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Smart Traffic Control System by Using FPGA and RFID

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Abstract: ***Traffic problems are not only including the traffic congestion because of large vehicle tightness and causes the difficulty for emergency vehicles to reach their destination, usually red light traffic violation causes accidents in the roads. Existing proposed systems for smart traffic monitoring of vehicles are usually depending on vehicle density traffic system by using Arduino. This causes difficulty for emergency vehicles. To solve the congestion of traffic problems at intersection roads, it is necessary to implement a smart and real time traffic system. These systems are implemented and limited to at least one or two focus areas. To overcome these problems, Smart Traffic Control System using FPGA (Field Programmable Gate Array) IR sensors and RFID (Radio frequency Identifier) is introduced to sophisticated traffic moves and provide the lane for the ambulances. The RFID uses in this system is determines the emergency vehicles from the long distance and this information passes and controlled by the FPGA and it control the main traffic control lights. Here these functionalities and simulations are achieved by using Verilog programming language and this is implemented on Xilinx 14.7 Software. The controlling and switching of the traffic lights states (Red, Yellow and Green) is found on the FSM (Finite State Machine). This system can be implemented by using Spartan 6 family. This implementation shows the results of identifying the emergency vehicles and Green signal is on till that emergency vehicles are passed.***

Keywords: Smart traffic control system, FPGA Spartan 6, IR Sensors, RFID.

I. INTRODUCTION

Basically, the traffic light control and monitoring system workson the specific switching lights of Red, Green and Yellow within the specific time. Usually, this static time based traffic monitoring system is worked based on Microcontroller or Microprocessor. To be capable to provide theSophisticated Lane for the vehicles, Automatic control and proper coordination are needed to ensure thesafety traffic moves, providing the easy way to the emergency vehicles and protecting the pedestrianswhile crossing the roads as safe as possible. The Fundamental concept behind the Smart TrafficController System Using FPGA (Field ProgrammableGate Array) and RFID (Radio Frequency Identifier) isto provide the specific traffic

Light switching mechanism control system by recognizing the emergency vehicles through the radio frequency identifier tag and reader. Along with through the IR (Infrared) Sensors the vehicle density of the traffic also detected. If multiple ambulances are detected simultaneously, based on theRFID tag identification detection priority the particular lane will be clear for the emergency vehicles. Traffic light System is the major challenging issue in the world. This is due to the increased mobility of the on road vehicles as increasing the population growth. Poor maintenance of the traffic system is the major cause for the accidents, time delay. The traffic control based on This problem can be overcome by using proposed method, this proposed system is uses the Combination of FPGA, Sensors and RFID tag and readers in the junction of four way for the sake of controlling the traffic Without wasting the time and providing the Sophisticated way for emergency automobiles with the help of RFID to save lifetime.

II. FPGA

Field Programmable gate array is Matrix of user-configurable logic, named as ALMs (adaptive logic module) plays an essential role in the field of Embedded System. It consists of an array of DSP (digital signal processing) logic blocks or storage elements (Random Access Memory) and they are arranged in programmable manner. The logic blocks are commonly used to perform the complex tasks. These logic blocks are consists of logic cells like four input LUT, D-Flip flop and Full adder. FPGA has the ability to cope up with both hardware and software simultaneously. Specific Configuration of FPGA is described HDL. It has the flexibility of reprogramming or re-configurable computing even though after complete the manufacturing. These Programmable gate arrays are uses the analog features to perform the digital functionalities. Apart from these blocks, the FPGA is also consists of configuration logic block, transceiver block and input output block. Due to the parallel nature of this, it is used in configuration of soft microprocessor or Xilinx Altera.

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III. XILINX ISE

Xilinx ISE refers Integrated Synthesis Environment. It is Software tool used to analysis and synthesis of the Hardware language designs like HDL, VHDL and Verilog. Hierarchy of ISE describes the functionalities that performs only on the present active module. It consists of various patent algorithms, due to that Xilinx allows the developer to run the designs up to thirty percent faster when compare to the other software tool. It permits the developer to compilation of their designs, like verifying the RTL schematic, reaction of the design for variety of inputs and mainly analysis of timing and delay. To achieve the different functionalities in our project, the Xilinx ISE is hardly coupled with the FPGA Spartan 6.

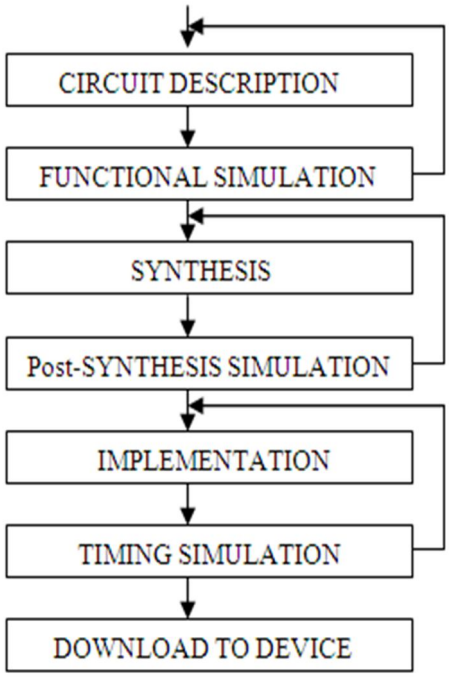


Figure1: FPGA data flow

IV. PROPOSED METHODOLOGY

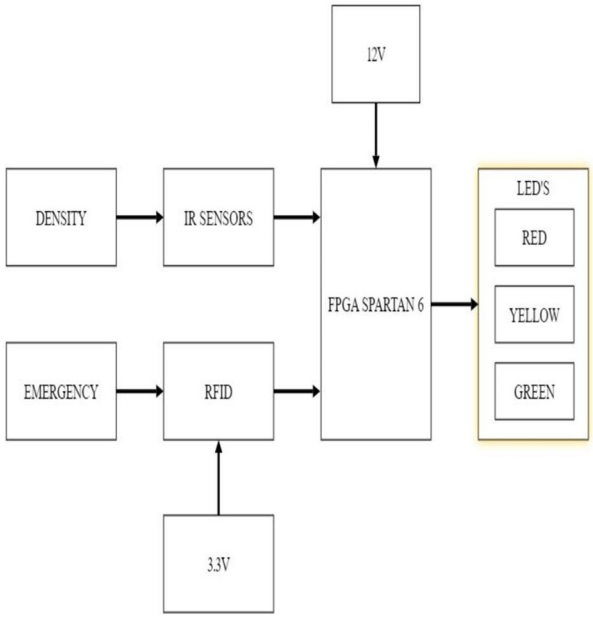


Figure 2: Block Diagram

The smart traffic control proposed system consists of three main important components. They are

1) Input sensors
2) FPGA Spartan 6 kit.
3) Light Emitting Diodes (LED's)

The FPGA Spartan 6 device is a heart of the control system. Which receives the multiple input signals from the input sensors (IR and RFID) and processes the input signal according to the programming and sends the multiple output signals to the output device i.e. light emitting diode (LED). Mainly these control system is worked based on the Finite State Machine (FSM). The RFID (Radio Frequency Identifier) is mainly employed to detect the emergency vehicles (EV) through the RFID tag and RFID reader. If any emergency vehicle is detected, this data is send to the FPGA it immediately on the "Green Corridor" to clear the traffic lane and provides the easy way for the emergency Automobiles. Always first preference is given for the identification of EV. The IR (infra-red) input sensors mainly used to the four ways of the junction to detect the density of traffic. The IR sensors are detects the length of the vehicles or vehicle density and this data is sends to the FPGA device. Depending upon the length of the traffic density, it blink the green LED lights to clear the traffic. If there is no Ambulance are detected and if the traffic jam in all four lanes are equal, the advanced traffic control system works in the regular sequence i.e. finite state machine(FSM).

V. FLOW CHART

Flow chart of the smart control system as shown in the diagram. First initialize the system by connecting the components to the power or battery source i.e. the 12VDC is connected to the FPGA Spartan 6 device and 3.3VDC is connected to the RFID sensors. Once the system is initialize, it start to detect the any emergency vehicles. If any emergency vehicles are detected in out of four road lanes, the "green corridor" will be automatically on for certain amount of period. Once the emergency vehicle is passed, the control system immediately starts to regulate the traffic in normal way. If there is no emergency vehicles are detected, the system is skips to the next condition that is calculation of vehicle density. If vehicle density is greater than certain limit, the controller is automatically on the green LED light to clear the traffic at that particular lane. If there is no traffic density at the lane, the controller is skips that lane and moved to control the other lane traffic in FSM sequence. If there is no emergency vehicle and equal traffic density at all four lane, the smart traffic control system starts to monitor the system in regular sequence.

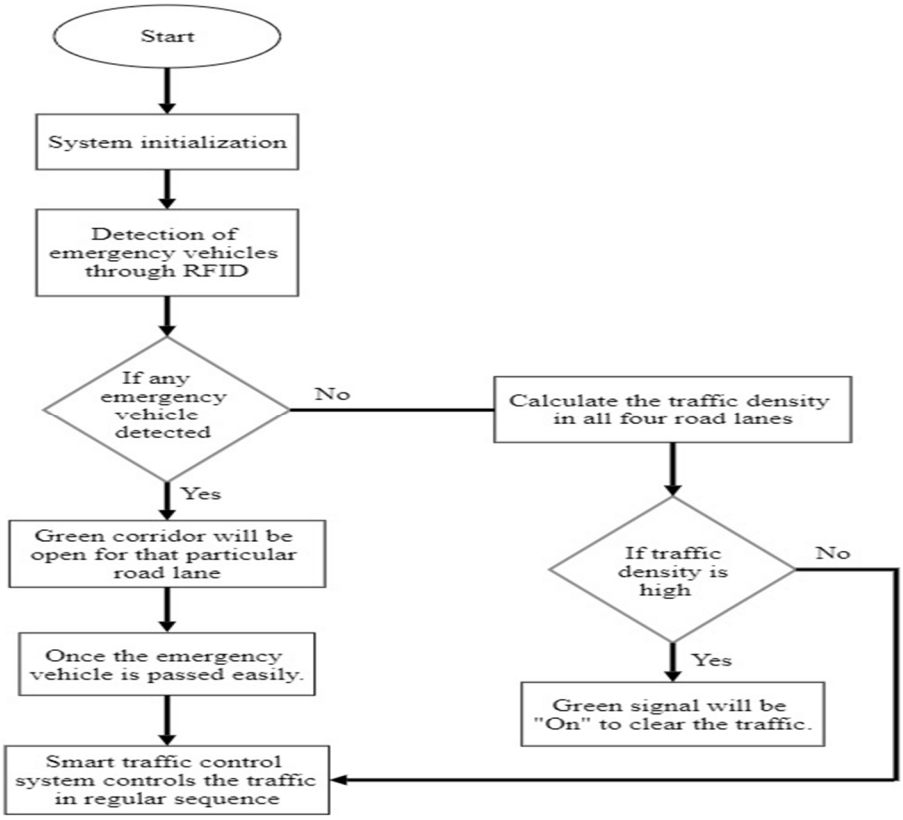


Figure 3: Proposed System Flow Chart

VI. FINITE STATE MACHINE

The FSM is Structural model with finite of states, finite stimuli and finite outputs. There are mainly two kinds of FSM. They are Moore and Mealy FSM's. Implementation of the state machine in our project employs Moore. In which outcomes Is always stands on the present state and next state is depends on input as well as current state. Oppositely in the mealy both outcomes and next state depends upon the input and present state.

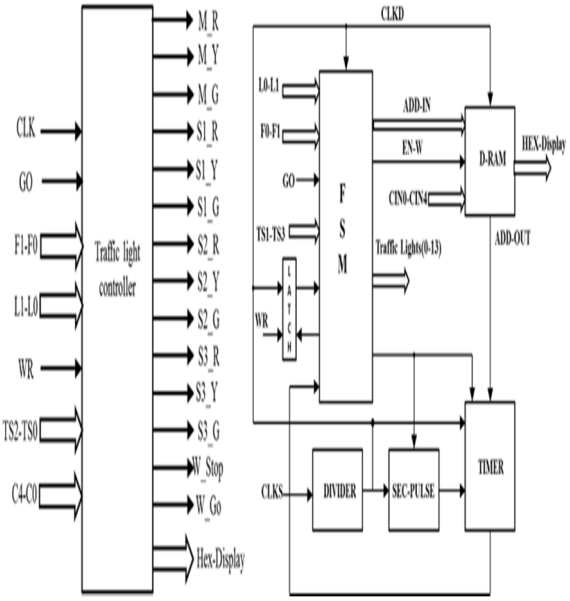


Figure 4: FSM Structure with controller

In the above diagram, we can see the pictorial representation of FSM with the controller. It consists of four states for each lane of the junction. They are Reading the previous timing parameter, writing the advanced timing parameter, Running of the normal mode traffic and running the blinking mode traffic. In the idle mode, the LED's are turned off. So that it is referred as rest mode. Where the model will visit to the reset state. For all direction green and red lights, the five seconds delay is given and for yellow two seconds delay is given.

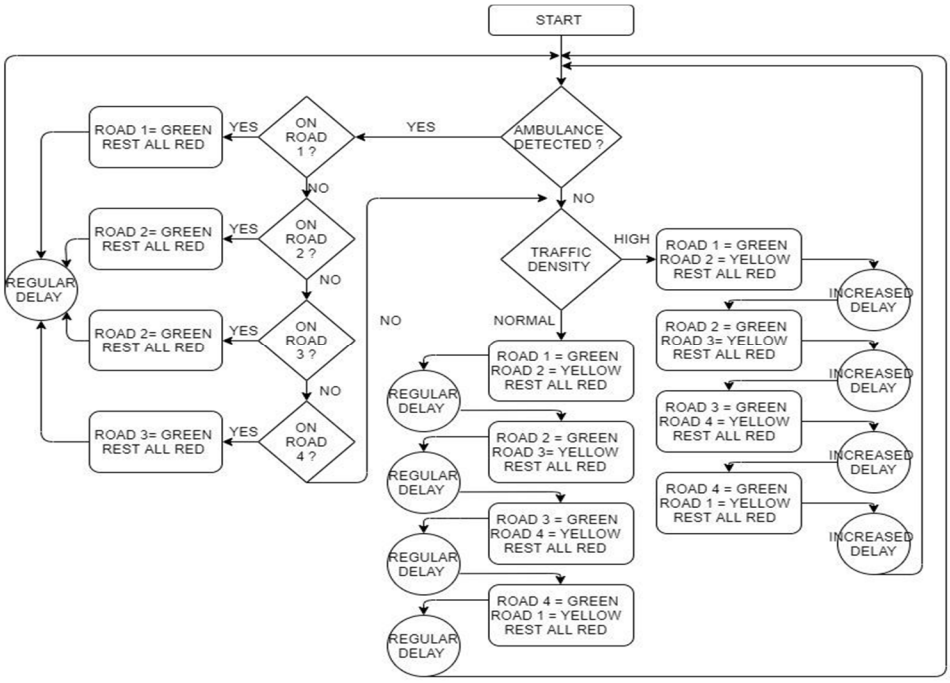


Figure 5: FSM of Four way Traffic control System

VII. RESULTS AND IMPLEMENTATION

To obtain the expected waveform, it is necessary to create the text bench with the different stimulus. The graphical representation of wave forms are help to meets the both the timing and behavioral design requirements. Distinct inputs can applied to observe the various representation of the wave form. Choose the test bench source file and Click on run all symbol, it automatically opens the waveform window. RTL Refers the Register transfer language. Normally indicates implementation of logic steps like how the data is transformed from one register to other. The transformation of data can be performed by using the combinational logic gates like multiplexer and adders. These are exhibits in-between the number of registers. The overview of the RTL Schematic is composed of combinations of the functional logic blocks, controller and registers.

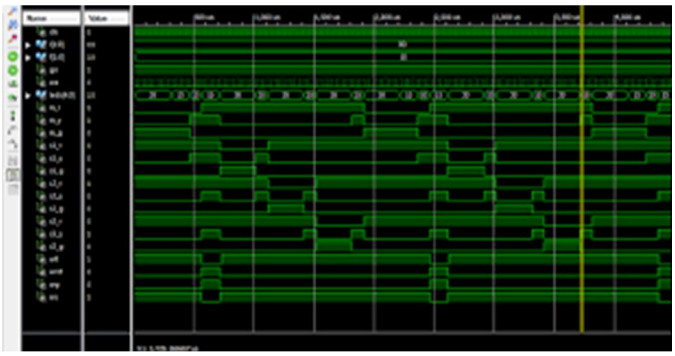


Figure 6: Waveform Results

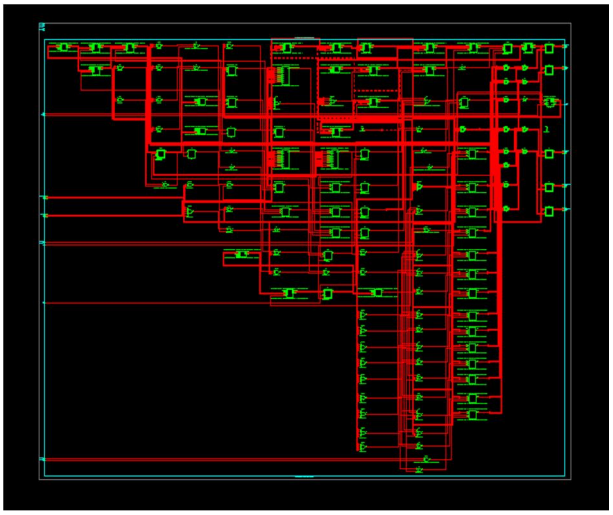


Figure 7: RTL Schematic

VIII. CONCLUSION

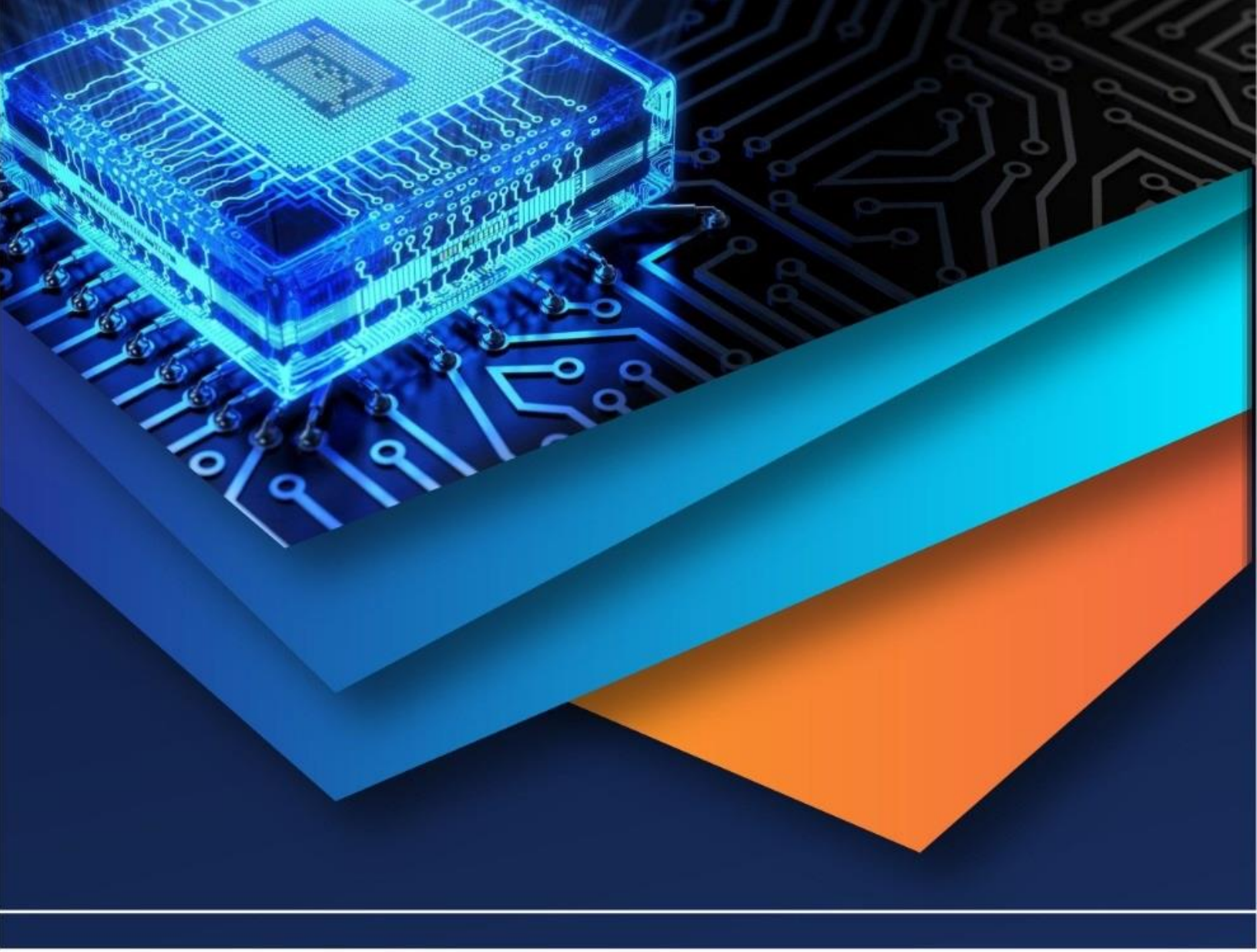
Smart traffic control system can be designed and implemented by using FPGA Spartan 6. Efficiently this system can calculate the traffic density in the real time through the IR Sensors and also recognizes the emergency vehicles with the RFID tag and reader. FPGA collects traffic data from these input sensors and effectively control the real time traffic congestion and traffic jam during the peak hours. In future we can use the surveillance camera to record the traffic data in the intersection.

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