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ADVANCED TRAFFIC LIGHT CONTROLLER FRAMEWORK

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Abstract

The Streamlining of vehicular and passerby movement is certain to handle the clogging due to expanded vehicular and person on foot activity in the present exceedingly populated world. Present Traffic Light controller framework experiences overwhelming roads turned parking lots, long holding up times, and collisions due to absence of person on foot location. Present paper abuses the rise of new method called "Ongoing activity light controller". The microcontroller with savvy calculations helped by IR sensors utilized as a part of this outline by optimizing the activity light changing to decrease automobile overloads and holding up times by dispensing time on the premise of volume of movement, and gives more wellbeing to the walkers by utilizing walker recognition sensors on the zebra line. Continuous movement light controller is eco-accommodating plan by decreasing sitting out of gear time of vehicles and can be the keen approach to control the vehicle and people on foot activity by overseeing time and security.

Introduction

Traffic Management on the road has become a severe problem of today's society. Traffic control is major challenge in cities because of growing population [8] [9]. Existing fixed timing traffic control systems are inadequate to meet the traffic problem especially to the pedestrians [1] [6]. Fixed timing traffic control systems are giving green signals to the vehicles on basis of time without considering or identifying pedestrians at the middle of the crossing line, which leads to accidents. Further during zero traffic on one road, other road vehicles should wait up to its turn. Pedestrian's traffic is cumulative especially morning and evening, at this time everyone is hurry to go their offices and homes. In order to alleviate the problem, a large number of methods and approaches have been suggested in the literature.

The author Cai Bai-gen et.al. [kk3] design a vehicle detection system based on magneto-resistive sensor is composed by wireless traffic information collection nodes which are set on two sides of road to detect vehicle signal. Themagneto-resistive sensor is costly and maintenance cost of the system will be more if the system fails. This system islack of emergence measures and proposed ITSC system will able to solve this problem effectively.

The author S.L.Toral et.al.[kk4] design will provide good result for vehicle detection where ARM-based video processor not only deals with the video processing algorithms but again the cost of system design will be more because camera will be required to capture video .

The author ShilpaS.Chavan et.al. [kk5] design of traffic light controller handles major problem of conventional traffic signal. At certain junction, sometimes even if there is no traffic but people have to wait because the traffic light remains red for the preset time and road users waits until the light turn to green. They try to solve this problem effectively by using GSM but system will leads to complications. The proposed ITSC system solves this problem byusing genetic algorithm.

The author Ahmed S. Salamaet.al.[kk6] provide integrated intelligent traffic light system using photoelectric sensors distributed on long range before and after traffic light on roads. Emergency cases such as, the passing president carand ambulance that require immediate opening of traffic signal. The system has the ability to open a complete path for such emergency cases until reaching the target but this system does not operate wells when more than one emergence Vehicles come on the signal from two sides.

Chattarajet.al., (2008) proposed a novel architecture for creating Intelligent Systems for controlling road traffic based on the principle of the use of Radio Frequency Identification (RFID) tracking of vehicles. This architecture can be used in places where RFID tagging of vehicles is compulsory and the efficiency of the system lied in the fact that it operated traffic signals based on the current situation of vehicular volume in different directions of a road crossing and not on pre-assigned times [3].

An intelligent traffic light monitoring system using an adaptive associative memory was designed by Abdul Kareem and Jantan (2011). The research was motivated by the need to reduce the unnecessary long waiting times for vehicles at regular traffic lights in

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urban area with 'fixed cycle' protocol. To improve the traffic light configuration, they proposed monitoring system, which will be able to determine three street cases (empty street case, normal street case and crowded street case) by using small associative memory. The experiments presented promising results when the proposed approach was applied by using a program to monitor one intersection in Penang Island in Malaysia. The program could determine all street cases with different weather conditions depending on the stream of images, which are extracted from the streets video cameras [4].

A framework for a dynamic and automatic traffic light control expert system was proposed by Wen W [5]. The model adopted inter-arrival time and inter-departure time to simulate the arrival and leaving number of cars on roads. Knowledge base system and rules were used by the model and RFID were deployed to collect road traffic data. This model was able to make decisions that were required to control traffic at intersections depending on the traffic light data collected by the RFID reader.

Implemented a hard real-time vision system that recognizes and tracks lanes, road boundaries, and multiple vehicles in videos taken from a car driving on highways [7].

Present paper aims to optimize the vehicles and pedestrians traffic flow by providing more safety with Real time traffic light control system (RTTLCS) by using Microcontroller with smart algorithms aided by IR sensors". The proposed RTTLCS system solves problems in existing traffic light controlling system in most effective way. The rest of the paper is organized as follows. Section 2 presents the overview of the RTTLCSalong with controlling parameters. Section 3 presents circuit diagram Section 4 discusses the results under various typical conditions and finally, Section 5 concludes the paper.

Real time traffic light control system

Activity burden is profoundly reliant on parameters, for example, time, day, season, climate and capricious circumstances, for example, mishaps, unique occasions or development activities. If these parameters are not considered, the movement control framework will create serious problems like for instance congested roads, air and commotion contamination, anxiety to drivers, fuel utilization and deferrals [10]. An activity control framework that takes care of these issues by persistently sensing and modifying the timing of movement lights as per the genuine movement burden is called continuous activity control framework.

Ongoing movement light control framework utilizing sensors, push to walk catches and microcontroller for programmed vehicle and passerby activity location up to activity light administration for a wide range (convergence) meeting the prerequisites of a sagacious transportation framework.

The framework contains IR transmitter and IR collector which are altered on the either sides of streets individually. The IR framework gets initiated at whatever point any vehicle passes on street between IR transmitter and IR collector. The microcontroller additionally considers push catch ('push to walk' catch), which offer need to people on foot. Microcontroller controls the IR framework, push to walk catches and distinguish the force of vehicles movement and people on foot. In light of activity force, the microcontroller doles out the time to the vehicles and walkers. Figure 1 clarifies the outline and Figure 2 clarifies the square chart of RTTLCS.

The round-robin (RR) booking calculation is outlined particularly for timesharing frameworks in microcontroller [2]. It is like FCFS (First started things out served) booking, yet acquisition is added to switch between methodologies. RTTLCS a quantum time of 35 second is allocated to every street to stay Green. What's more, seizure will be carried out if the vehicle on that street completes its distributed time and turn will be exchanged to the following street. Once more, if there are vehicles gets done with passing through that street before their apportioned time is up, it will again exchange turn to the following street with the expansion of remaining time from Current Street.

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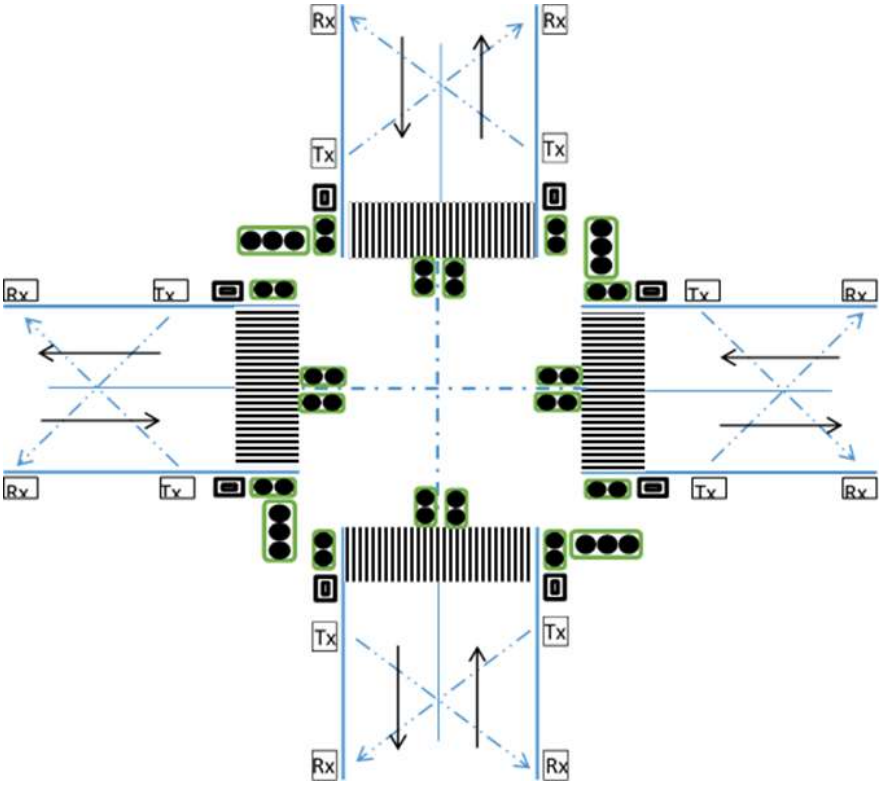

Figure1: Overview of RTTLCS

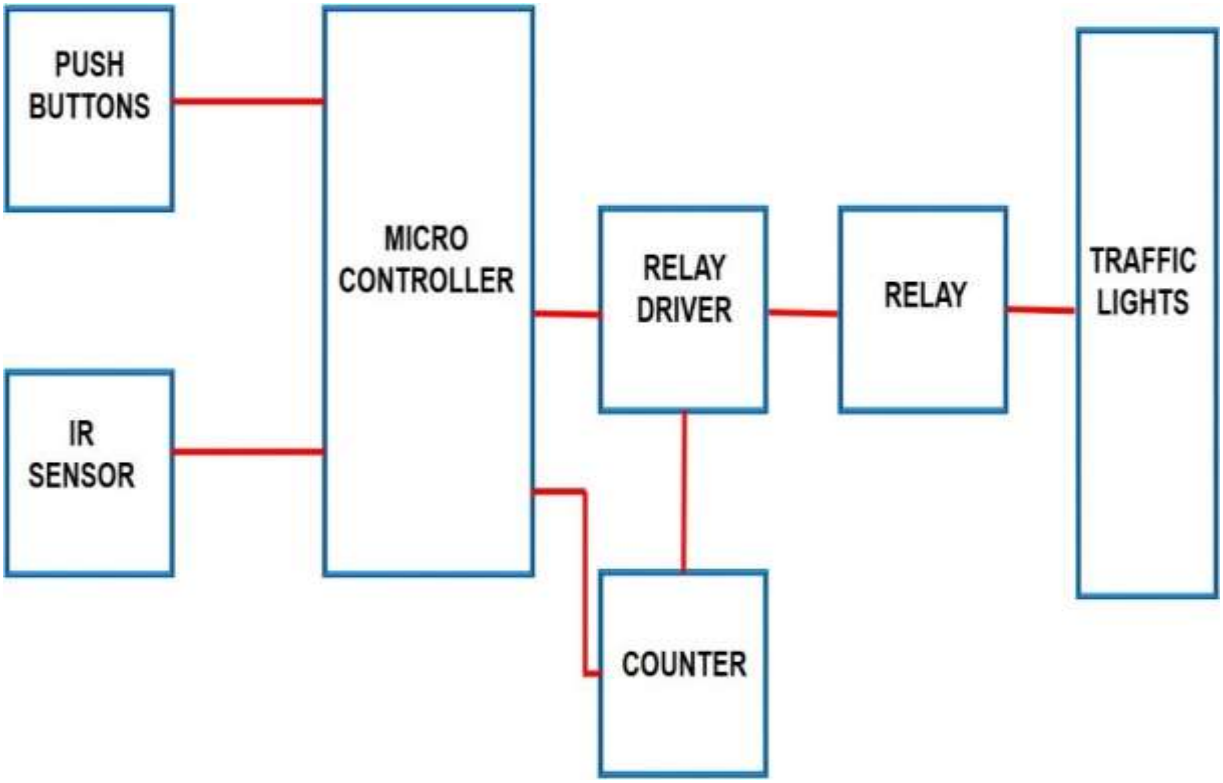

Figure2: Block Diagram of RTTLCS

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Controlling parameters of RTTLCS

The following parameters used to control the traffic in RTTLCS. They are

1. Next-to-go time(NTGT)
2. Allocated Green time (AGT)
3. Minimum pedestrian crossing time (MPCT)

Next-to-go waiting time (NTGT)

This parameter represents the time the vehicles in the "next-to-go" road will wait. NTGT depends on the time taken by the previous road and shows the previous road's remaining time. Under best condition, while zero vehicle traffic and pedestrians, NTGT=0.Under Exceptional conditions, pedestrian request to cross road at zero vehicle traffic on other roads, NTGT = min time for pedestrians to cross is equal to10 sec.

Apportioned Green Time (AGT)

Represents the time allocated to the each road i.e. Green signal-on-time. AGT=35 SEC, if road was congested other roads surplus time will be allocated to congested road, thus AGT >=35seconds

The traffic sequence is W→S →E→N. NTGT (next-to-go wait time) of South Road (SR) is 37 sec(35sec GREEN Signal + 2Sec Yellow Signal), East Road (ER) is 2*37 sec, North Road (NR) is 3*37 sec. Ratio yields are (SR : ER : NR)=1 : 2 : 3. If time remains of West Road (WR) should be divided among the other congested roads with this ratio, thus SWR (surplus time of West Road) will be added to other congested roads as follows

- 1/6th of remaining time of SWR is added to AGT of SR.
- 2/6th of remaining time of SWR is added to AGT of ER.
- 3/6th of remaining time of SWR is added to AGT of NR.

And the same cycle implied to all the roads.

Minimum pedestrian crossing time (MPCT)

MPCT represents the additional time allowed to pedestrians to cross the road while pedestrians stays in middle of the road. Assume the pedestrian stays at the middle of the road during pedestrian light turns in to Red, the pedestrian will have very less time to cross the road as well as leads to accidents in existing traffic light control systems. In order to ensure safety, the RTTLCS will provide additional time from surplus time received from Roads to the pedestrians to cross the Road. Thus, the minimum pedestrian crossing time (MPCT) will be increased in RTTLCS.

Circuit Diagram

Figure 3 gives the schematic diagram of RTTLCS, figure 4 explains the working condition of traffic lights. The traffic signal system consists of three important parts. The first part is the microcontroller, AT89C51. Microcontroller AT89C51 is used to efficient control and fast response time by this the problem of fixed timing traffic light system is totally eliminated and follows the international standards for traffic light operation. It consists of a computer that controls the selection and timing of traffic movements in accordance to the varying demands of traffic signal as registered to the controller unit by IR sensors. The second part is the signal visualization or in simple words is signal face. Signal faces are part of a signal head provided for controlling traffic in a single direction and consist of one or more signal sections. It comprises of solid red, Amber, and green lights. The third part is the IR detector or sensor, is a device to indicate the presence of vehicles.

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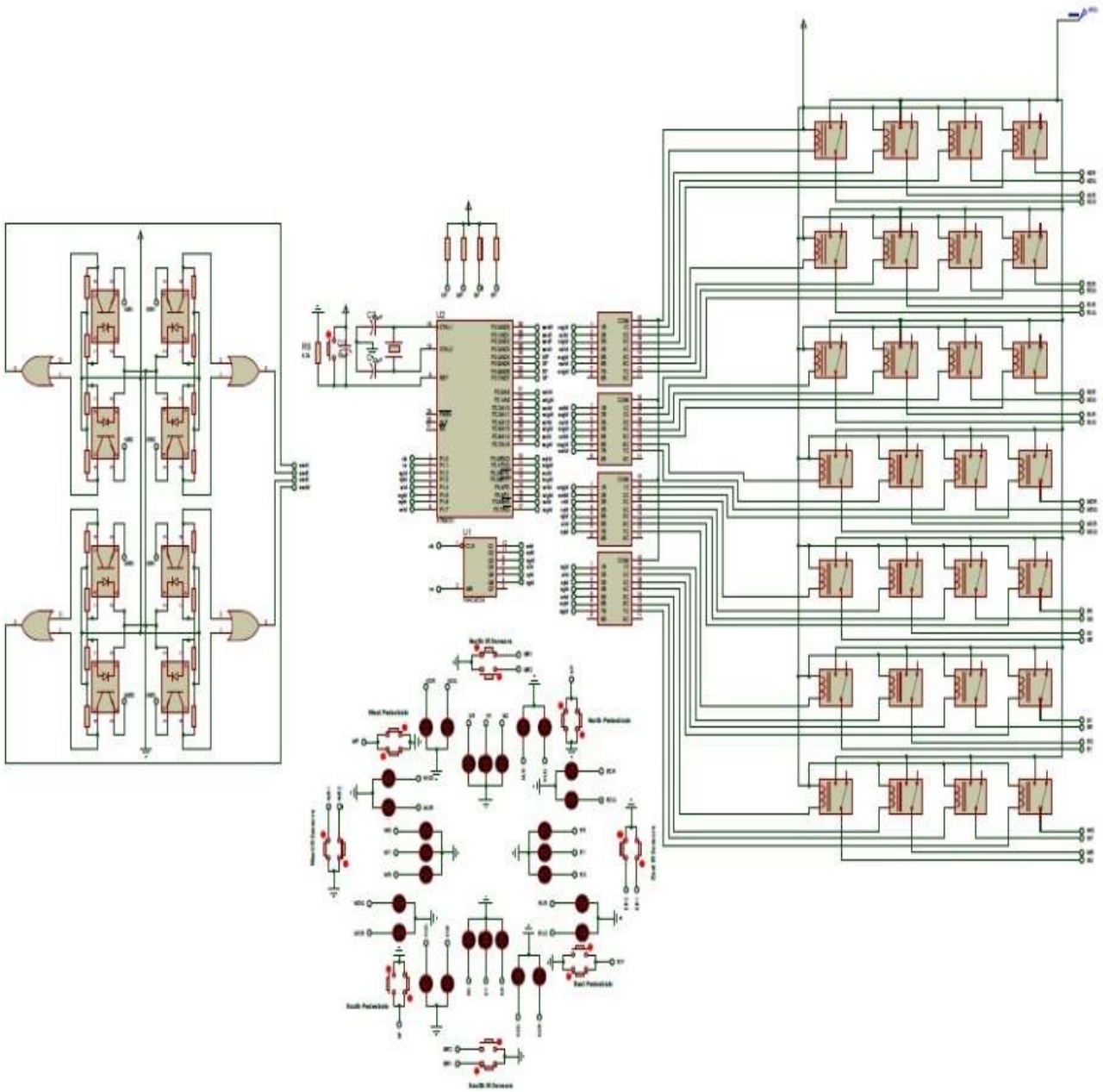

Figure 3: Schematic circuit Diagram of RTTLCS

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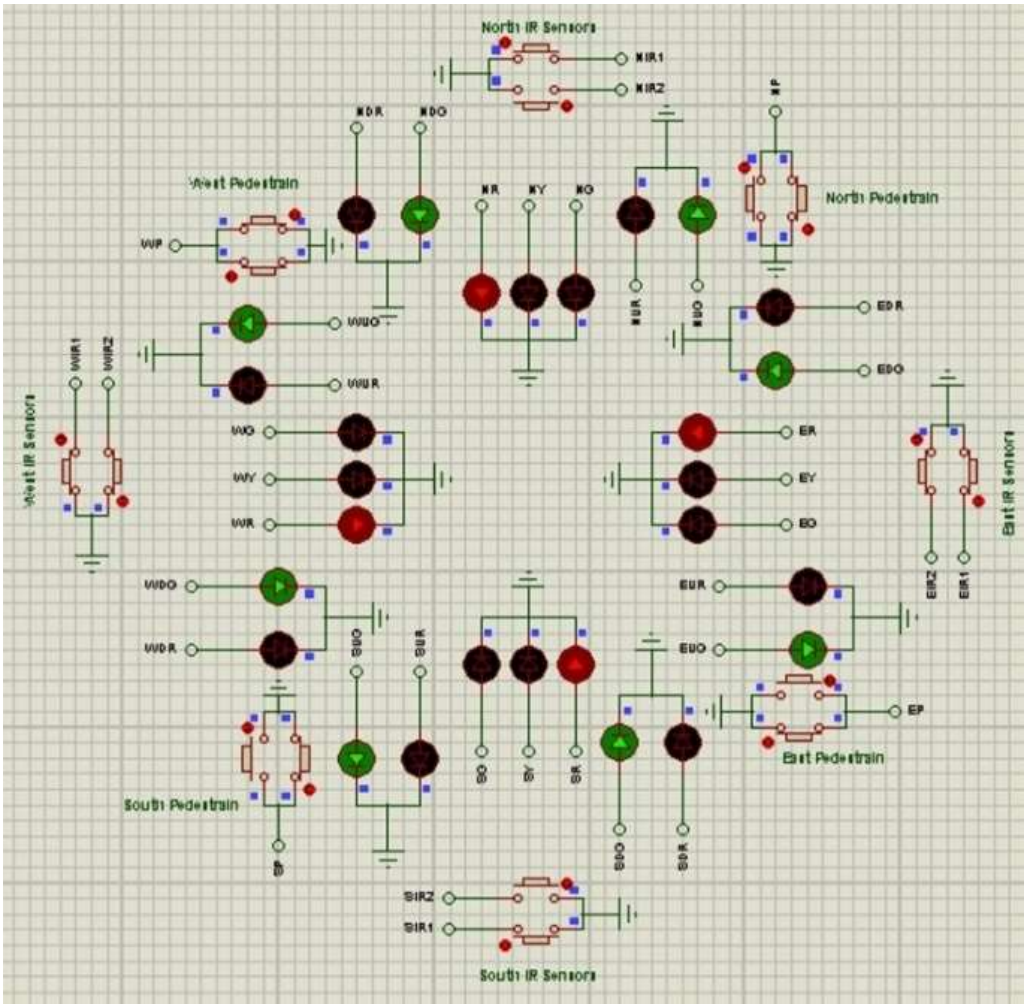

Figure 4: Schematic circuit Diagram of traffic lights

Results and discussion

The system was tested using simulation tools "Proteus Professional" and "Keiluvision". Proteus Profession is used to design the circuit and Keiluvision is used for writing the program in embedded C language. The tested conditions are as follows:

Tested conditions

Condition-1: When there are no vehicles on any road

Under this condition IR Sensors of all the roads are illuminating. This was done by closing all the switches which are connected to IR sensors for all the roads in simulation software.

***Result*:**

All the vehicle traffic lights are turned to RED Signal and all pedestrian traffic lights are turned on to GREEN Signals.

Discussion:

Since there are no vehicles on any road all the pedestrians are allowed to cross the road.

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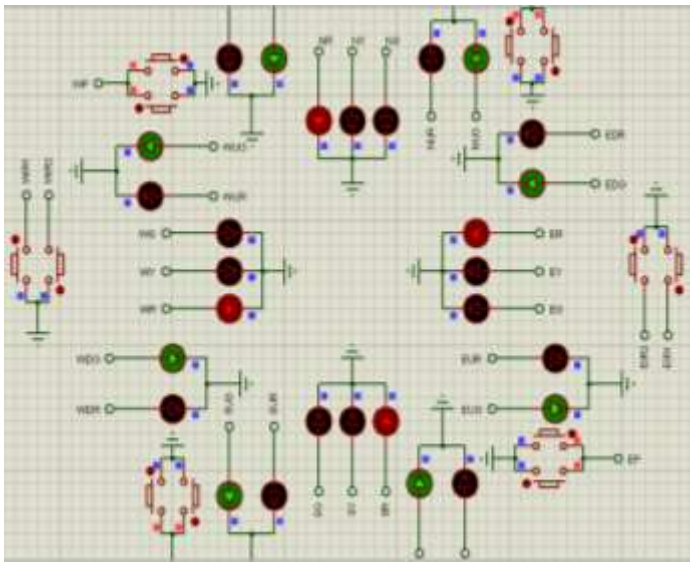


Figure 5: No vehicles on any road

Condition-2: When there are vehicles on all roads

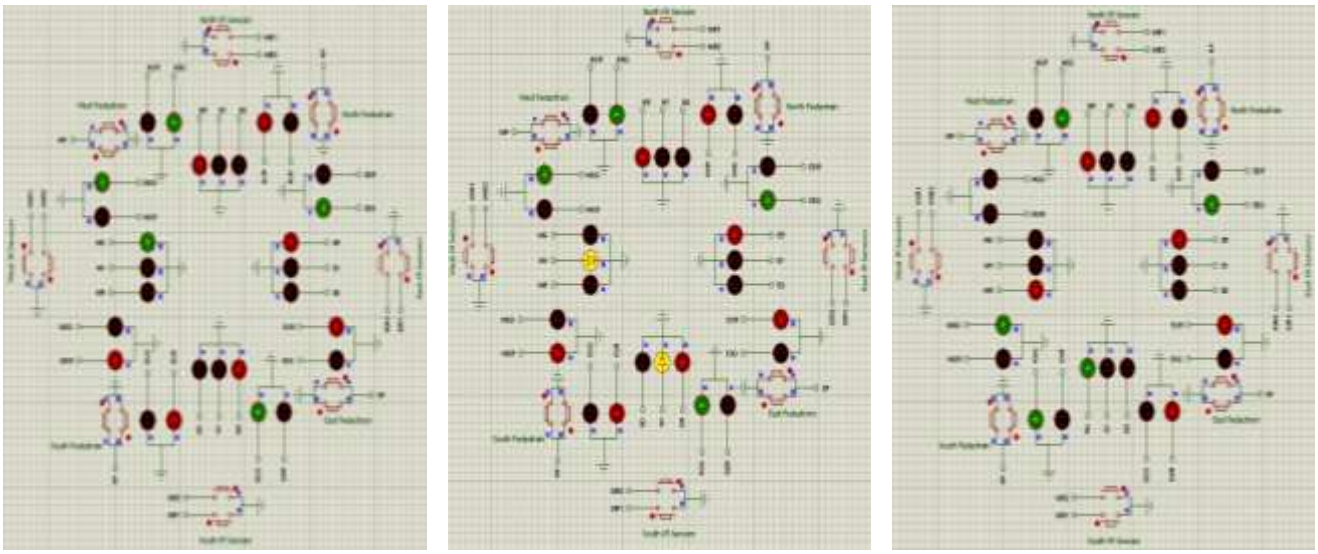
Under this condition IR sensors' signals of all the roads are interrupted. This was done by opening all the switches which are connected to IR sensors for all the roads in simulation software.

Result:

All the vehicle traffic lights are turned on by GREEN signal one by one for every 37 seconds i.e. 35 seconds GREEN LIGHT for Vehicle traffic, 2 seconds YELLOW LIGHT.

Discussion:

Since there are vehicles on all roads, all roads have equal priority. This case is similar to the fixed time system and there are no unique conditions.



(a) (b) (c)

Figure 6: Vehicles on all road

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Condition-3: When there are vehicles only on one road (Assume East Road Contains Vehicles, Remaining all the roads holds zero traffic)

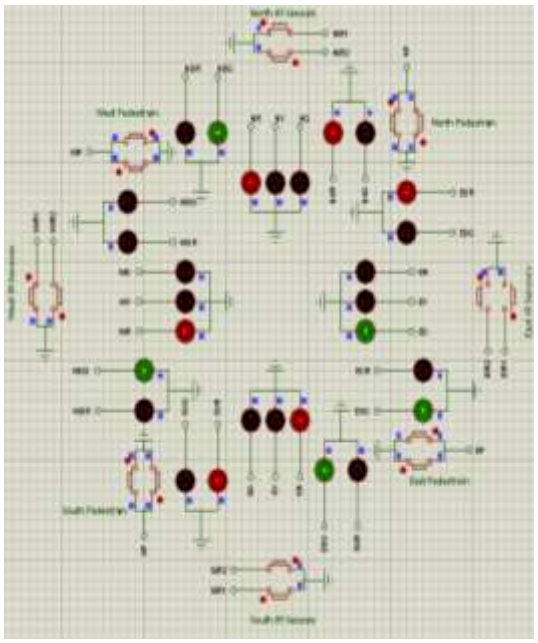
Under this condition IR sensors' signals of the East road is interrupted. This was done by opening the East road switch.

Result:

- The GREEN vehicle traffic light of East Road turned ON indefinitely, while all the other roads holds RED signal. East road pedestrian traffic light stays in Red and all other roads pedestrian traffic lights holds Green Signal.
- Assume when South Road pedestrian push button was used by pedestrian:
  - The YELLOW vehicle traffic light of East Road turned ON for 2 seconds
  - Then RED vehicle traffic light of East Road turned ON and all the GREEN pedestrian traffic lights turned on for 10 seconds while other vehicle traffic light stayed RED.
- Then the YELLOW vehicle traffic light of East Road turned on for 2 seconds
- Then the GREEN Signal vehicle traffic light of East Road lasted turned ON while other road RED Signal vehicles lights stayed ON until push button will be used by pedestrian on any road.

Discussion:

Since vehicle traffic is congested on East road and other roads holds zero traffic, east road vehicles are allowed to pass by continuously by holding green signal and other roads holds red signal will allowed the flow of traffic on East road. This is very advantageous in urban areas because of huge flow of traffic to certain roads at certain times. Further Pedestrians are free to pass by using push button on all roads.



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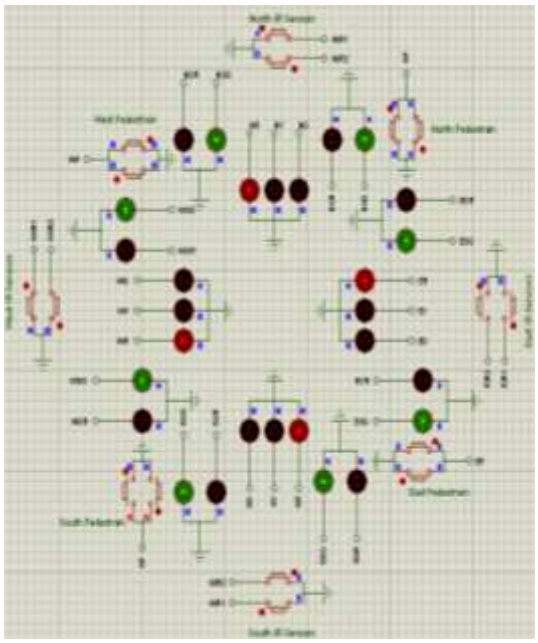

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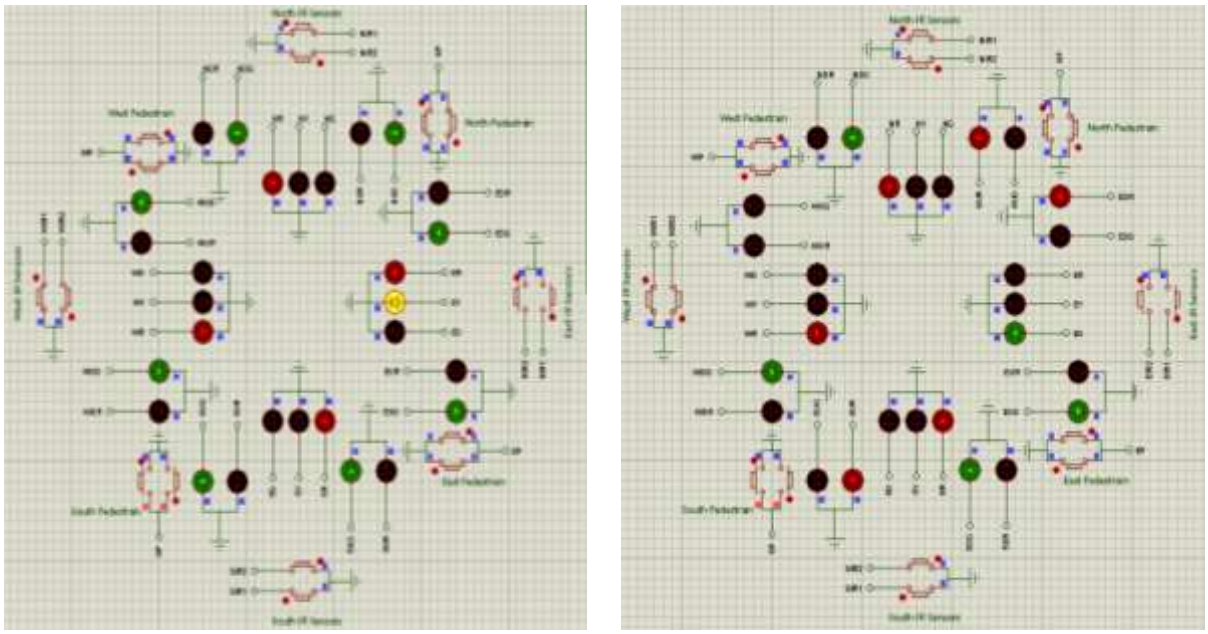

(c) (d)

Figure: 7 Vehicles only on one road Vehicles only on one road

Condition-4 When there are vehicles on two roads (Assume South Road & North Road)

Under this condition IR sensors' signals of the South and North Roads are interrupted. This was done by opening the South and North roads switches. The remaining two roads holds zero traffic, i.e. IR sensors are uninterrupted.

Result:

- The South Road GREEN vehicle traffic light turned ON for 35 seconds, while the other roads' holds RED vehicle traffic light turned ON. All the other sides of pedestrian traffic lights remaining green except South Road.
- Then the YELLOW vehicle traffic light of South Road turned ON for 2 seconds.
- Then all the RED vehicle traffic lights of all Roads turned ON and GREEN pedestrian traffic lights for all the roads turned ON for 10 seconds.
- Then the YELLOW vehicles traffic light of North Road turned ON for 2 seconds.
- Then the GREEN vehicles traffic light of North Road turned ON for 41 seconds (35 seconds plus Surplus time of Zero traffic Roads) and the other roads' RED vehicle traffic lights Stays ON.
- Then the YELLOW vehicles traffic light of South Road and North Road turned ON for 2 seconds.
- Then the GREEN vehicles traffic light of South Road turned on for 59 seconds (35 seconds plus Surplus time of Zero traffic Roads) and the other roads' RED vehicle traffic lights stays ON.
- Then the YELLOW vehicle traffic light of South Road turned ON for 2 seconds.
- Then all the RED vehicle traffic lights of all Roads turned ON and GREEN pedestrian traffic lights for all the roads turned ON for 10 seconds.
- Then the YELLOW vehicles traffic light of North Road turned ON for 2 seconds.
- Then the GREEN vehicle traffic light of North Road turned on for 59 seconds and the other roads' RED vehicle traffic lights stays turned ON.

Discussion:

Since there were no vehicles on South and North roads, the green vehicle traffic lights shuttles between South and North Roads. The additional 6 seconds which were added to North Road in the first cycle is the surplus time of East Road, according to the formula in the algorithm will be 17% of the remaining time. In the second cycle South Road receives 24 seconds additional time

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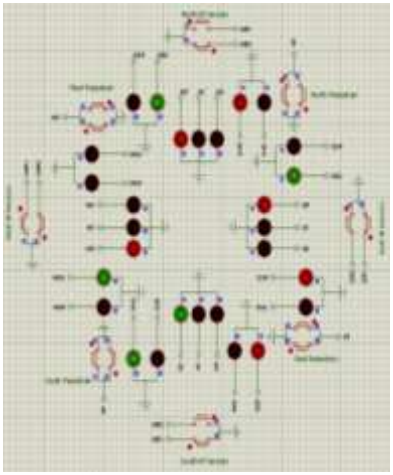
is the surplus time of East and West Roads, according to the formula in the algorithm will be 17% of remaining time of East Road and 50% of remaining time of West Road i.e. 6 and 18 seconds respectively.

Here pedestrians are getting 10sec every time after complete the waiting time of each vehicle traffic roads.



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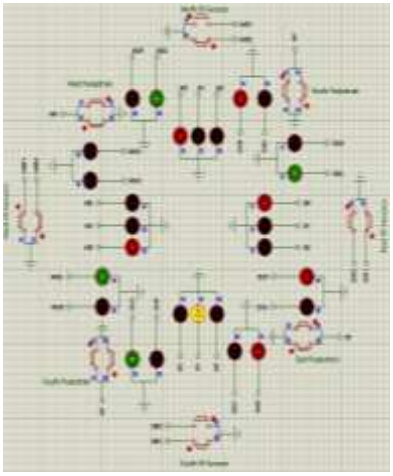

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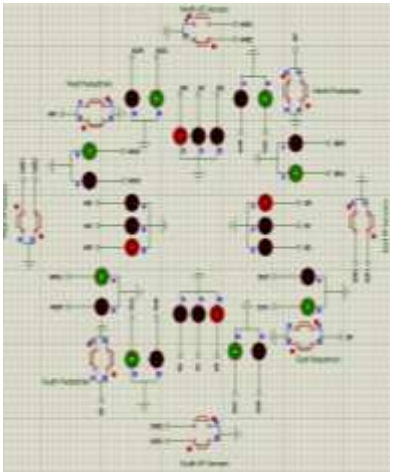

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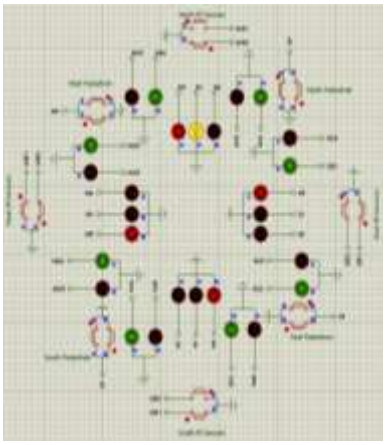

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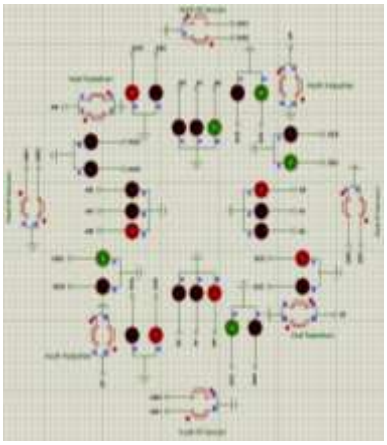

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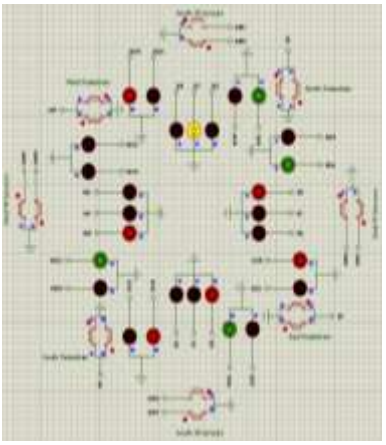

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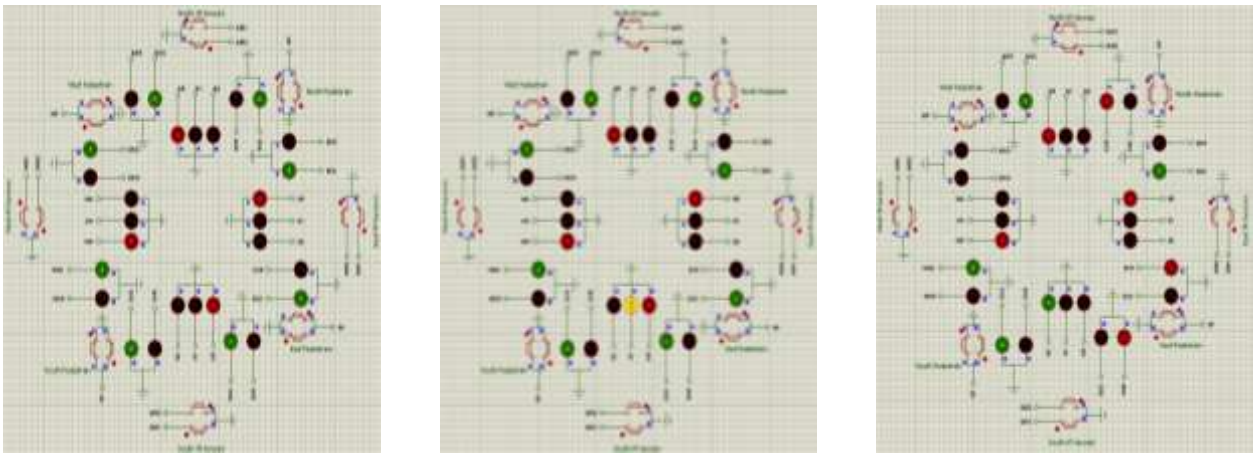


(g) (h) (i)

Figure 8: Vehicles on two roads

Condition-5: All roads have traffic but one road have less traffic

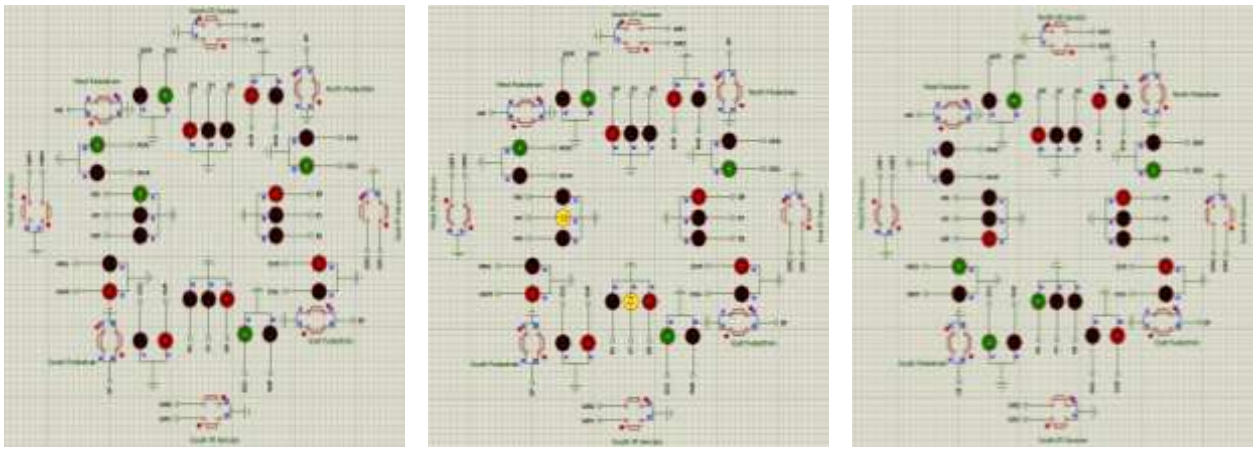
Under this condition IR sensors' signals of all Roads are interrupted, but one road (assume West road) has very less traffic completed in 10sec.This was done by open all the switches and closing the West road switch after 10 seconds.

Result:

- The GREEN vehicle traffic light of West Road and stays for 10 seconds. Remaining roads' holds RED vehicle traffic lights turned ON.
- After 10 seconds the YELLOW vehicle traffic light of West Road and South Road turned ON for 2 seconds.
- Then GREEN vehicle traffic light of South Road stays for 39 seconds and other roads' RED vehicles traffic lights turned ON.

Discussion:

West road vehicle traffic completed in 10 seconds, no need to stay on west road, south road GREEN vehicle traffic light is going to be turned ON after 12 seconds for 39 seconds, additional 4 seconds surplus time of West road (17% of the remaining 25 seconds).



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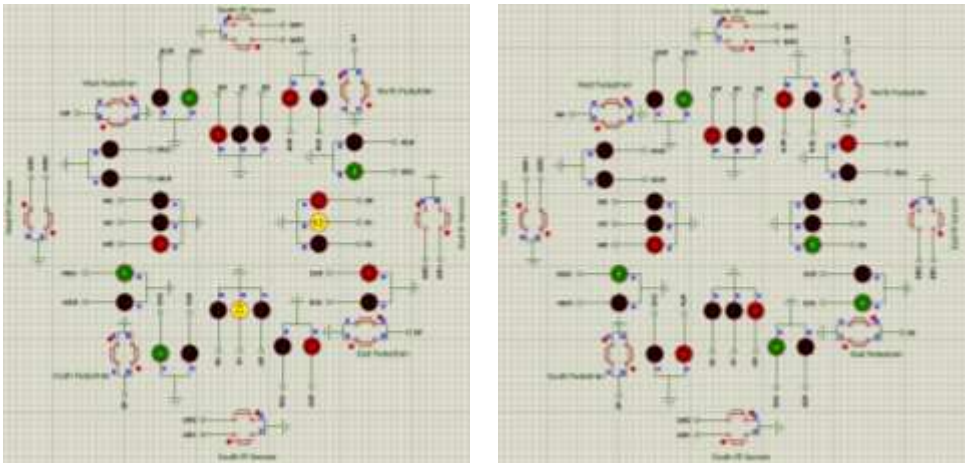
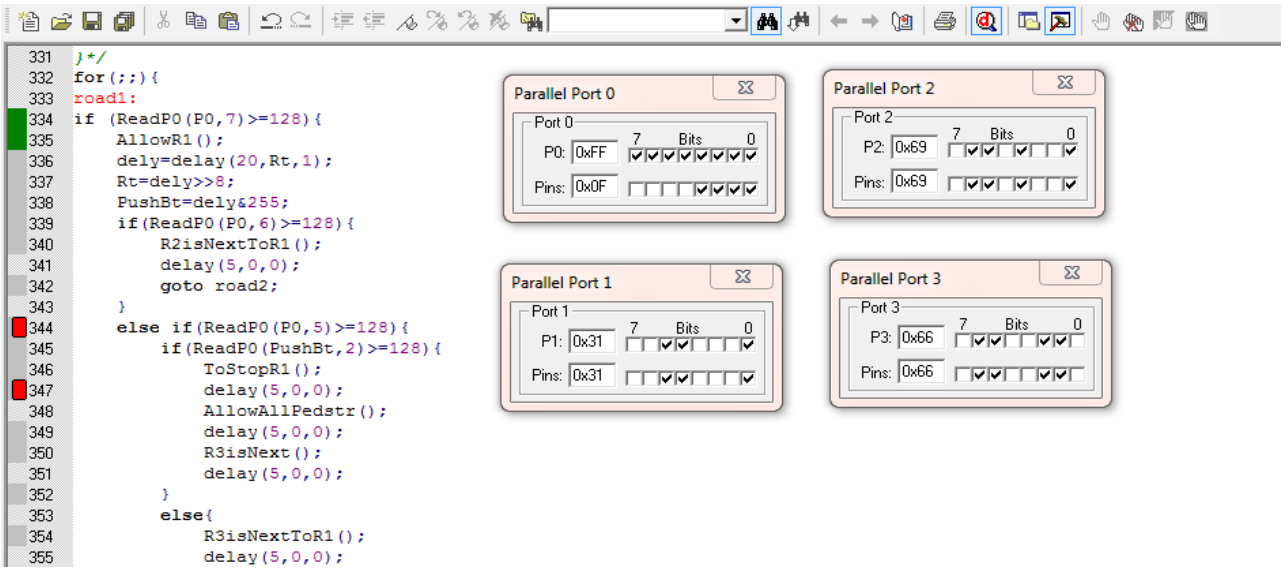


(d) (e)

Figure 9: All roads have traffic but one road have less traffic

Simulation output

In RTTLCS develop the algorithms writing in Embedded C language and simulated using Keil µvision software. Figure 5 shows the simulation output using microcontroller I/O Ports. Figure 6 shows the output wave forms using logic analyzer and I/O Ports.



```
331  }*/
332  for(;;){
333  road1:
334  if (ReadP0(P0,7)>=128){
335      AllowR1();
336      dely=delay(20,Rt,1);
337      Rt=dely>>8;
338      PushBt=dely&255;
339      if(ReadP0(P0,6)>=128){
340          R2isNextToR1();
341          delay(5,0,0);
342          goto road2;
343      }
344      else if(ReadP0(P0,5)>=128){
345          if(ReadP0(PushBt,2)>=128){
346              ToStopR1();
347              delay(5,0,0);
348              AllowAllPedstr();
349              delay(5,0,0);
350              R3isNext();
351              delay(5,0,0);
352          }
353          else{
354              R3isNextToR1();
355              delay(5,0,0);
```


Figure 10: Simulation output using Microcontroller I/O Ports

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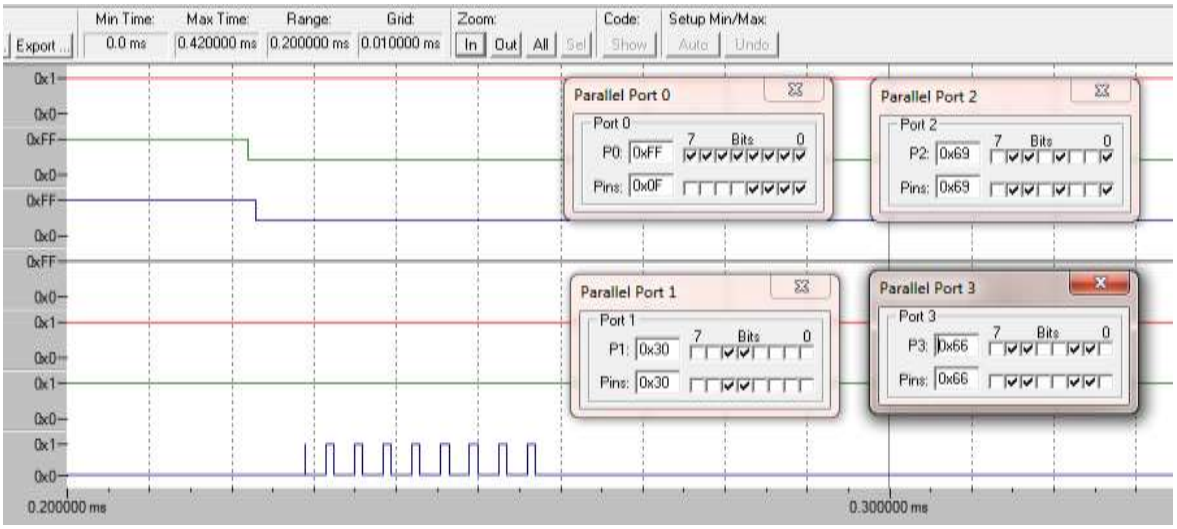

Figure 11: simulation output on keil using logic analyzer

Conclusion

The present study is intended to design and develop the 'Real time traffic light control system' (RTTLCS) by using microcontroller with smart algorithms aided by IR sensors. The designed RTTLCS is not only to optimize the traffic flow of vehicles as well as pedestrians but also considering the safety and time management according to traffic flow. In this method, instead of fixed-time traffic control, followed the variation in the time allocation base on the volume of traffic at each road. This method manages the traffic and time allocation using the smart algorithms with the microcontroller and IR sensors. The IR sensors were interfaced with Microcontroller AT89c51 and this interface is synchronized with the whole process of the traffic system which was done on simulation tool, 'Proteus Professional'. This design can be easily implemented in real life situations. One of the important advantages of this method over previous methods, it gives equal importance to pedestrians when compared to vehicle traffic. It was observed that this system provided better performance in terms of total waiting time as well as total moving time to control the vehicle traffic efficiently.

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