EMERGENCY TRAFFIC SIGNAL: MANAGEMENT & CONTROL SYSTEM USING SOUND SENSORS

A Project Report Submitted In Partial Fulfilment of the Requirements for the Award of Degree

BACHELOR OF TECHNOLOGY

In

ELECTRONICS AND COMMUNICATION ENGINEERING

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This is a bonafide report of the work carried out by me. The material contained in this report has not been submitted to any University or Institution for the award of any degree or diploma.

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This is to certify that the dissertation work entitled "EMERGENCY TRAFFIC SIGNAL: MANAGEMENT & CONTROL SYSTEM USING SOUND SENSORS'' that is being submitted by **PATKARI SURYA TEJA (18011M3402), PARTHASARATHY SINGH SAMANTA (18011M2012),BOMIDIKA SAI TEJA REDDY (18011M2005), G.SAI PRANEETH REDDY(18011M2016)** in partial fulfillment of the requirements for the award of the degree of **BACHELOR OF TECHNOLOGY in ELECTRONICS AND COMMUNICATION ENGINEERING from JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD, COLLEGE OF ENGINEERING HYDERABAD (Autonomous)** is a bonafide record of project work carried out during the academic year 2016-2017. The material contained in this report has not been submitted to any university or institution for the award of any degree or diploma.

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ABSTRACT

This innovative project is an effective emergency traffic signal management project that allows for managing a 4-way traffic signal management system when handling emergency clearance for high-priority vehicles. This work mainly aims at providing a solution for the problem faced by ambulances that are moving towards the traffic signal during high-density traffic.

The system consists of 4 signals corresponding to each road connected with sound sensors located at a certain fixed distance from the traffic junction. This is implemented by detecting the frequency of the ambulance heading towards the traffic signal by using the sound sensors and monitoring the ambulance to pass the respective traffic lane. The frequency of ambulances is around 750Hz-1000Hz. The sensors detect the threshold value of sound in decibels. Once the signal strength at the frequency range of the ambulance exceeds the threshold value, it indicates that the ambulance is detected, and the respective lane is made green for the ambulance to pass the lane completely.

This module is also advantageous on high-priority vehicles such as fire disaster prevention vehicles, VIP vehicles, and Police Jeeps which are heading towards high-density traffic signals.

The most contribution of our proposed system is that it is often used to select the simplest possible options for changing the green light and control the traffic system, such that the waiting time is minimized. The implementation cost is reduced because it does not involve any complex hardware installation. The plan was developed to regulate two or four-way traffic junctions. Additionally, our plan can be extended to handle various lanes and assign priority to the ambulance if the ambulances are approaching at different lanes simultaneously. This sensor-based system was developed to provide an automated environment and save human lives.

LIST OF FIGURES

FIGURE	TITLE	PAGE NUMBER
2.3	FLOW CHART	16
2.5.2	SIMULINK 1	22
2.5.2.1	MODEL CREATION STEPS	25
2.5.2.2	SIMULINK 2	26
2.6.1	ZEDBOARD	27
2.6.1.1	Block Diagram of ZYNQ XC7Z020-CLG84	29
2.6.2	LED	30
2.6.3	SOUND SENSOR	31
3.1	BLOCK DIAGRAM OF EMERGENCY VEHICLE DETECTION SYSTEM	34
3.2.1	EVD SYSTEM OUTER BLOCK	35
3.2.2	INTERNAL BLOCK DIAGRAM OF EMERGENCY VEHICLE DETECTION SYSTEM	36
3.2.3	INTERNAL BLOCK DIAGRAM OF INPUT SENSOR BLOCK	36
3.2.4	INPUT BLOCK DIAGRAM OF AMBULANCE DETECTOR BLOCK	37

3.2.5	AMBULANCE DETECTION WITHOUT SAMPLING RATE	16,38
3.2.6	OUTPUT WAVE OF AMBULANCE DETECTION WITHOUT SAMPLING RATE	16,38
3.2.7	AMBULANCE DETECTION WITH SAMPLING RATE	39
3.2.8	OUTPUT OF AMBULANCE DETECTION WITH SAMPLING RATE	39
3.2.9	CONTROL BLOCK	40
3.2.10	INTERNAL BLOCK DIAGRAM OF CONTROL BLOCK	41
3.2.11	INTERRUPT EXECUTOR	42
3.2.12	INTER BLOCK DIAGRAM OF INTERRUPT EXECUTOR	43
3.2.13	TRAFFIC CONTROLLER	44
3.2.14	TRAFFIC SYSTEM NORMAL MODE	45
3.2.15	INTERNAL LOGIC OF TRAFFIC POST 1 AND 2	45
3.2.16	INTERNAL LOGIC OF TRAFFIC POST 3 AND 4	46
3.2.17	INTERNAL BLOCK OF INTERRUPT SYSYTEM	47
3.2.18	INTERNAL BLOCK OF EACH INTERRUPT TRAFFIC POST	47
3.2.19	TRAFFIC SIGNAL	48

TABLE OF CONTENTS

ACKNOWLEDGEMENT **5**

ABSTRACT **6**

LIST OF FIGURES **7**

CHAPTER 1: INTRODUCTION

1.1: INTRODUCTION **11**

1.1: MOTIVATION **12**

1.2: AIM **12**

1.3: OBJECTIVE **12**

CHAPTER 2: METHODOLOGY

2.1: LITERATURE **13**

2.2: WORKING ALGORITHM **14**

2.2.1: EMERGENCY VEHICLE DETECTION ALGORITHM **15**

2.2.2: CONTROL BLOCK ALGORITHM **17**

2.2.3: INTERRUPT EXECUTER ALGORITHM **18**

2.3: SOFTWARE AND HARDWARE SPECIFICATION **19**

2.5: SOFTWARE DESCRIPTION **19**

2.6: CIRCUIT COMPONENTS **27**

CHAPTER 3: IMPLEMENTATION

3.1: MATLAB CIRCUIT BLOCK DIAGRAMS **35**

3.2: CIRCUIT DESCRIPTION **35**

3.3: ADVANTAGES OF PROJECT **49**

3.4: DISADVANTAGES OF PROJECT **50**

CHAPTER 4: RESULTS AND SIMULATIONS **51**

CHAPTER 5: CONCLUSIONS

5.1: CONCLUSION **55**

5.2: FUTURE SCOPE **55**

5.3: REFERENCES **56**

CHAPTER 1

INTRODUCTION

In today's world traffic being the main issue of concern, is creating innumerable problems to the general life. Apart from the common issues of congestion, it poses a serious hindrance to the normal functioning of emergency vehicles. Emergency vehicles have to be prioritized in comparison with all other vehicles, but either due to unavoidable situations or due to self-centered motorists, emergency vehicles do not reach their destinations on time. The delayed arrival of emergency vehicles may pose threats to life. Apparently, there has to be a system that detects the emergency vehicle prior to its arrival at the junction and clears the traffic ahead of it beforehand. This may minimize the delays and facilitate the needy during their emergency. Unfortunately, there are no efficient measures taken to deal with this problem in most of the countries including India. And thus either emergency vehicles may remain statutory or may override the signal. In case the emergency vehicles override the traffic signal, there are high possibilities of encountering accidents. The recent development of technology has led us to IoT, which provides an efficient method to address these issues.

Sensors are embedded in every physical device. Sensors continuously emit data of the working state of the devices. Sensors are functionally simple devices that convert physical variables into electrical signals. Smart sensors [8] are built as IoT components that change the existing variable that is being measured into a digital data stream for transmission from one gateway to another. Traffic is generally organized in many domains with marked lanes, junctions, intersections, traffic signals, or signs. The main problem is to regulate the movements at an intersection.

An ambulance is an emergency vehicle to provide emergency care to sick or injured people and to get them to the hospital. An ambulance is mainly used to transport patients between hospitals. The siren sound of the ambulance has an alternative sequence of high frequency and a low-frequency signal, the sequence of the frequency change used to be the feature of the sound. They provide easy and quick access to health services, particularly out of hours. Thus it is very important for an ambulance to reach the destination at the correct time.

1.1 MOTIVATION

The number of vehicles used by the people is constantly increasing due to rapid growth in population leading to high-density traffic which increases the waiting time of vehicles. Emergency vehicles such as ambulances, fire disaster prevention vehicles, and VIP cars are required to reach their destination as quickly as possible. The main constraint is the time that is consumed by the vehicle's high-density traffic signal. This method focuses on providing a smart way of controlling the traffic when ambulances are arriving towards the signal. Traffic jams are common due to heavy traffic on the road, as a result, the emergency vehicles like ambulances and fire engines get stuck in traffic. The proposed method will be useful for the ambulance to pass through the traffic junctions without waiting so that they can reach their destination quickly.

1.2 AIM

The aim of this project is to design an energy-efficient, independent, and automatic emergency vehicle detection and traffic system.

1.3 OBJECTIVE

- ➔ This work mainly aims at providing solutions for the problem faced by ambulances that are moving towards the traffic signal during high-density traffic.
- ➔ The objectives of the project are:
    - ◆ Detection of emergency vehicles (Ambulance) using sensors and bandpass filters.
    - ◆ To control the traffic post system based on the priority of incoming signals from sensors.
    - ◆ To manage the mode of operation of the target traffic post between standard traffic system and emergency mode of operation

CHAPTER 2

METHODOLOGY

2.1 LITERATURE

A siren sound in emergency vehicles indicates the direction in which it is approaching. It is done using varying the pitch of the sound. When properly timed and maintained, a traffic signal increases the traffic handling capacity of an intersection. Traffic jams are common due to heavy traffic on the road, as a result, the emergency vehicles like ambulances and fire engines get stuck in traffic. The proposed method will be useful for the ambulance to pass through the traffic junctions without waiting so that they can reach their destination quickly. The difficulties faced by emergency vehicles can be avoided using the Automated Traffic Control System. One or more smart object(s) are installed in every lane of a particular intersection which is designed to sense the siren of approaching emergency vehicles which triggers the camera to capture images and to verify if the vehicle is an emergency vehicle or not by comparing the obtained image with the stored data set. If the vehicle is identified as an emergency vehicle then the signal is transmitted to the Decision Support System. The Decision Support System clears the traffic by identifying the lane through which the emergency vehicle is approaching. All other signal lights of that junction are turned to red. Sound detection sensors are used to identify the departing emergency vehicle, after which traffic lights are flipped back to their normal functioning. The emergency vehicle is detected prior to its arrival thus the system prevents latency.

In India, the siren sound of all emergency vehicles is present and follows a similar pattern. The siren sound repeats in two tones. The tones are 960 Hz and 1200 Hz, and these are repeated at every 1.3 sec period. The siren sound is affected by the Doppler Effect and varies its frequency due to the motion of the emergency vehicle. This method focuses on providing a smart way of controlling the traffic when ambulances are arriving towards the signal.

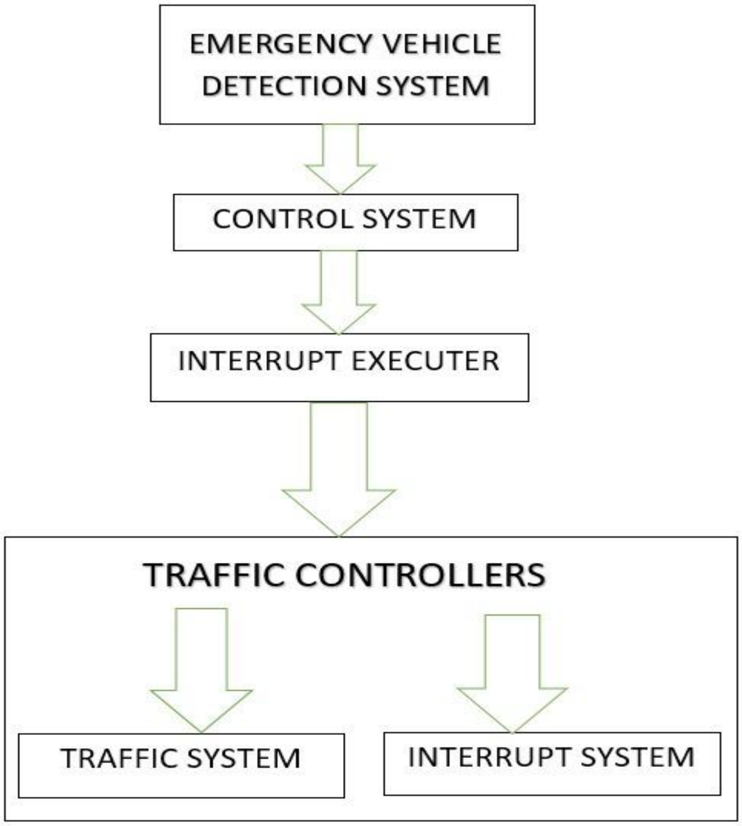


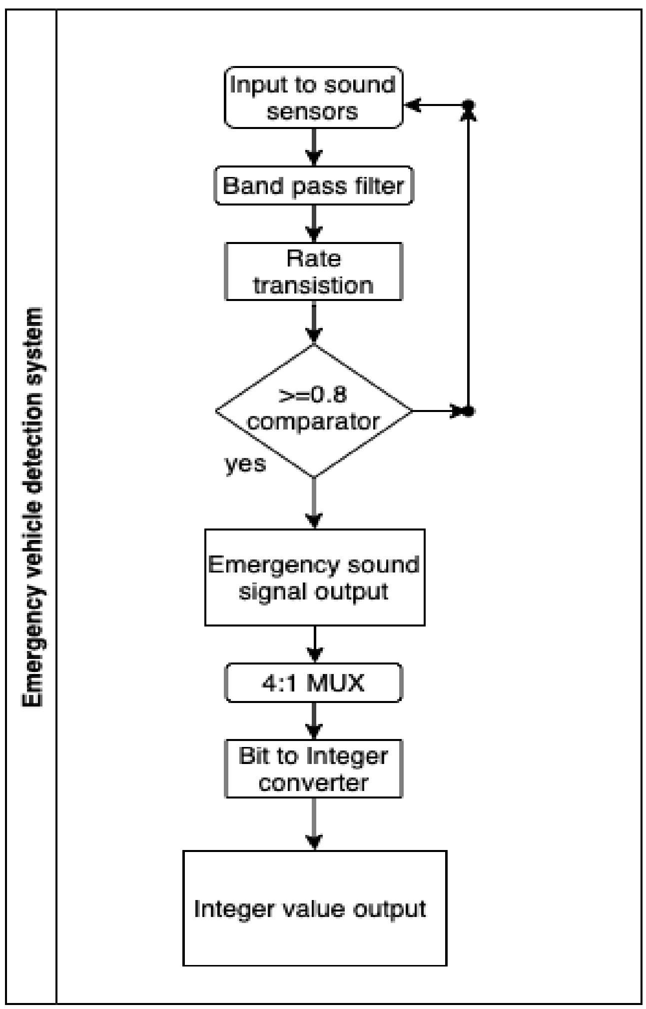
FIG: EMERGENCY TRAFFIC MANAGEMENT SYSTEM BLOCK SYSTEM

2.2 WORKING ALGORITHM

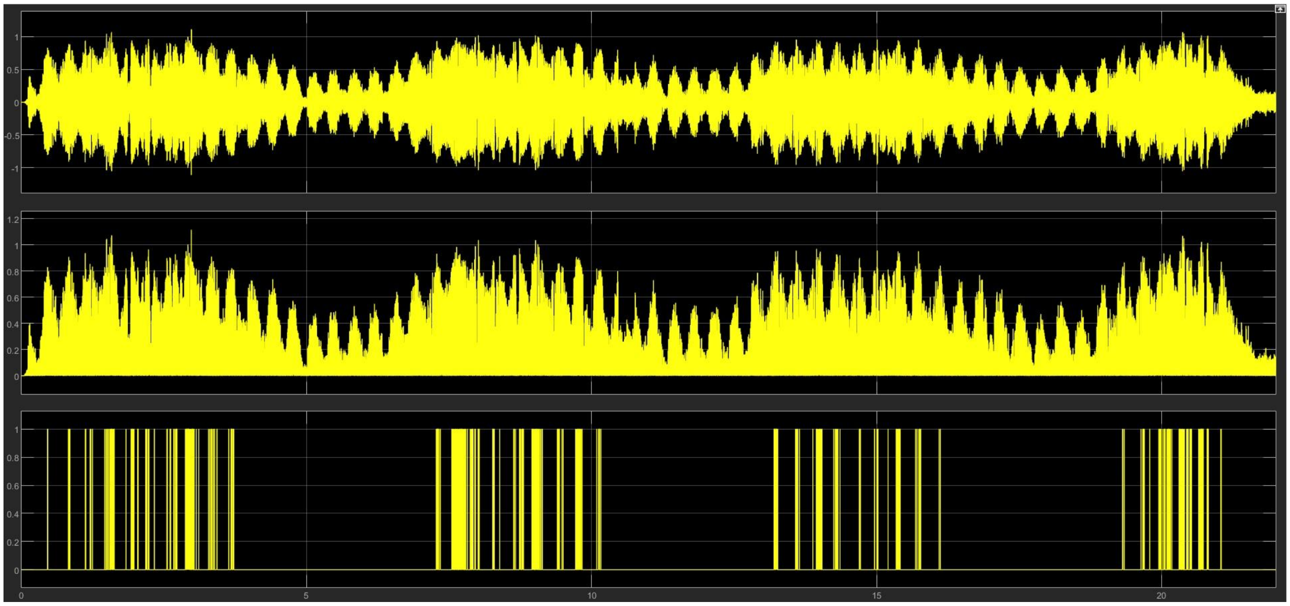
This work is carried out using MATLAB that detects the frequency of the incoming ambulance i.e., Frequency of around 900Hz-1200Hz. The sensors detect the threshold value of sound in decibels. Once the frequency exceeds the threshold value, it indicates that the ambulance is detected and the respective lane is made green providing the necessary delay for the ambulance to pass the lane completely. The proposed system works in two phases. The first phase is about the detection of emergency vehicles and the second phase is all about taking the action at the intersection. The system uses the sound detection sensor and microcontroller for processing the data.

2.2.1 EMERGENCY VEHICLE DETECTION ALGORITHM

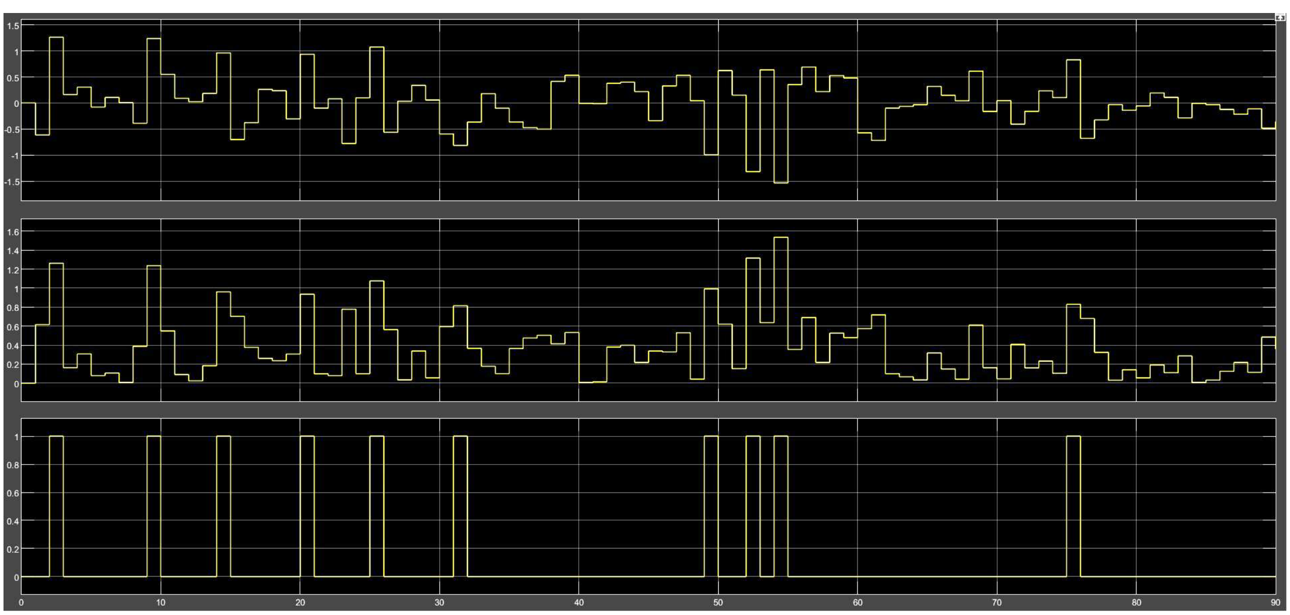
In the first phase, the Sensor detects the emergency vehicle on the road. If the emergency vehicle is on the way towards the signal then the smart object which is placed (200 m) away from the signal junction will detect the siren sound of the emergency vehicle by using a sound detection sensor. The sensor continuously detects the sound waves around it. The continuously sensed data from the sensors is passed on to the bandpass filter which filters out the frequency components of the signal and only passes the components of the signal which lies between the frequency range of (900-1200) Hz. The resultant signal strength is compared to check if the signal is perceived through the same sensor. This set of processes determines the detection of ambulances on the road. This signal is then passed to the traffic control system.



(a)The bandpass filter output (b) the magnitude of the detected signal output (c) the detected signal:

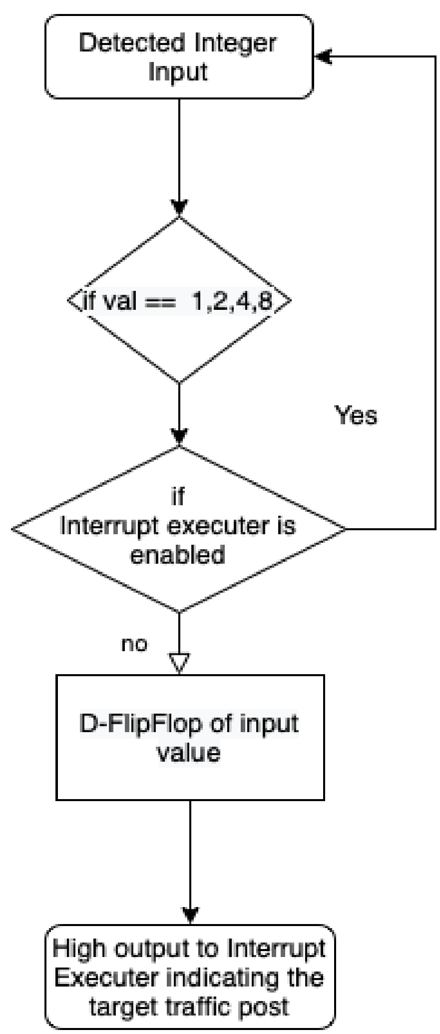


The detected signal output from the ambulance detection system thus obtained contains irregular pulses. These pulses have a very short width which is not enough to drive the output of the traffic system. These pulses might go undetected through the ambulance detection system; this happens as the audio signals are of the very high frequency of around 48KHz while the detection system has a very low frequency of operation. In order to avoid such cases, we use the rate transition system which increases the pulse width of the detected signal which is long enough to be detected by the ambulance detection system.

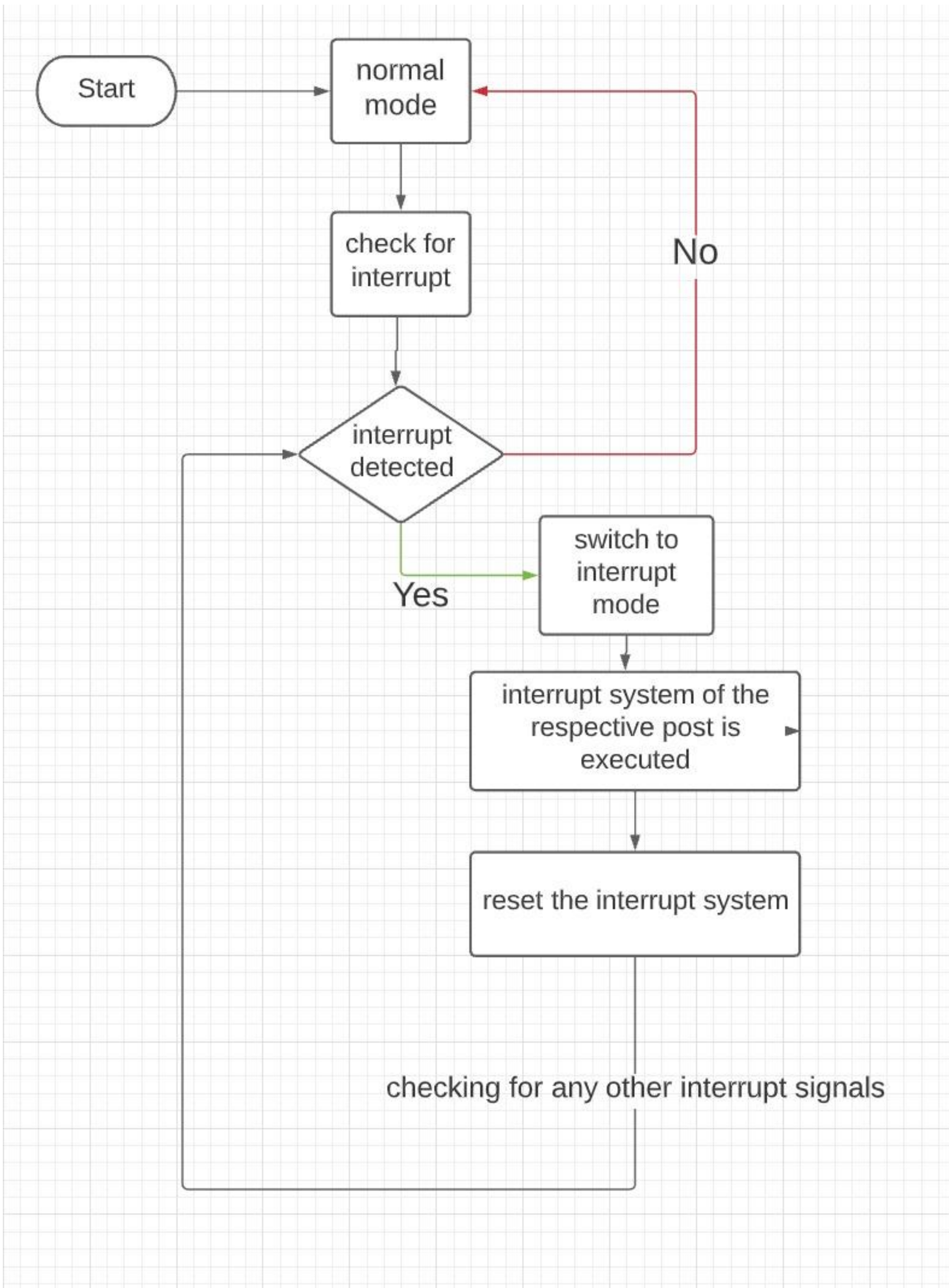


2.2.2 CONTROL BLOCK ALGORITHM

The next process is about controlling the execution blocks of each post based on the priority of the signals. Once the post on which execution has to be performed is decided, then it disables the original algorithm and executes the interrupt system. The interrupt algorithm makes the post green for a sufficient amount of time to make sure that the emergency vehicle has crossed the junction. This time is calculated based on the distance locality and density of vehicles at the post. Once the execution is done the control system checks for any other ambulance signal detection. When not found it can be reverted back to its normal functioning.



2.2.3 INTERRUPT EXECUTER ALGORITHM



2.4 SOFTWARE AND HARDWARE SPECIFICATIONS

- **Software:**

  Simulation Environment: MATLAB version - R2021a - Model version: 1.222

  Simulation Tools: Simulink version: R2021a Update 5

- **Hardware:**

  Processor: Intel Core i7-10750H CPU: 2.60GHz 2.59 GHz

  RAM: 8.00 GB

  64-bit operating system, x64-based processor

  Hard Disk: 1TB

2.5 SOFTWARE DESCRIPTION

Software's used are:

- MATLAB
- Simulink

2.5.1 MATLAB

MATLAB (matrix laboratory) is a fourth-generation high-level programming language and interactive environment for numerical computation, visualization and programming. MATLAB is developed by MathWorks. It allows matrix manipulations; plotting of functions and data; implementation of algorithms; creation of user interfaces; interfacing with programs written in other languages, including C, C++, Java, and FORTRAN; analyzing data; developing algorithms, and creating models and applications.

It has numerous built-in commands and math functions that help you in mathematical calculations, generating plots, and performing numerical methods. MATLAB's Power of Computational Mathematics. MATLAB is used in every facet of computational mathematics. Following are some commonly used mathematical calculations where it is used most commonly −

- Dealing with Matrices and Arrays
- 2-D and 3-D Plotting and graphics
- Linear Algebra
- Algebraic Equations
- Non-linear Functions
- Statistics
- Data Analysis
- Calculus and Differential Equations
- Numerical Calculations
- Integration
- Transforms
- Curve Fitting
- Various other special functions

Features of MATLAB:

- It is a high-level language for numerical computation, visualization and application development.
- It also provides an interactive environment for iterative exploration, design, and problem-solving.
- It provides a vast library of mathematical functions for linear algebra, statistics, Fourier analysis, filtering, optimization, numerical integration, and solving ordinary differential equations.
- It provides built-in graphics for visualizing data and tools for creating custom plots.

- MATLAB's programming interface gives development tools for improving code quality maintainability and maximizing performance.
- It provides tools for building applications with custom graphical interfaces.
- It provides functions for integrating MATLAB-based algorithms with external applications and languages such as C, Java, .NET, and Microsoft Excel.

Uses of MATLAB :-

MATLAB is widely used as a computational tool in science and engineering encompassing the fields of physics, chemistry, math, and all engineering streams. It is used in a range of applications including −

- Signal Processing and Communications
- Image and Video Processing
- Control Systems
- Test and Measurement
- Computational Finance
- Computational Biology

2.5.2 SIMULINK

Simulink is a simulation and model-based design environment for dynamic and embedded systems, integrated with MATLAB. Simulink, also developed by MathWorks, is a data flow graphical programming language tool for modeling, simulating, and analyzing multi-domain dynamic systems. It is basically a graphical block diagramming tool with customizable set-off block libraries.

It allows you to incorporate MATLAB algorithms into models as well as export the simulation results into MATLAB for further analysis.

Simulink supports −

- system-level design
- simulation
- automatic code generation
- testing and verification of embedded systems

There are several other add-on products provided by MathWorks and third-party hardware and software products that are available for use with Simulink.

The following list gives a brief description of some of them −

- **State-flow** allows developing state machines and flow charts.
- **Simulink Coder** allows the generation of C source code for real-time implementation of systems automatically.
- **xPC Target** together with **x86-based real-time systems** provide an environment to simulate and test Simulink and State-flow models in real-time on the physical system.
- **Embedded Coder** supports specific embedded targets.
- **HDL Coder automatically** generates synthesizable VHDL and Verilog.
- **SimEvents** provides a library of graphical building blocks for modeling queuing systems.

Simulink is capable of systematic verification and validation of models through modeling style checking, requirements traceability, and model coverage analysis.

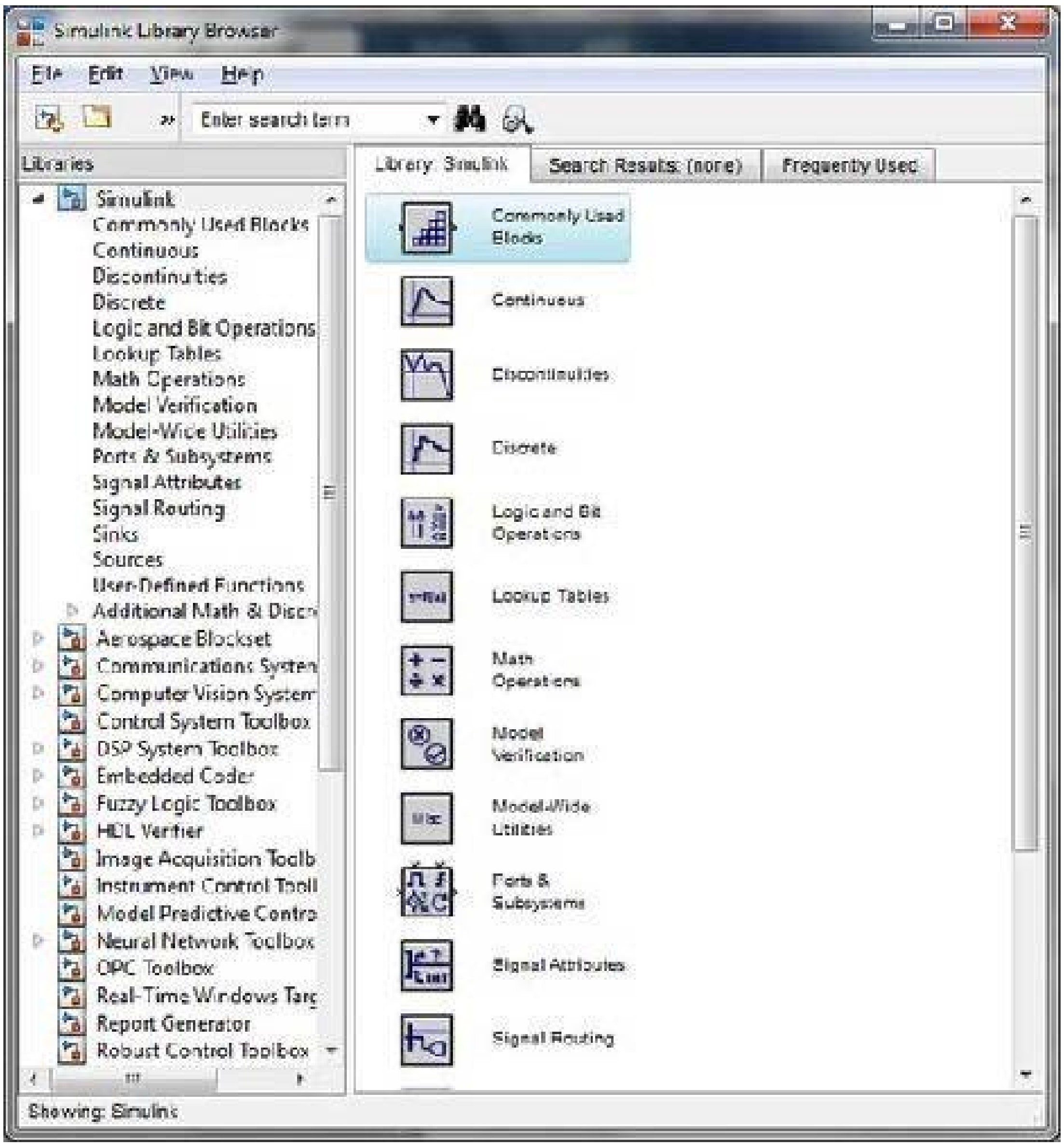
Simulink Design Verifier allows you to identify design errors and to generate test case scenarios for model checking.

Using Simulink:

To open Simulink, type in the MATLAB workspace −

>>>>> Simulink

Simulink opens with the **Library Browser**. The Library Browser is used for building simulation models.



On the left side window pane, you will find several libraries categorized on the basis of various systems, clicking on each one will display the design blocks on the right window pane.

Categories

There are two major categories of elements in Simulink:

- Blocks
- Lines

Blocks are used to generate, modify, combine, output, and display signals. Lines, on the other hand, are used to transfer signals from one block to another.

Blocks

There are several general classes of blocks, some of which are:

- Sources: Used to generate various signals. Source blocks have outputs but no inputs. One may want to use a Constant input, a Sine Wave, a Step, a Ramp, a Pulse Generator, or a Uniform Random number to simulate noise. The Clock may be used to create a time index for plotting purposes.
- Sinks: Used to output or display signals. Sinks blocks have inputs but no outputs. Examples are Scope, Display, To Workspace, Floating Scope, XY Graph, etc.
- Discrete: Discrete Filter, Discrete State-Space, Discrete Transfer Fcn, Discrete Zero-Pole, Unit Delay, etc.
- Continuous: Integrator, State-Space, Transfer Fcn, Zero-Pole, etc.
- Signal routing: Mux, Demux, Switch, etc.
- Math Operations: Abs, Gain, Product, Slider Gain, Sign, Sum, etc.

Lines

Lines transmit signals in the direction indicated by the arrow. Lines must always transmit signals from the output terminal of one block to the input terminal of another block. One exception to this is that a line can tap off of another line. This sends the original signal to two (or more) destination blocks.

Lines can never inject a signal into another line; lines must be combined through the use of blocks such as a summing junction. A signal can be either a scalar signal or a vector signal.

Building a Simulink model of a system consists of selecting the appropriate blocks and connecting them in a way that represents the mathematical models.

Model Creation

Creating a working model with Simulink is straightforward. The process involves four (4) basic steps as depicted in the following flowchart:

First you will gather all the necessary blocks from the Library Browser. Then you will modify the blocks so that they correspond to the blocks of the desired model. Lastly, but not the least, you will connect the blocks with lines to form the complete system and set the overall simulation parameters. After this, you will simulate the complete system to verify that it works.

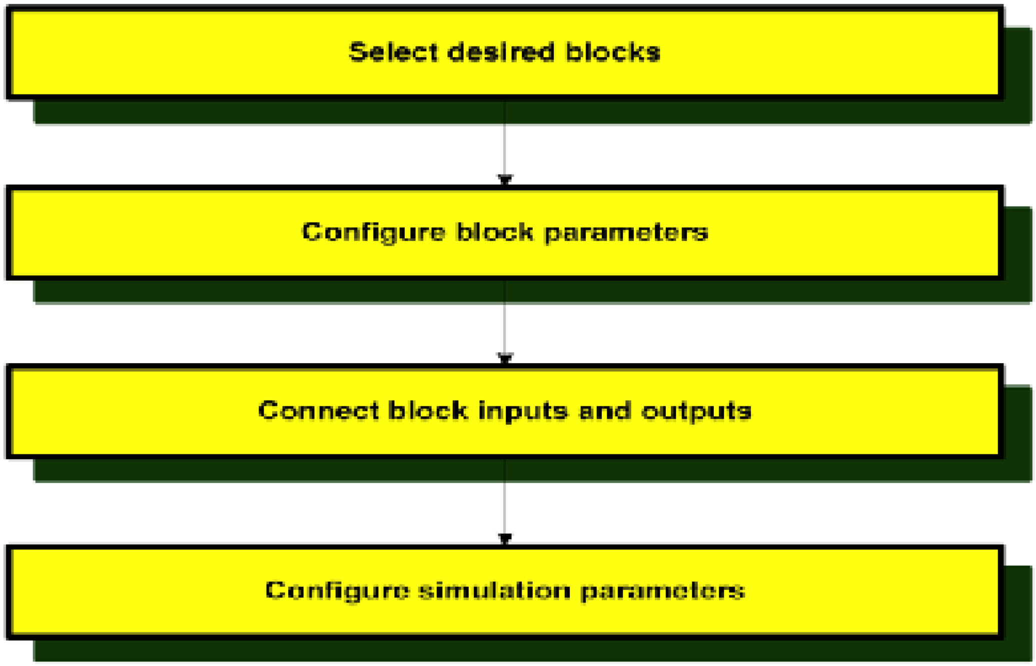


Fig 2.5.2.1 Model creation steps

Building Models

To create a new model, click the **New** button on the Library Browser's toolbar. This opens a new untitled model window.

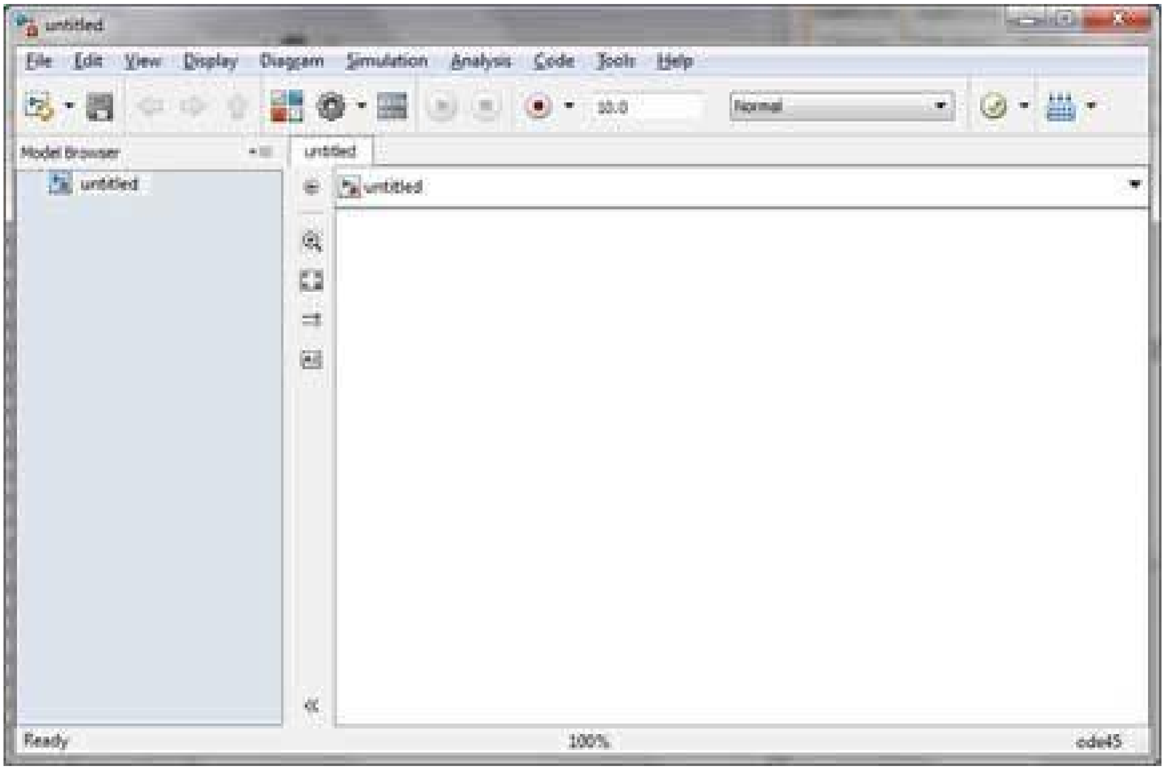


Fig 2.5.2.2: A Simulink model is a block diagram.

Model elements are added by selecting the appropriate elements from the Library Browser and dragging them into the Model window.

Alternatively, you can copy the model elements and paste them into the model window.

2.6 CIRCUIT COMPONENTS

- ZedBoard
- Sound sensor.
- LED indicator

2.6.1 Zed-Board

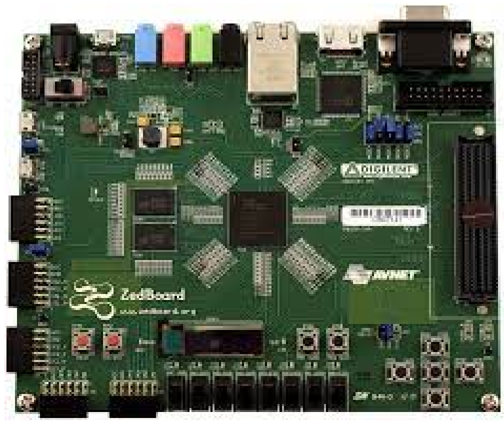


Fig 2.6.1: ZedBoard

- The ZedBoard featuring the XC7Z020T-1CSG324 adaptive SoC
- 12V power supply with USA and European adapters
- 4 GB SD Card
- Micro-USB cable
- USB Adapter: Male Micro-B to Female Standard-A
- Getting Started Guide
- Vivado Design Suite: WebPack Edition DVD with device-locked Vivado Logic Analyzer license

Features:

- Dual ARM® Cortex™-A9 MPCore™ with CoreSight™
- 32 KB Instruction, 32 KB Data per processor L1 Cache
- 512 KB unified L2 Cache

- 256 KB On-Chip Memory
- 2x UART, 2x CAN 2.0B, 2x I2C, 2x SPI, 4x 32b GPIO
- 2x USB 2.0 (OTG), 2x Tri-mode Gigabit Ethernet, 2x SD/SDIO on-chip peripherals
- 85K logic cells (13300 logic slices, each with four 6-input LUTs and 8 flip-flops)
- 560 Kbits of fast block RAM
- Four clock management tiles, each with phase-locked loop (PLL)
- 220 DSP slices
- Internal clock speeds exceeding 450MHz
- 2x 12 bit, 1 MSPS On-chip analog-to-digital converter (XADC)

Description:

Digilent ZedBoard Zynq-7000 Development Board is a low-cost development board for the Xilinx Zynq-7000 all programmable SoC (AP SoC). This board contains everything necessary to create a Linux®, Android®, Windows®, or other OS/RTOS-based design. Additionally, several expansion connectors expose the processing system and programmable logic I/Os for easy user access. The ZedBoard allows a user to take advantage of the Zynq-7000 AP SoCs tightly coupled Arm® processing system and 7-series programmable logic to create unique and powerful designs. Target applications include video processing, reconfigurable computing, motor control, software acceleration, Linux/Android/RTOS development, exploring RISC processors (Arm), and general Zynq-7000 AP SoC prototyping. The hardware platform for this guide is based on the Processor System (PS) configuration and Programmable Logic (PL) bitstream described in the

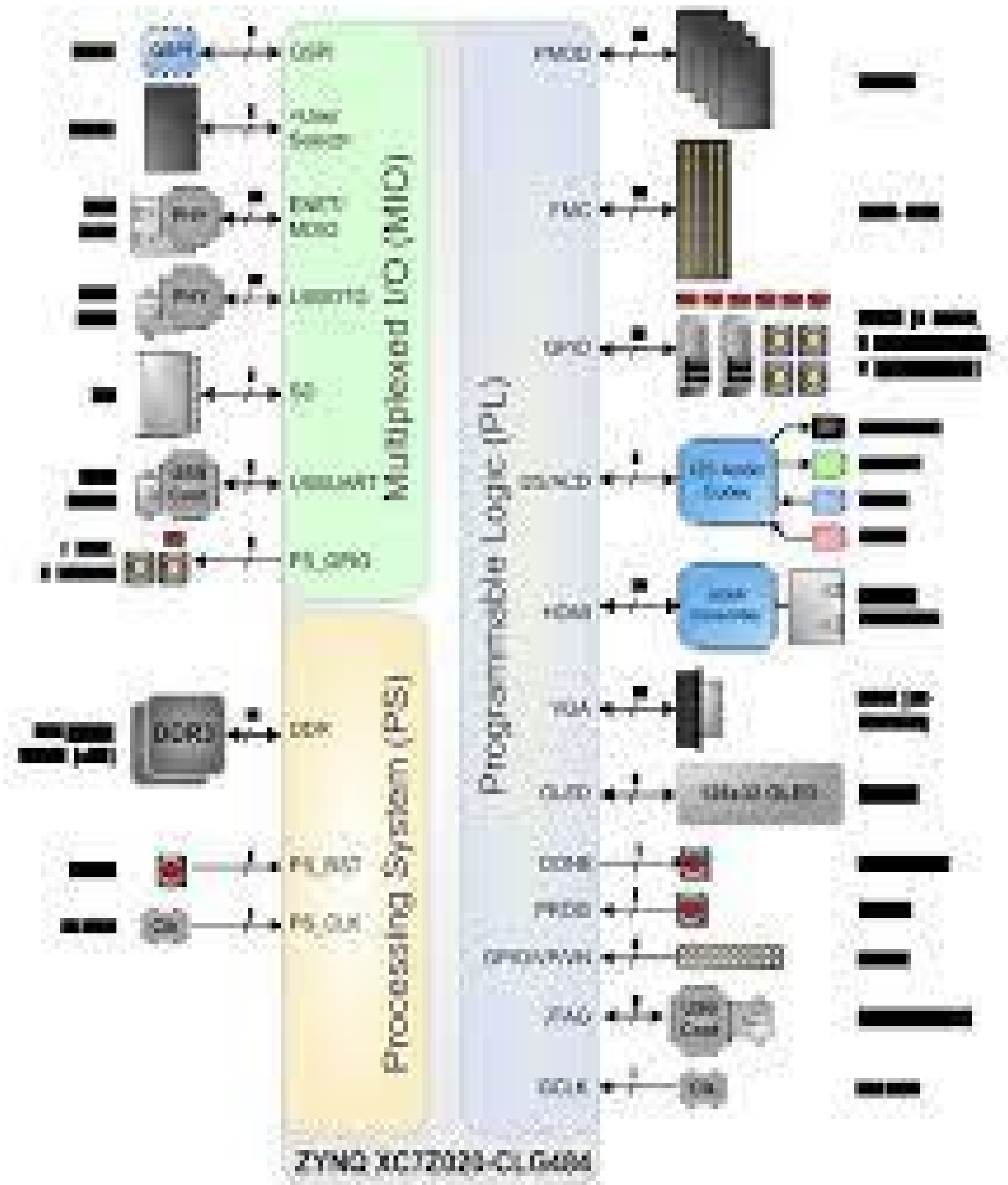


Fig 2.6.1.1: Block Diagram of ZYNQ XC7Z020-CLG84

2.6.2 LED

A light-emitting diode (LED) is a two-lead semiconductor light source . It is a basic pn-junction diode, which emits light when activated. When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the color of the light (corresponding to energy of the photon) is determined by the energy band gap of the semiconductor.

Fig 2.6.2: LED

An LED is often small in area (less than 1 mm2) and integrated optical components may be used to shape its radiation pattern.

Appearing as practical electronic components in 1962, the earliest LEDs emitted low-intensity infrared light. Infrared LEDs are still frequently used as transmitting elements in remote-control circuits, such as those in remote controls for a wide variety of consumer electronics. The first visible-light LEDs were also of low intensity and limited to red. Modern LEDs are available across the visible, ultraviolet, and infrared wavelengths, with very high brightness. Early LEDs were often used as indicator lamps for electronic devices, replacing small incandescent bulbs. They were soon packaged into numeric readouts in the form of seven-segment displays and were commonly seen in digital clocks.

2.6.3 SOUND SENSOR:

Figure 2.6.3: Sound Sensor

Micro-Electro-Mechanical Systems (MEMS) is the integration of mechanical elements, sensors, actuators, and electronics on a common silicon substrate through micro-fabrication technology. While the electronics are fabricated using integrated circuit (IC) process sequences (e.g., CMOS, Bipolar, or BICMOS processes), the micro-mechanical components are fabricated using compatible "micro-machining" processes that selectively etch away parts of the silicon wafer or add new structural layers to form the mechanical and electromechanical devices.

MEMS promises to revolutionize nearly every product category by bringing together silicon-based microelectronics with micromachining technology, making possible the realization of complete **systems-on-a-chip**.MEMS is an enabling technology allowing the development of smart products, augmenting the computational ability of microelectronics with the perception and control capabilities of microsensors and microactuators, and expanding the space of possible designs and applications.

Microelectronic integrated circuits can be thought of as the "brains" of a system and MEMS augments this decision-making capability with "eyes" and "arms", to allow microsystems to sense and control the environment. Sensors gather information from the environment by measuring mechanical, thermal, biological, chemical, optical, and magnetic phenomena. The electronics then process the information derived from the sensors and through some decision-making capability direct the actuators to respond by moving, positioning, regulating, pumping, and filtering, thereby controlling the environment for some desired outcome or purpose. Because

MEMS devices are manufactured using batch fabrication techniques similar to those used for integrated circuits, unprecedented levels of functionality, reliability, and sophistication can be placed on a small silicon chip at a relatively low cost.

Mems sound:

A sound sensor is defined as a module that detects sound waves through its intensity and converts them to electrical signals. A sound sensor consists of an in-built capacitive microphone, peak detector, and an amplifier (LM386, LM393, etc.) that's highly sensitive to sound. They are used in consumer electronics such as phones, computers, music systems. Security and Monitoring systems such as burglar alarms, door alarms, etc. Home automation such as lighting your house by detecting whistle/clap instead of physically turning the light switch. Ambient sound recognition and sound level recognition.

HOW DOES AN SOUND SENSOR WORK?

The working principle of this sensor is related to human ears. Because the human eye includes a diaphragm and the main function of this diaphragm is, it uses the vibrations and changes into signals. Whereas in this sensor, it uses a microphone and the main function of this is, it uses the vibrations and changes into current otherwise voltage. Generally, it includes a diaphragm which is designed with magnets that are twisted with metal wire. When sound signals hit the diaphragm, then magnets within the sensor vibrate & simultaneously current can be stimulated from the coils.

PRINCIPLE OF OPERATION

First, we need to connect the module to the 5v power supply. Then set the threshold voltage at the Non-Inverting input (3) of the IC according to the silent environment by rotating the preset knob for setting the sensor sensitivity.

When the sensor detects Sound then a Low amount of voltage from the microphone is given to the Inverting input (2) of the IC. Then the Comparator IC compares this voltage with the threshold voltage. In this condition, this input voltage is less than the threshold voltage, so the sensor output goes LOW (0).

In contrast, when the sensor does not detect Sound then a High amount of voltage from the microphone is given to the Inverting input (2) of the IC. Then the Comparator IC compares this voltage with the threshold voltage. In this condition, this input voltage is greater than the threshold voltage, so the sensor output goes High (1).

Sound Detection Sensor Module Features & Specifications

- Operating Voltage: 3.3V to 5V DC
- LM393 comparator with threshold preset
- PCB Size: 3.4cm * 1.6cm
- Induction distance: 0.5 Meter
- Operating current: 4~5 mA
- Microphone Sensitivity (1kHz): 52 to 48 dB
- Easy to use with Microcontrollers or even with normal Digital/Analog IC
- Small, cheap and easily available

CHAPTER 3

IMPLEMENTATION

3.1 Block Diagram

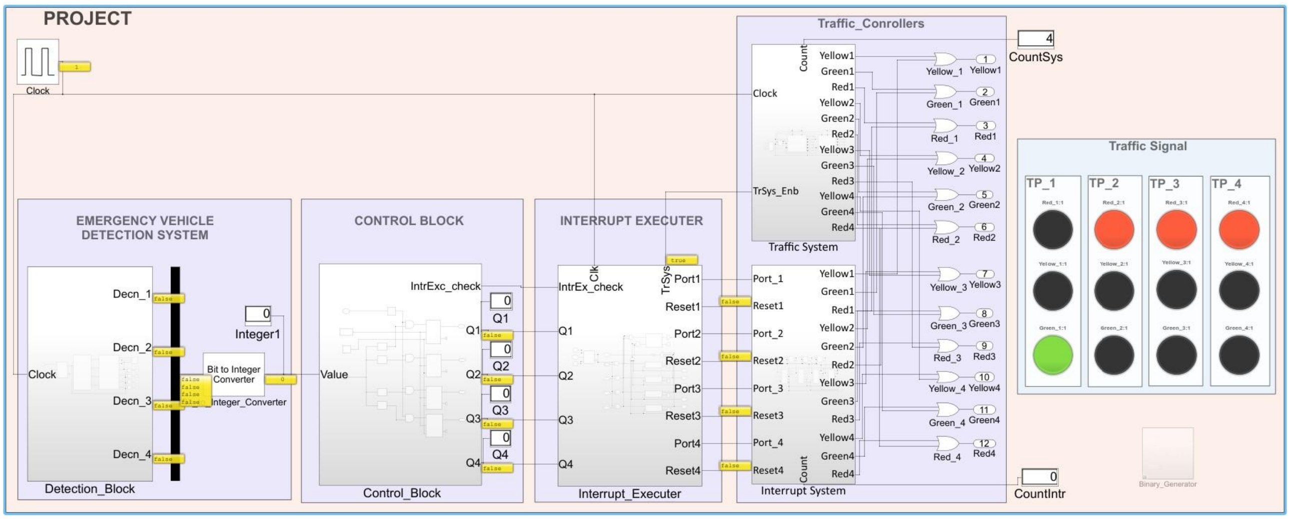


Fig 3.1: Block diagram of Emergency Vehicle Detection System.

The block diagram of an Emergency Vehicle Detection System consists of an Emergency Vehicle Detection System using sensors. The input to the system is mono audio of surrounding vehicles and the sound sensor. The Emergency Vehicle Detection system will also filter the sound of the required sound signal. Later blocks will help manage the traffic system of multiple roads.

3.2 Circuit Description

(a) Emergency Vehicle Detection:

In this block the received sound input from surrounding vehicles is of mono audio type and this audio is obtained from multiple roads from sound sensors to the emergency vehicle detection system block. The sound of emergency is detected using the bandpass filter having the emergency vehicles sound frequency. After the Decn outputs are obtained are converted from boolean to an integer value using a bit to integer converter.

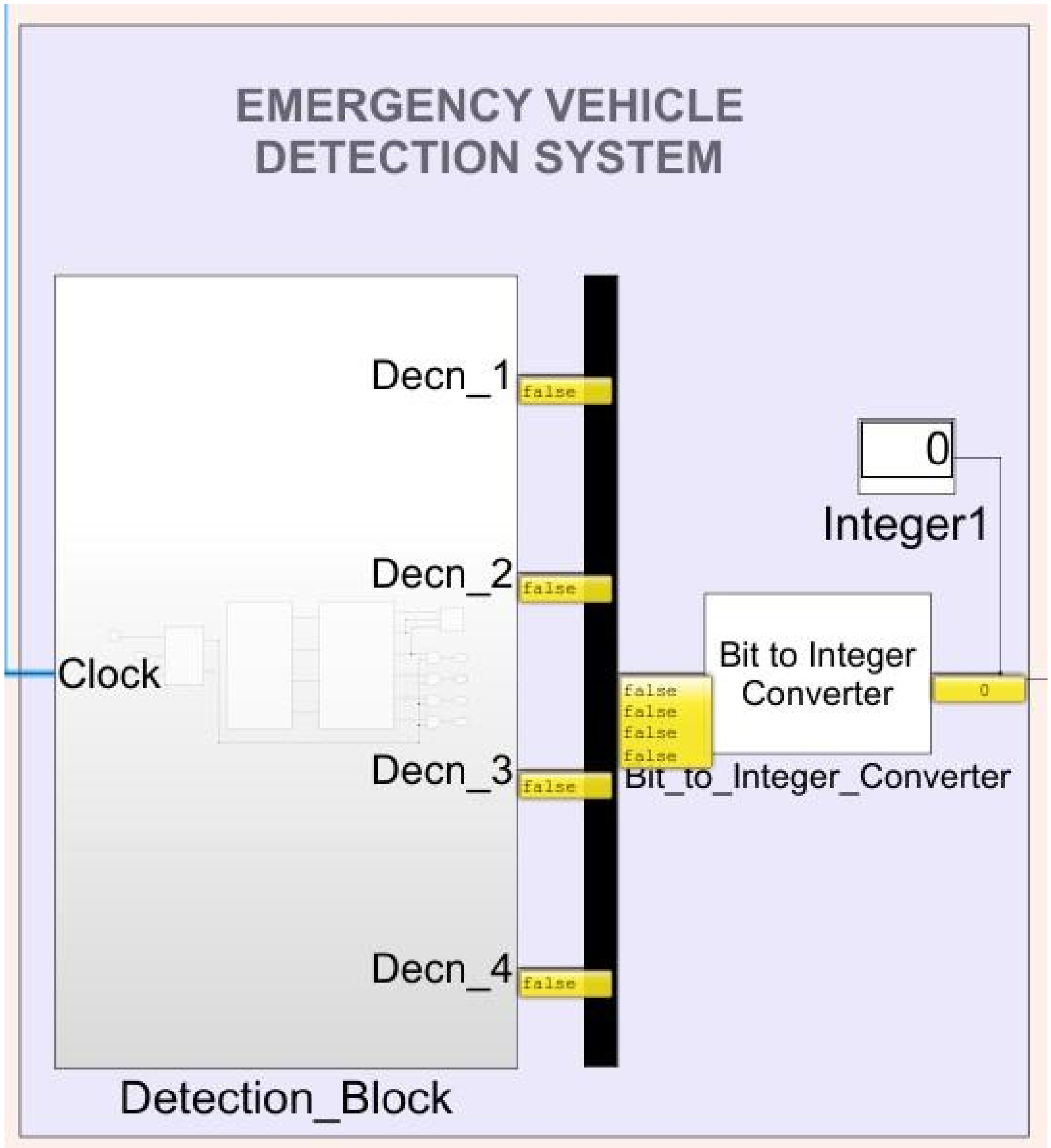


Fig 3.2.1: EVD SYSTEM Outer block

In the above block Decn(1,2,3,4) are the outputs from the system . This output is false if no emergency sound is detected in that road and returns true if an emergency vehicle sound is detected . This block contains sound sensors and filtering of the detected sound signals.

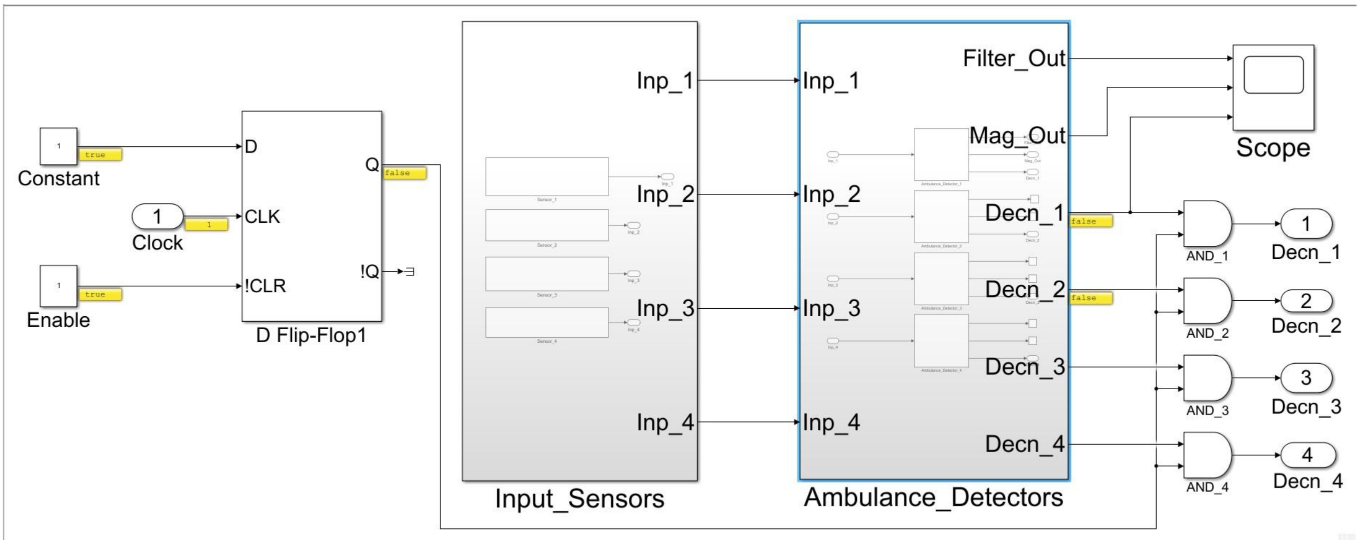


Fig 3.2.2: Internal Block diagram of Emergency Vehicle detection system

- The EVD system has an Input sound sensor to detect sound from surroundings
- The gathered sound from sensors is passed to the ambulance detector block to detect the emergency vehicle sound and to filter and convert the detected sound .

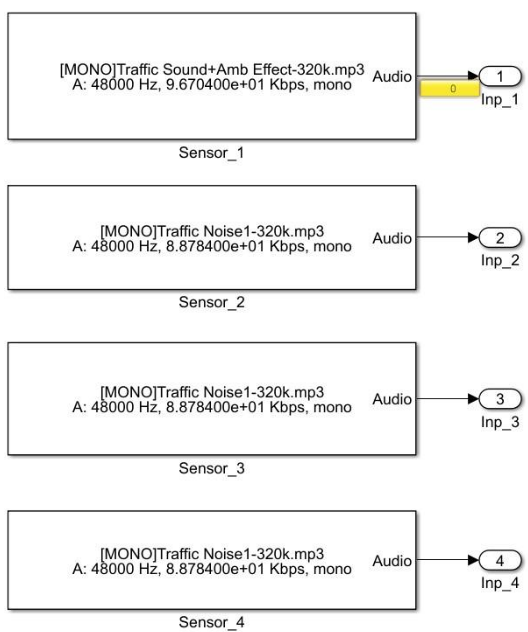


Fig 3.2.3: Internal Block diagram of Input sensor block

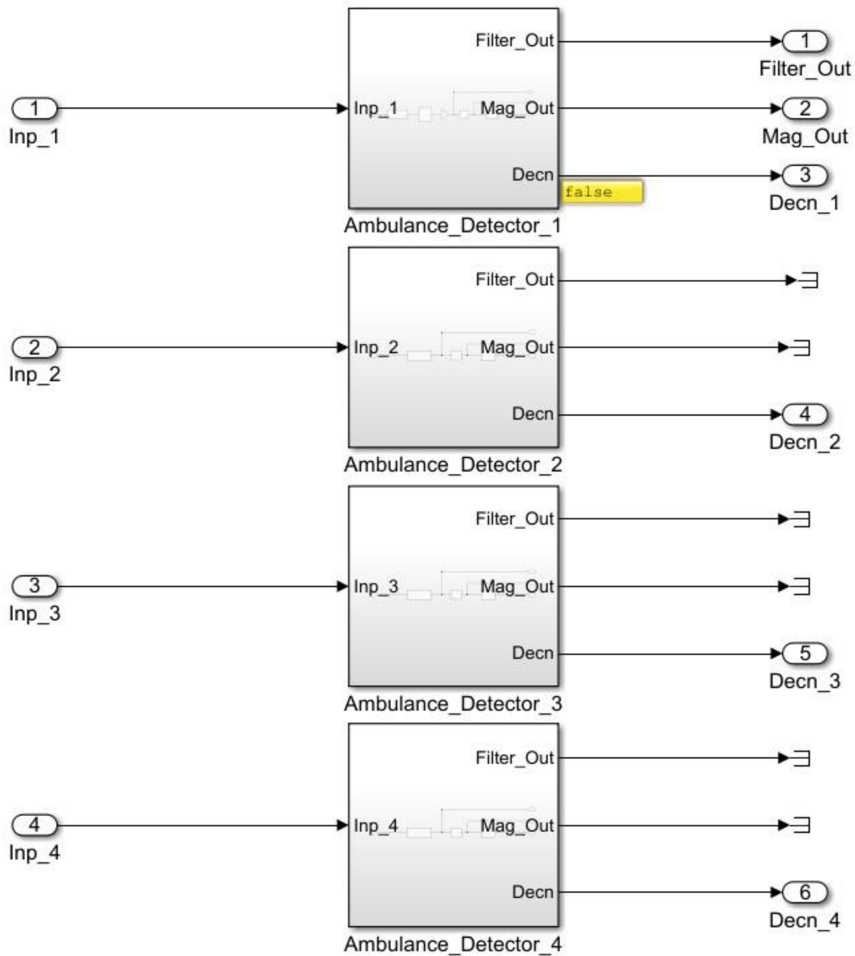


Fig 3.2.4: Internal Block diagram of Ambulance Detector block

- The ambulance detector block will detect the emergency vehicle sound and filter the detected sound.
- The 4 inputs are from the sound sensor block's 4 outputs to the ambulance detector block. The input which has the ambulance sound will return true else false.

- Internal block of inputs of the ambulance detector.

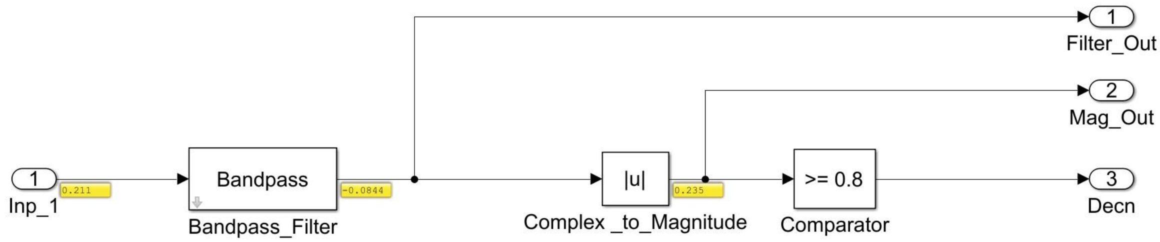


Fig 3.2.5: Ambulance Detection without sampling rate

- The input of the sensors is passed through a bandpass filter to filter the ambulance sound and convert the sound using magnitude and if the frequency is greater than 0.8 then ambulance sound is detected and returned true.
- For the above arrangement, the detected sound time is very less as shown in the above wave from which will be difficult for further blocks to consider this sound like an emergency sound.

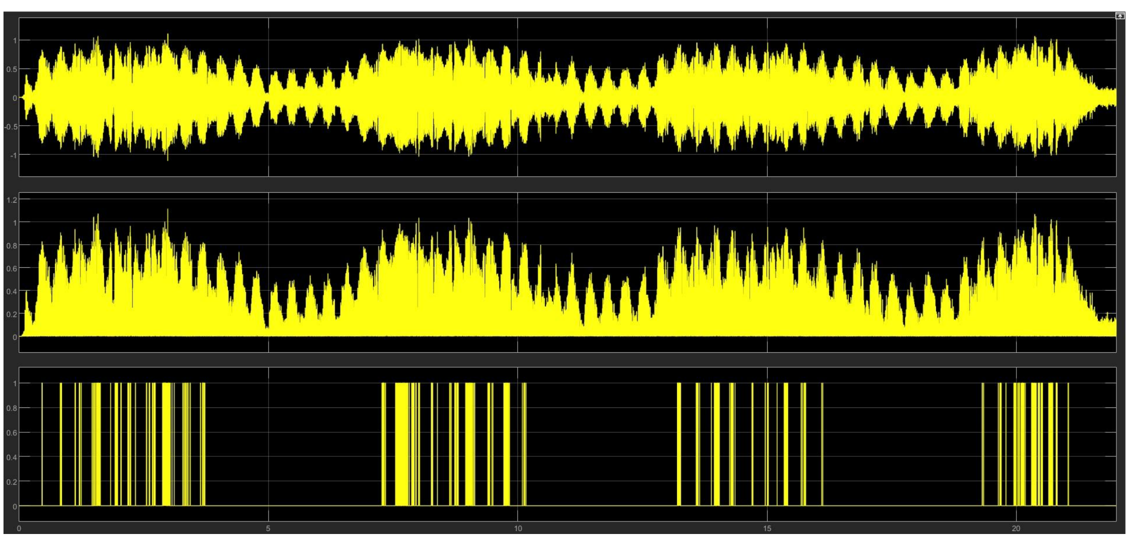


Fig 3.2.6: Output wave of Ambulance Detection without sampling rate

- Since the detected emergency sound time is very less as seen in graph 1 . We expand the signal using rate transition as shown in the above figure so that to increase the time to help

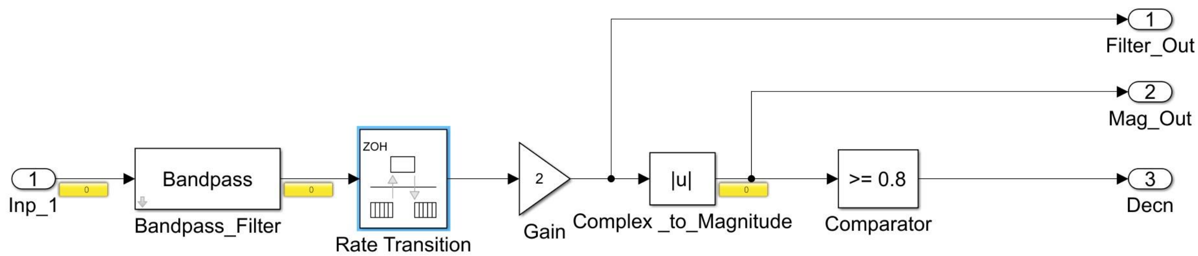


Fig 3.2.7: Ambulance Detection with sampling rate

further blocks to consider the emergency sound as real. Then the expanded sound signal is converted into magnitude form as shown if wave 3.

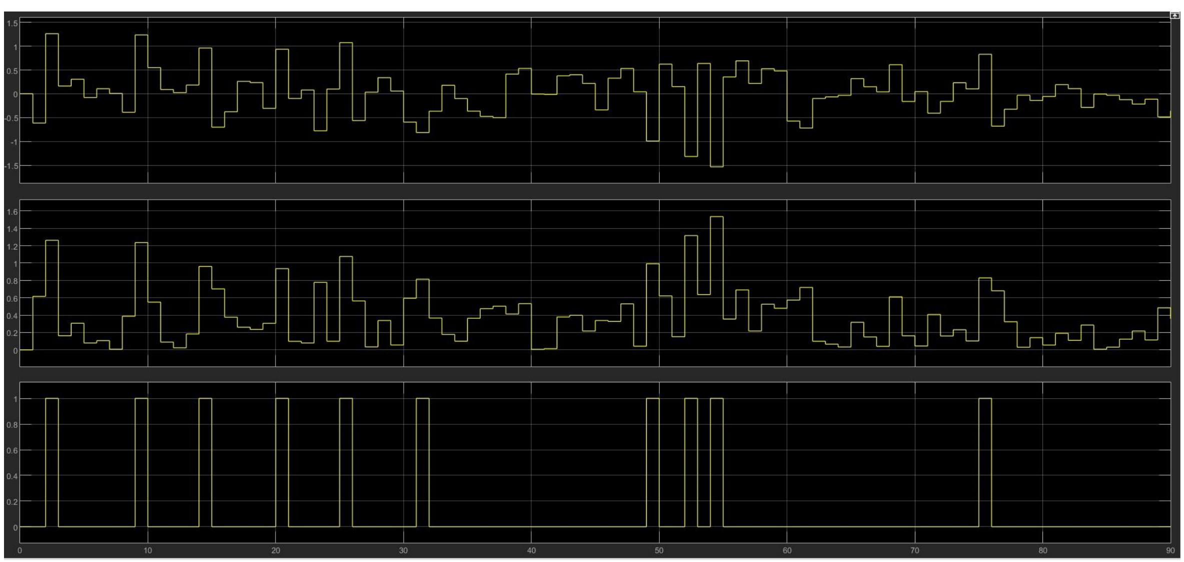


Fig 3.2.8: Output of Ambulance Detection with sampling rate

(b) Control Block:

In this block the integer values from the emergency vehicle detection system is obtained.The integer values of respective four roads after conversion are 1,2,4 and 8.Here it checks the integer value of each road and turns high for that respective road while keeping others low.

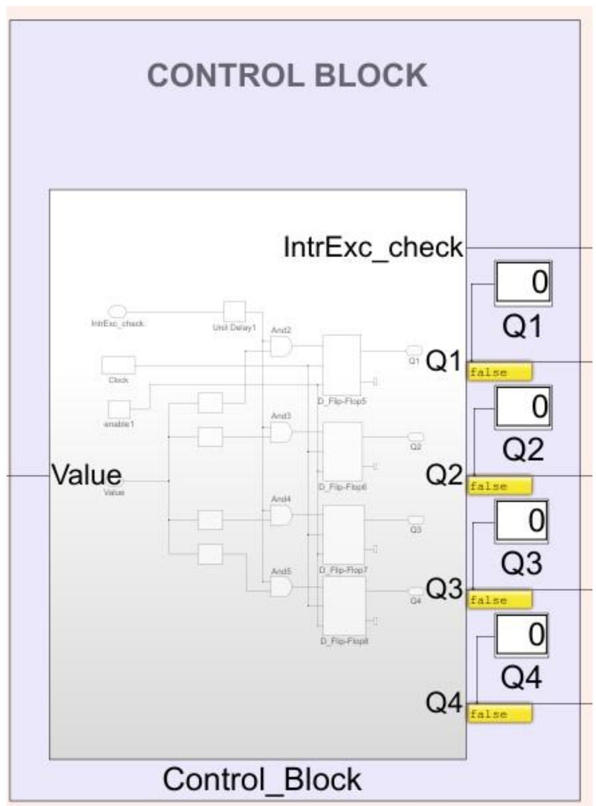


Fig 3.2.9: Control block

- For example, If the value is 1 the Q1 is turned true while all other outputs false.
- The control block is used to pass the interrupt block indicating which traffic post mode to change from normal operation to emergency mode.

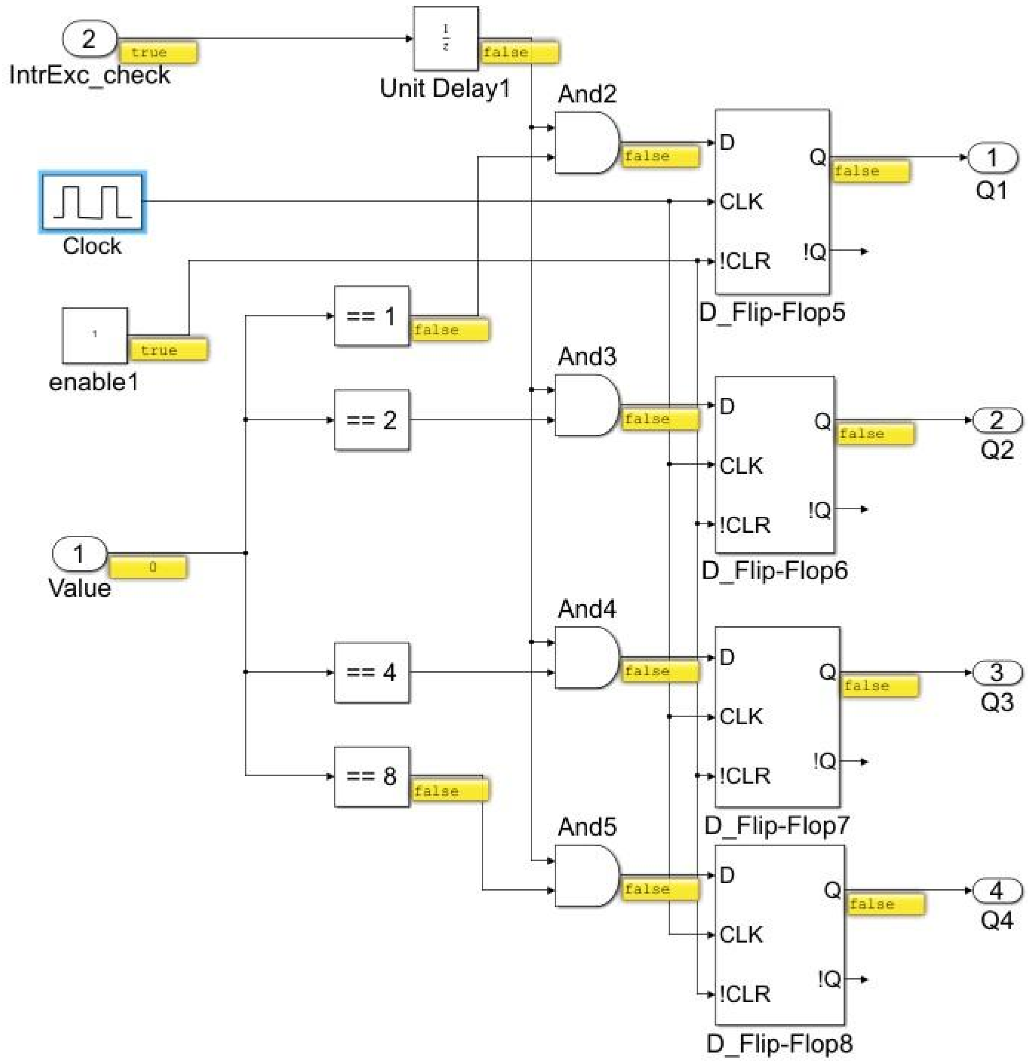


Fig 3.2.10: Internal diagram of control block

- In the above block if the value is 1 then the respective control flip flop of post 1 is made high and others low .Then the output Q1 will be high.This will be passed to interrupt executor block.

(c) Interrupt Executor block:

This block is used to change the traffic mode of operation of the respective road. It is done when we get a high value from the control system block of that respective road. Initially, the interrupt executor operates the traffic system block of all traffic systems. Whenever It detects a control signal for set-reset flip flop of respective traffic post it tries to instruct the interrupt system of the respective traffic post. After executing the interrupt system it again checks for any control signal(If it exists) from other roads otherwise it executes the traffic post to the normal mode of operation.

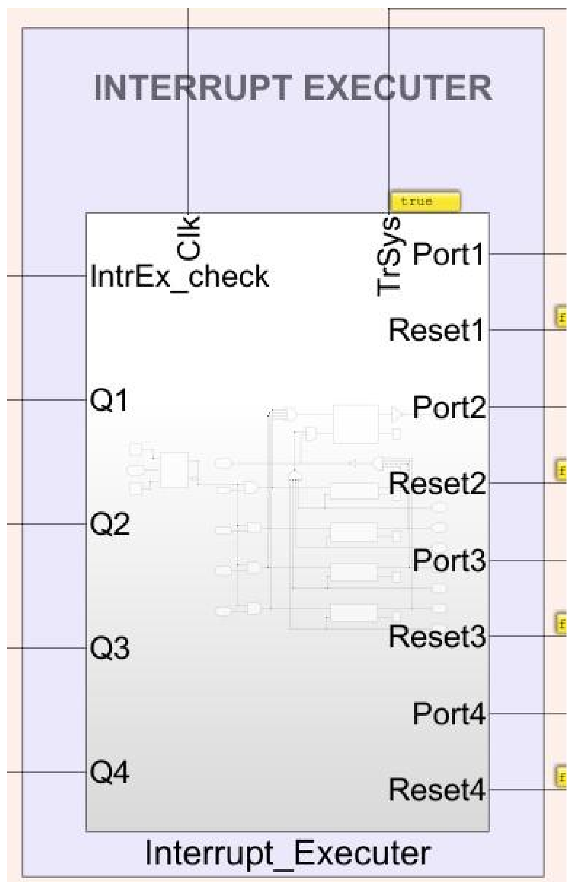


Fig 3.2.11: Interrupt Executor

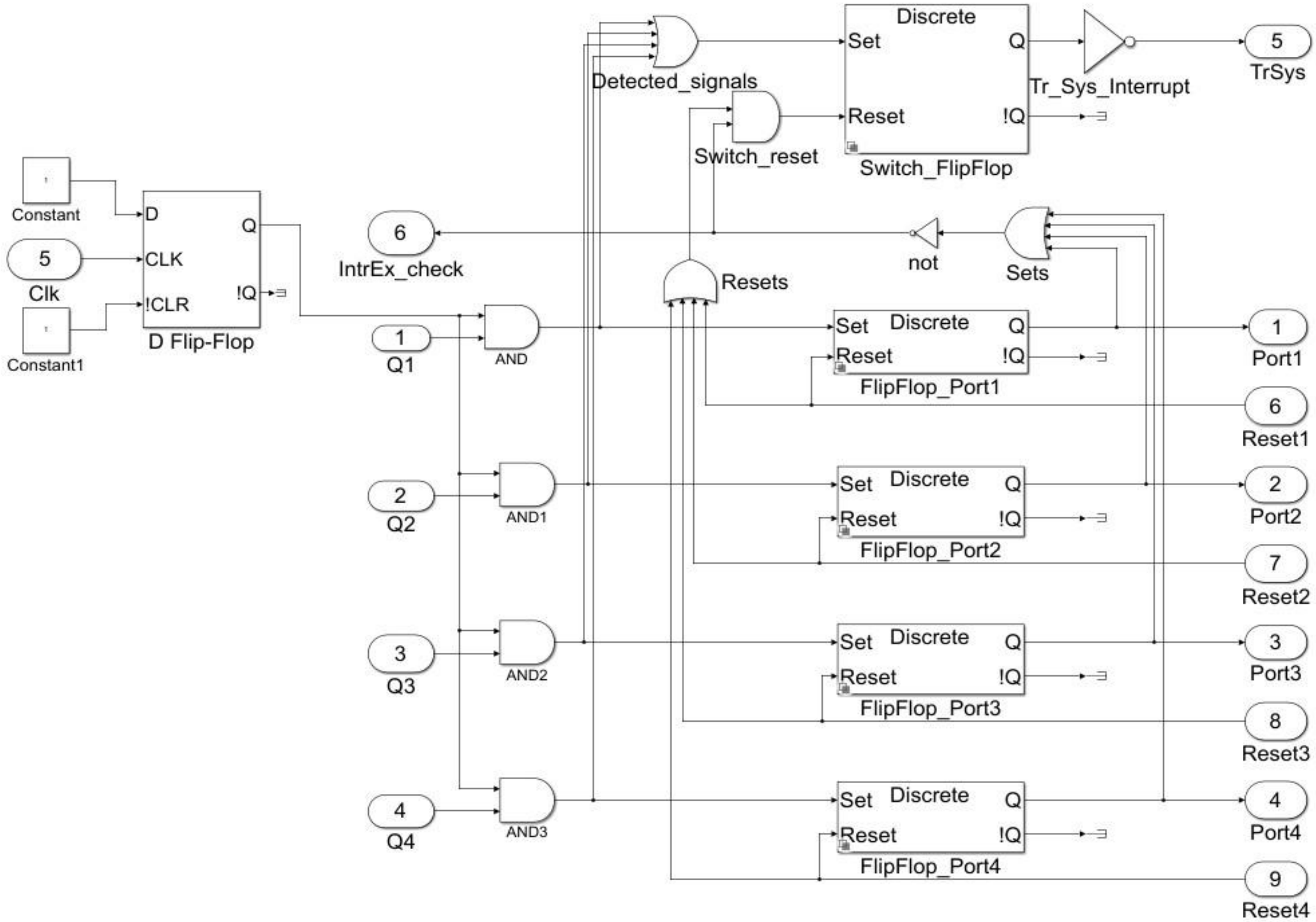


Fig 3.2.12: Internal block diagram of interrupt executor.

- The interrupt executor has four inputs of four roads and port ,reset of all four roads.If The reset value is true then that traffic post mode of operation is changed to emergency mode .
- For example if Q1 is high then the set reset flip flop of that port is turned on and the flip flop makes the respective traffic system to change its mode of operation from normal mode to emergency mode of operation.

(d) Traffic controller :

(i)Traffic system (Normal mode)

(ii)Interrupt system (Emergency mode)

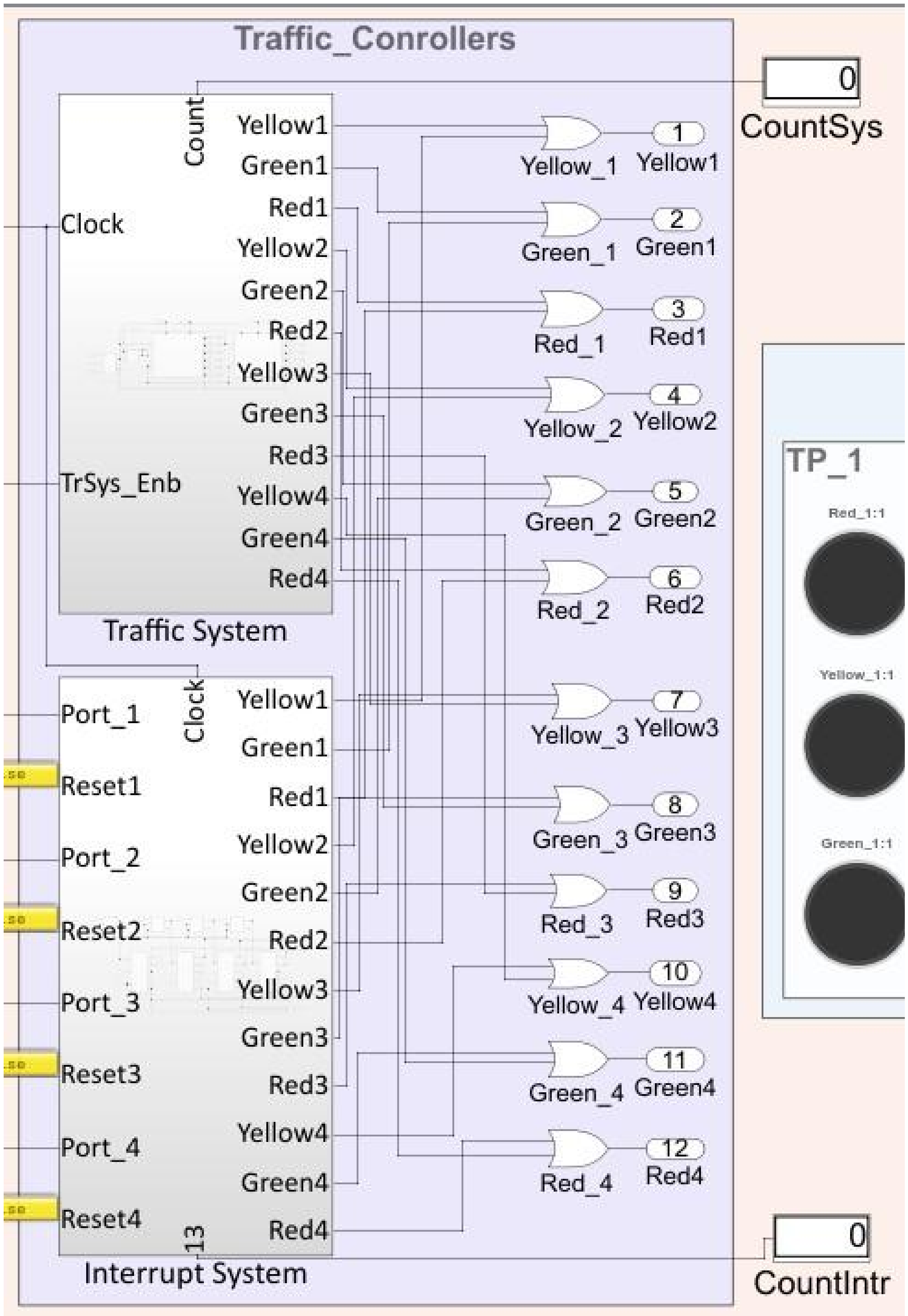


Fig 3.2.13: Traffic controller

(i) Traffic system (Normal mode):

This is the standard traffic post system used in real-time. It follows the normal protocol of traffic post with each of the three signal indications (RED, ORANGE, GREEN) .

The duration for each of three signal modes is standard and they can be scaled according to the location of the traffic post if not interrupted from interrupt executor.If we get interrupted from the interrupt executor then this mode of operation is switched off for the respective side.

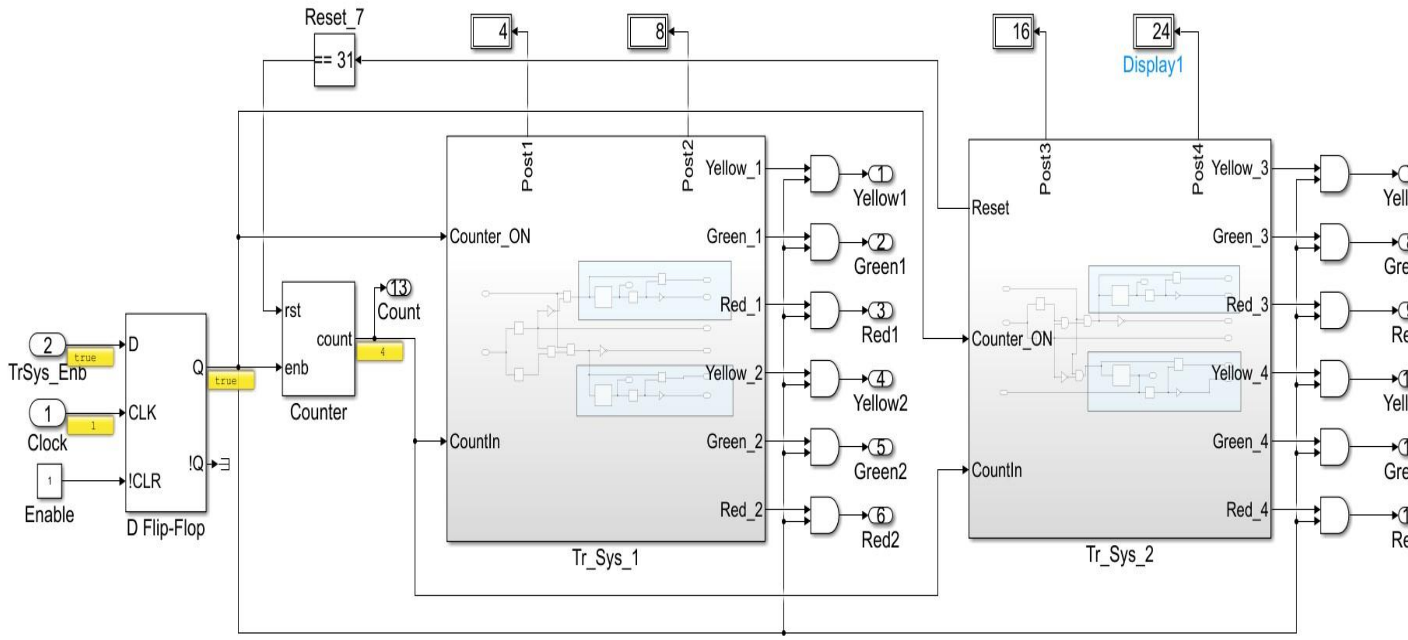


Fig 3.2.14: Traffic system normal mode.

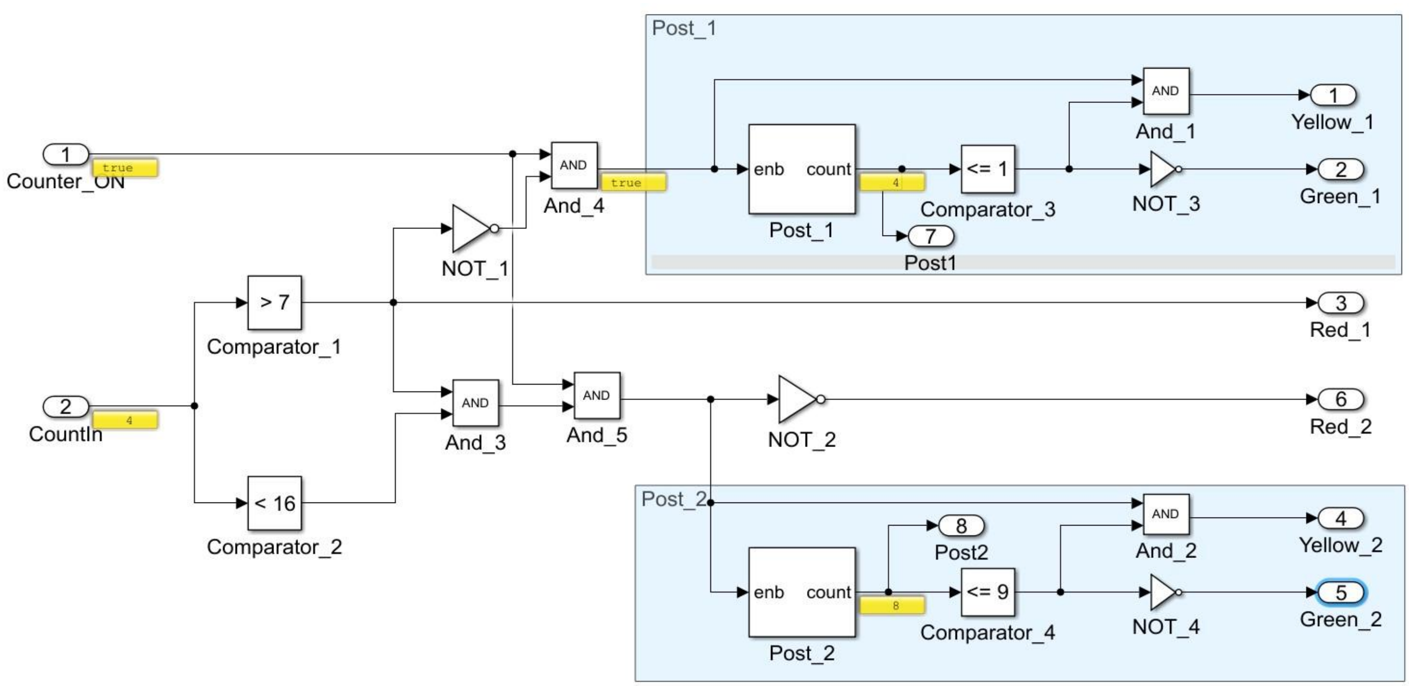


Fig 3.2.15: Internal logic of traffic post 1&2

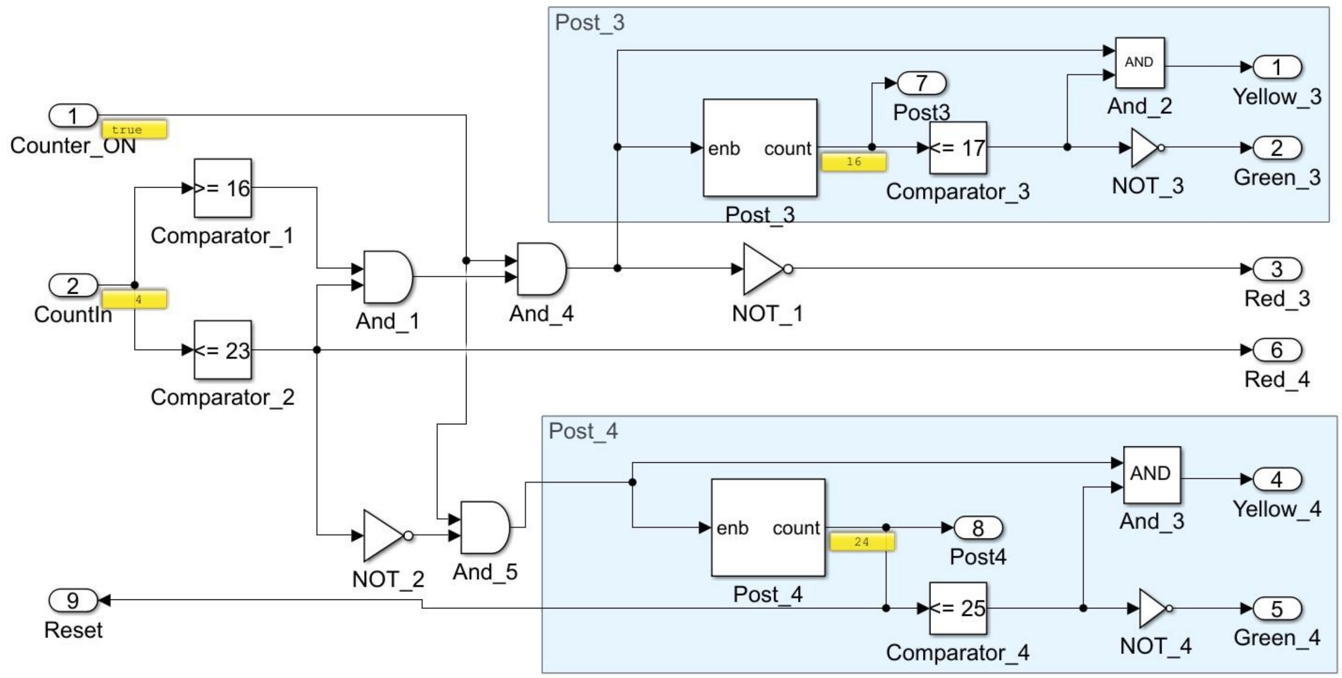


Fig 3.2.16: Internal logic of traffic post 3&4

(ii) Interrupt system (Emergency mode):

This is enabled when the emergency mode of operation is triggered from the interrupt executor block . This mode of operation will turn the green light in traffic signal posts for a duration which is calculated such that an emergency vehicle gets sufficient amount of Time to pass through traffic under heavy traffic conditions.

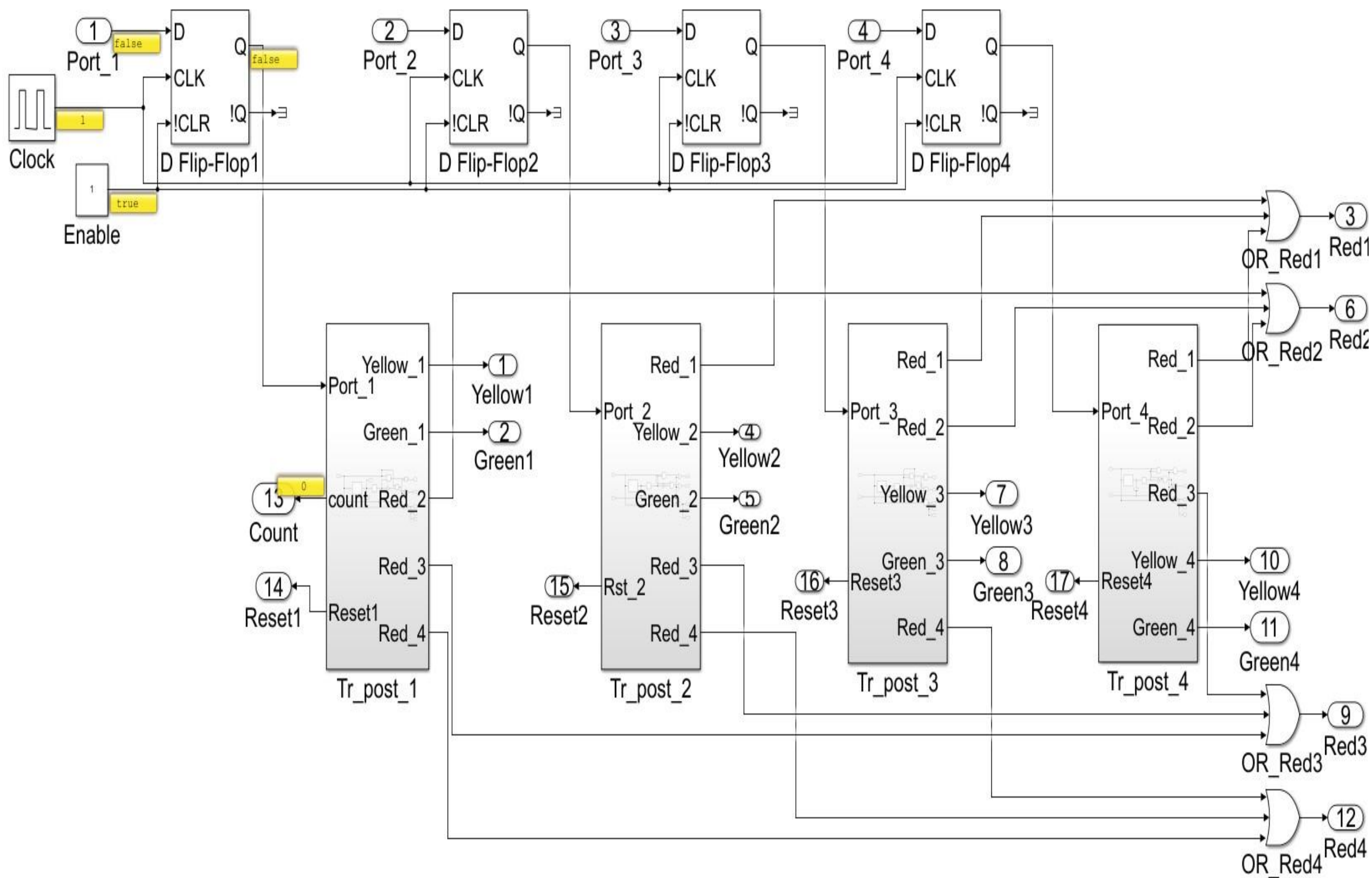


Fig 3.2.17: Internal block of interrupt system.

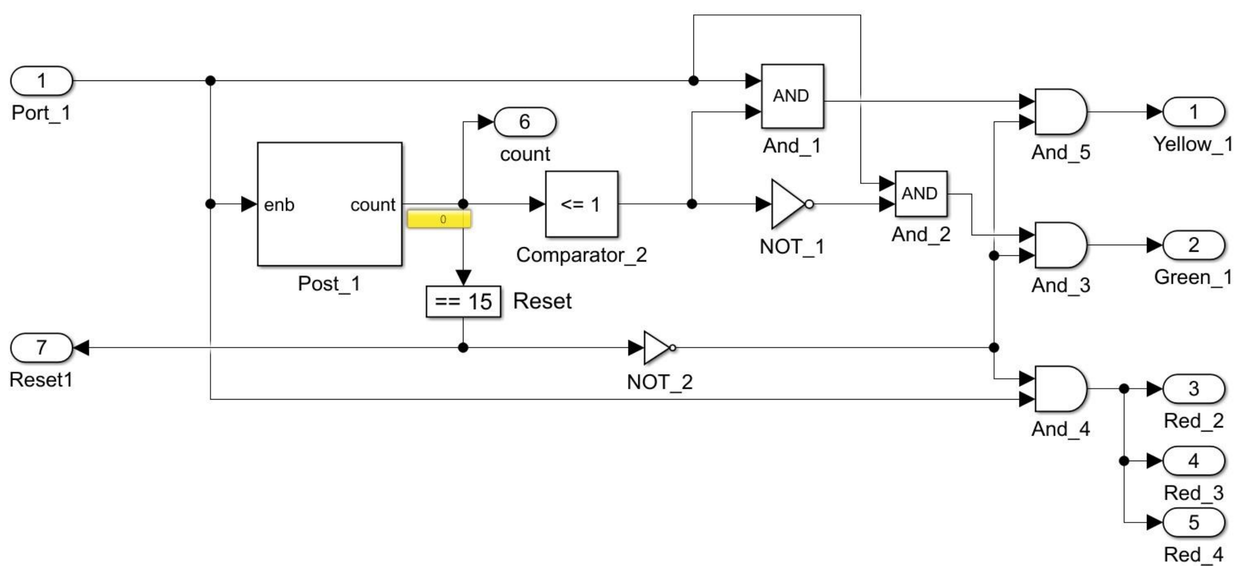


Fig 3.2.18: Internal block of each interrupt traffic post.

(e)Traffic lights:

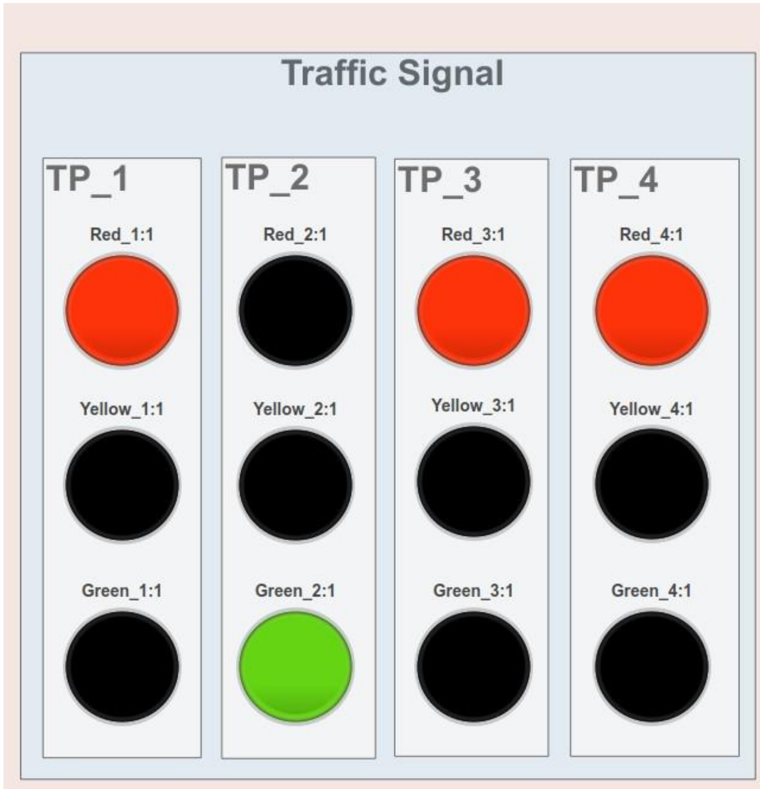


Fig 3.2.19: Traffic Lights

3.3 Advantages of the Project

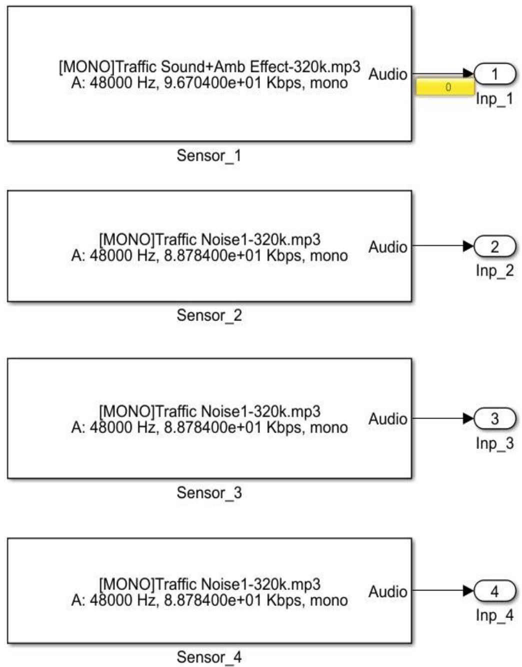
- According to the statistics about 30% deaths are caused due to ambulance getting stuck in traffic this model aims to cross out this factor .
- Low power consumption works on solar power and can run on small capacity power backups as well.
- No need for human monitoring 24/7.
- The cost of manufacturing and installing is low as it requires connecting and a small tweaking to be done with the existing traffic systems.
- Efficiently designed to work with all kinds of traffic systems around the world.

3.4 Limitations of the Project

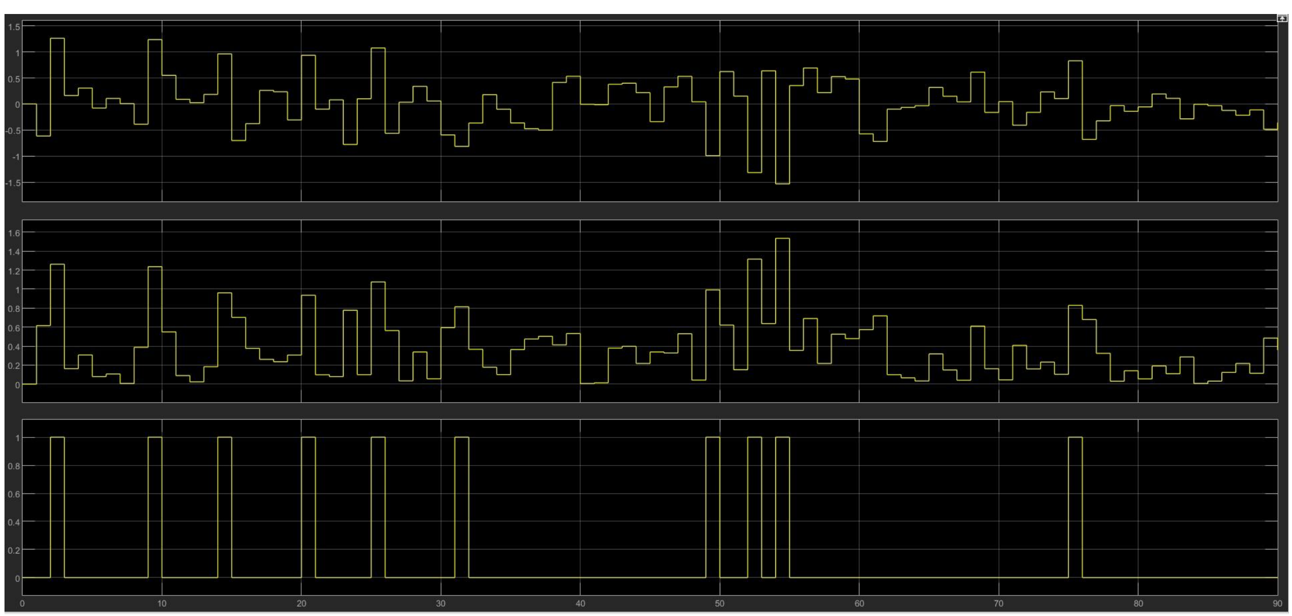
- In case of mild traffic the system is even when the emergency vehicles can pass easily the system will activate unnecessary green signals for more time.
- Poor solar power can decrease the performance of a system.
- Sound sensors take time to detect the signal and processing the sound will be a bit time taking.

CHAPTER 4

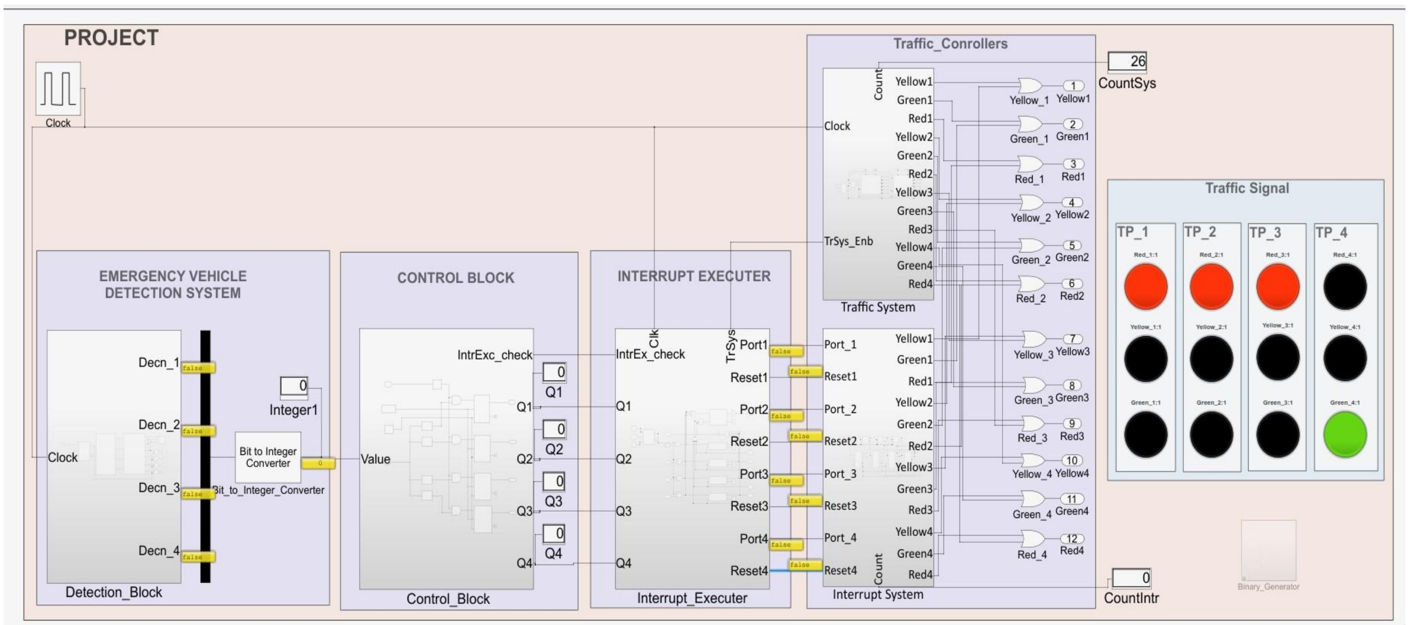
RESULTS AND SIMULATIONS



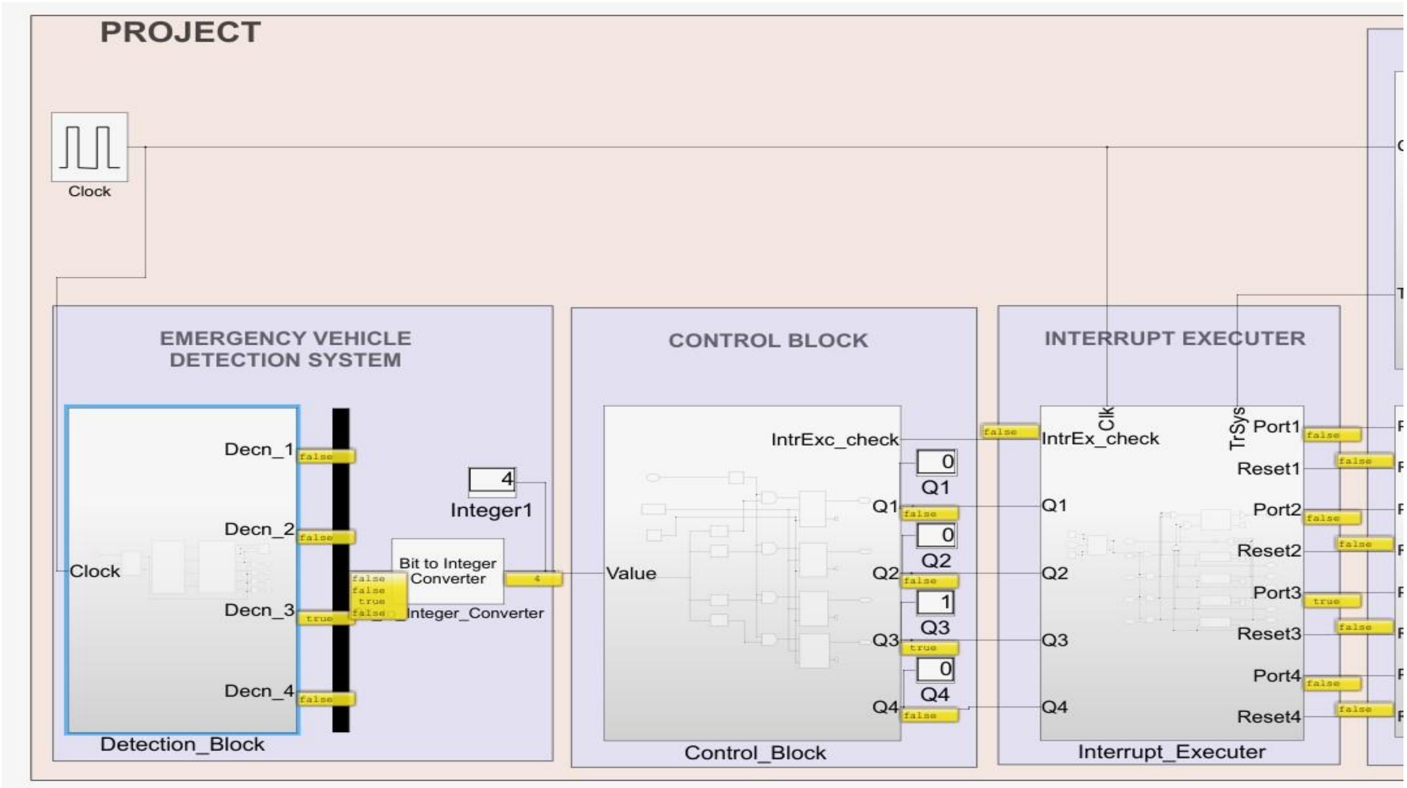
In the above scenario, the system detected ambulance sound at sensor 1. So, the above system will return a high output for Inp_1 while keeping others as low.



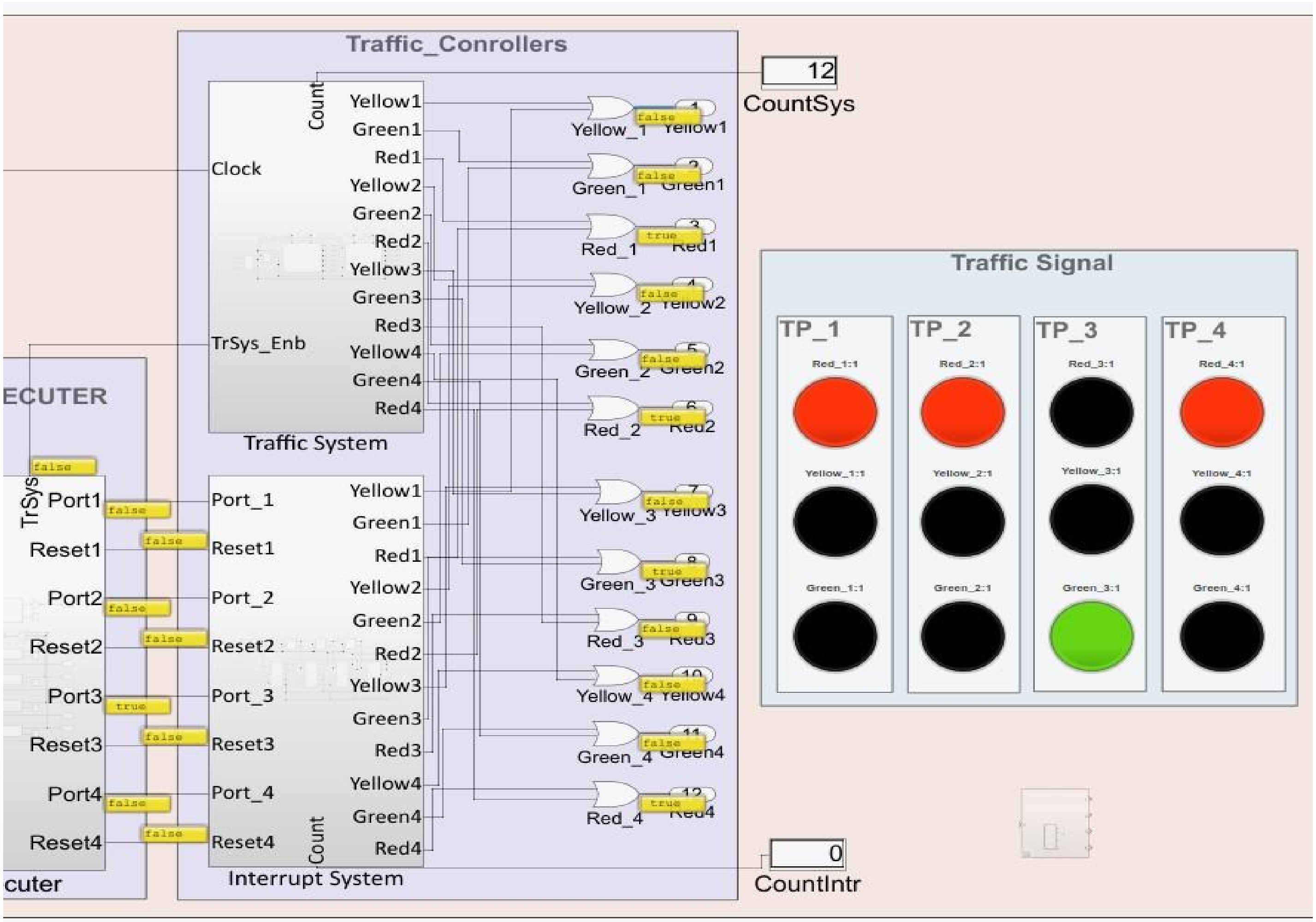
In the above waveforms, the first waveform is a sensor-detected ambulance signal .This wave have very small width .So we use rate transition and having increased sample time obtained by passing it through the Rate transition block and gain the width of the signal is increased.This will provide extra time so that we can analyse the signal this wave from is second one in the above figure. And then the signal is sent through the comparator, if the signal is from range 700 Hz to 1200HZ frequency i.e frequency >=0.8 then the output of the signal is given to 4:1 MUX and the output bits from multiplexer are converted to integers, these integers are the input to the control block from Emergency vehicle signal which is the third waveform as shown in the above figure.



The above figure is an example of the normal execution of a traffic system when there is no emergency vehicle detected. As we can see all ports in the system are false.



- In the above scenario ,the system detected an emergency vehicle on road 3 so it returned true for Decn_3 and false for all other roads, and the output integer is 4.
- Then the control block detected the road from which it received the ambulance signal. i.e port 3. Now the control block will return Q3(true) to the Interrupt executer, and the function of interrupt check is to check whether the post has previous sound sensors with the ongoing present sound sensor.
- Now the interrupt executor will change the mode of operation of the traffic post of road 3(true) from normal mode to interrupt mode, making the traffic system not operational(false) as shown in the above figure.



- After the interrupt executor resets the traffic post ,as shown in the above picture the green light returns true at Green _3 then the traffic lights for road 3 get turned on to green while other traffic post signals are kept red.

CHAPTER 5
CONCLUSION

5.1 CONCLUSION

With automatic traffic signal control based on the traffic density in the route, the manual effort on the part of the traffic policeman is saved. As the entire system is automated, it requires very less human intervention. With emergency vehicle detection, the signal automatically turns to red following the developed algorithm. Emergency vehicles like ambulance, fire trucks need to reach their destinations at the earliest. If they spend a lot of time in traffic jams, the precious lives of many people may be in danger. With emergency vehicle clearance, the traffic signal turns to green as long as the emergency vehicle is waiting in the traffic junction. The signal turns to red, only after the emergency vehicle passes through. The timing for the signals can be decided upon by analyzing the traffic pattern in an area for a fixed amount of time and calculating the extended time for which the signal lights have to be switched on accordingly.

5.2 FUTURE SCOPE

This idea can be implemented for a larger network by using encryption algorithms to ensure the safety and stability of systems. Also, the extended time can be calculated by the system itself. By keeping records of traffic patterns and using an algorithm, the timing can be chosen according to the traffic patterns. Through this paper, we have been able to present and implement a smart solution for emergency cases in traffic to give maximum preference to lives at stake.

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