road t5 because the highest priority is given to the road with high density of traffic.

Here E sensor is having highest density of traffic and the output result for this is shown below

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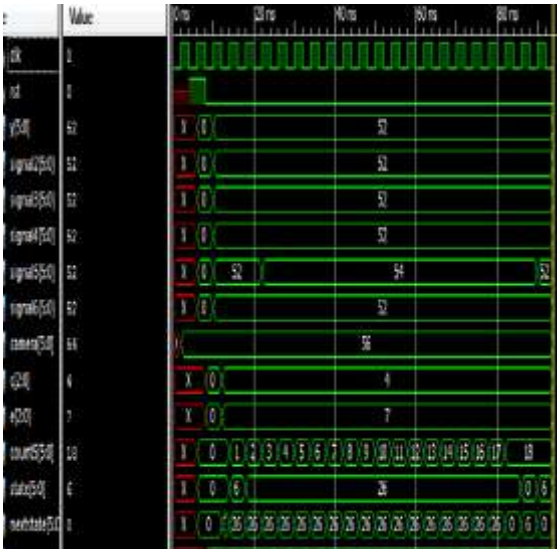

Fig10. Green signal ON condition for high density road

In case of ss1=1 and b=4 then the highest priority is given to sound sensor so the green signal is in ON state for road t1 and the output result should be as shown below

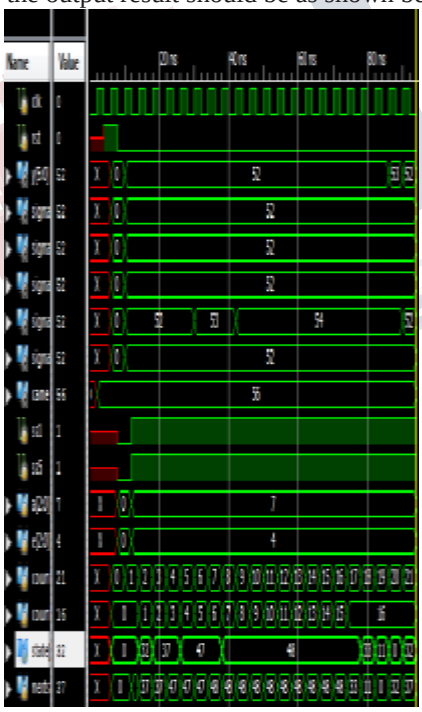

Fig11. Green signal ON condition for the sound sensor

V. SYNTHESIS REPORT FOR THE PROPOSED SYSTEM:

The RTL schematic for the intelligent and adaptive traffic light controller is shown below

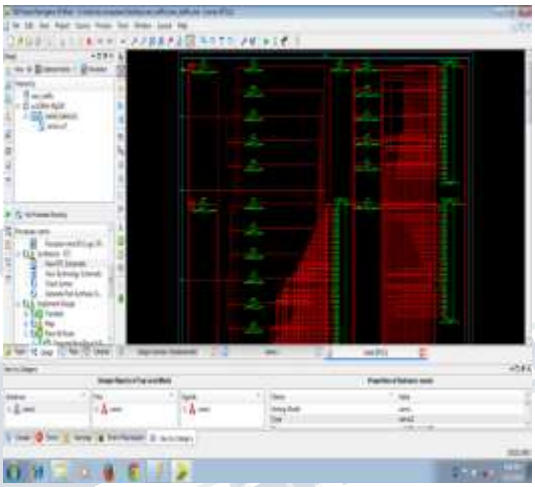

Fig12. RTL schematic for the traffic control system

The technology schematic consists of LUTs (look up tables) and flip-flops

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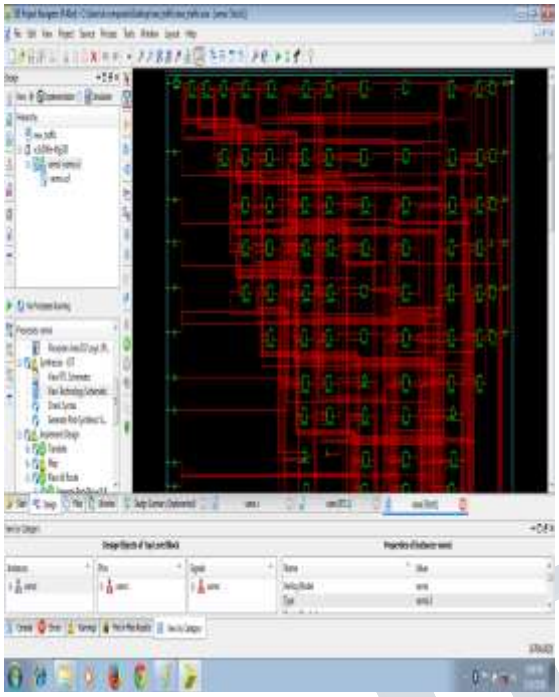

Fig13.technology schematic for traffic control system.

The device utilization summary for the IA-TLC is represented below

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Device utilization summary:
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Selected Device : 3s500eft256-4

 Number of Slices:                      276  out of   4656    5%
 Number of Slice Flip Flops:            119  out of   9312    1%
 Number of 4 input LUTs:                519  out of   9312    5%
 Number of IOs:                          74
 Number of bonded IOBs:                  74  out of    190   38%
 Number of GCLKs:                         1  out of     24    4%
```

VI. CONCLUSION :

High efficient traffic light control system is designed successfully and the desired results are obtained density of traffic is sensed and according to that time is allocated as per the objective even though there is high traffic in one road the traffic of road with emergency vehicles is cleared first. And due to camera module whenever aperson crosses the red signal then RC sensor is activatedwhich in turn activates the camera that captures the images of that person. By making small changes in the design we can implement it for the junction which is having more than six roads. Processing of image captured by camera module to find out the defaulter vehicle no. remains the future work for this study.

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