



Design and Implementation of Smart Traffic Light Signals for Ambulance and Emergency



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INTRODUCTION

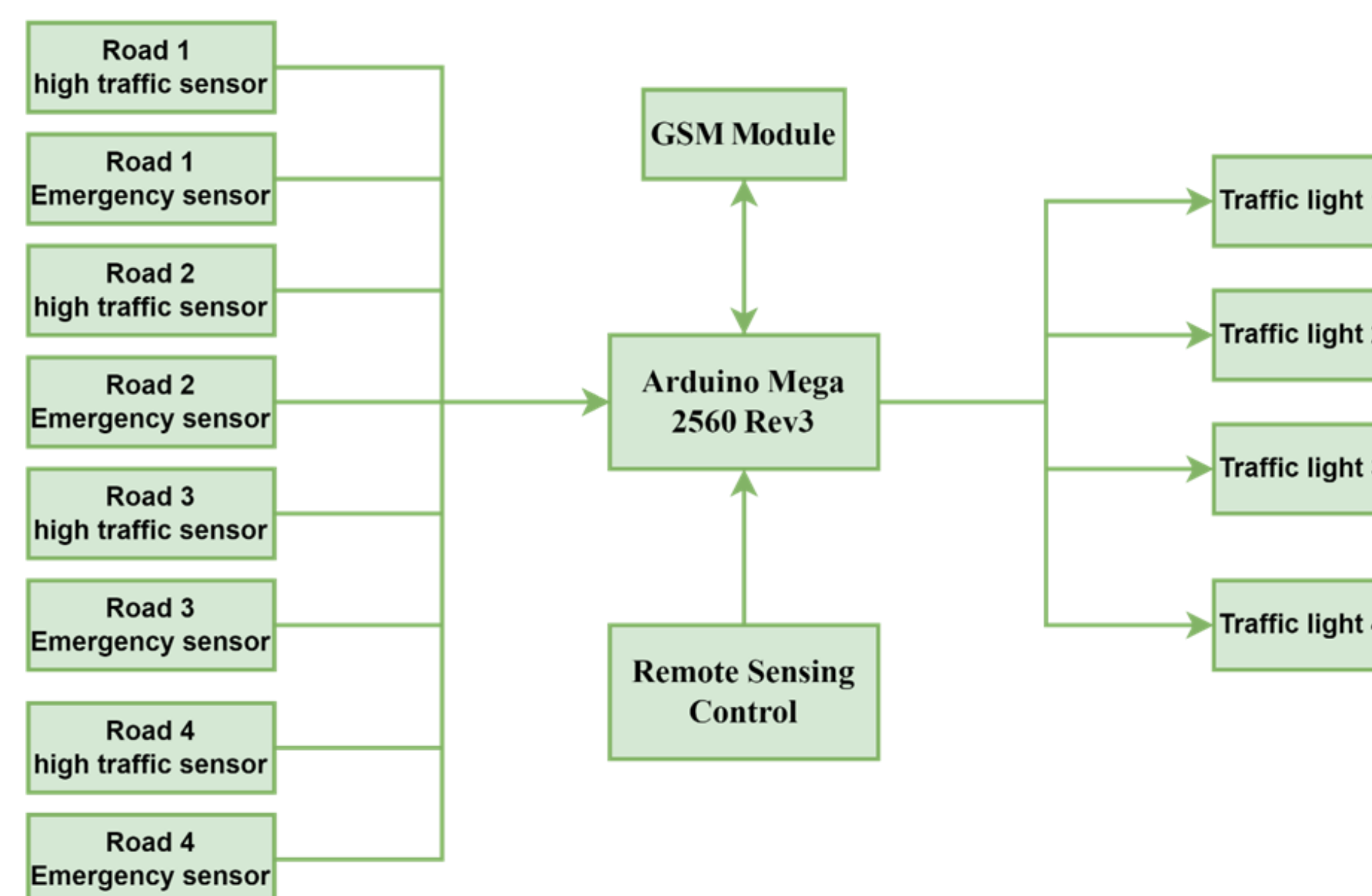
Traffic light is an electrical traffic sign to manage the traffic at the road intersection. Traffic light generates a sequence of lights to give a sign for drivers and organize their movement. Starting with red light which makes the traffic stop and not allowed to cross the intersection then orange light which gives a time space for cars to be ready for the next action and empty the buffer (intersection) from cars which did not cross yet. Then green light which gives an order to cars to move. The sequence repeats itself over and over based on a pre-scheduled deterministic time table. The main problem with this type of traffic lights is that it follows a pre-scheduled time table blindly. As we know traffic is stochastic process and if we solve it by deterministic traffic light schedule then there are some cases where the traffic in one side will be so heavy traffic and on the other side it will be light traffic and the deterministic traffic light will give the same priority for both sides. Also, emergency vehicles have to stop at the traffic lights. The solution for this problem is to build an interactive traffic light which senses the traffic of emergency vehicles and the traffic in each side and determine the time for each signal based on that. In this project, we will design this interactive traffic light and implement it as a prototype. We hope this will solve daily problem for people and if so it will reflect on too many things such save lives, energy consumption, time saving and car accident reduction.

PROJECT OBJECTIVES

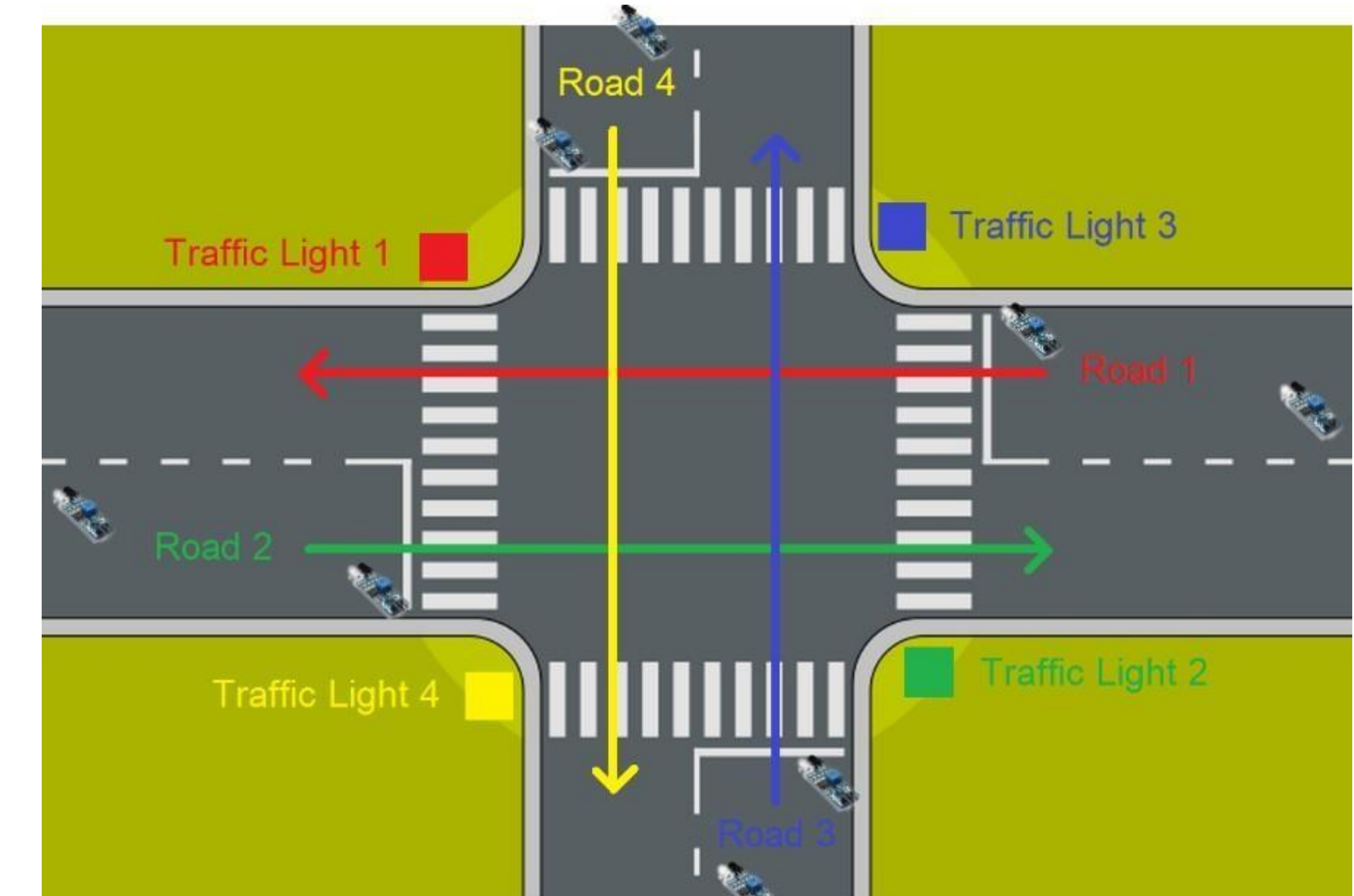
- To simulate the smart traffic control using Visual Basic programming.
- To develop a suitable algorithm to implement the design.
- To layout and put into effect a smart visitors manipulate system

PROJECT FRAMEWORK / METHODOLOGY

In this project, Methodology version takes the essential method sports of Project Plan, specification, Analysis, Design, development, validation and evolution and represents them as separate method phases. Do to Specific system models, system architecture and detailed design of the project, to implementation process using Arduino IDE tool and Arduino Mega 2560 with C++ language for developing the modules in windows platform, using Proteus 8 Professional to make schematic drawings and make electrical circuit analysis. In smart traffic light control system we are going to use IR object detection sensors to detect the crowded roads by setting it at a specific distance from the traffic light (ex: 10 car distance far from the traffic light), also on the emergency lanes to detect any emergency vehicle which wants to cross the traffic light, send these feedback signals to our Arduino Mega 2560 to take the right decision for each situation. For the feedback SMS alert to the traffic men we are going to use GSM module connected to our controller (Arduino Mega 2560) allowing it to send the alert SMS in the emergency situation. We are going to use a set of (Red – Yellow – Green – Blue) LEDs for each traffic light. Wires, jumpers and bread board are used to connect all the smart traffic light system together.



FIGURES / CHARTS / TABLES



	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Emergency y1	Emergency y2	Emergency y3	Emergency y4
Traffic light 1	Red	Green	Yellow	Red	Red	Red	Green Blinking Blue	Red	Red	Red
Traffic light 2	Red	Green	Yellow	Red	Red	Red	Green Blinking Blue	Red	Red	Red
Traffic light 3	Red	Red	Red	Red	Green	Yellow	Red	Red	Green Blinking Blue	Red
Traffic light 4	Red	Red	Red	Red	Green	Yellow	Red	Red	Red	Green Blinking Blue

RESULTS AND DISCUSSION

Junction layout

Our smart traffic light system will be controlling a 4 roads junction as shown in Figure 5, by using 4 traffic light for the 4 roads and 2 IR object detection sensors for each road one for the crowded detection and the other is for emergency vehicles detection

Normal smart traffic light system sequence

The smart traffic light system normal sequence starts with all traffic lights red and waits for a clearance delay of 2 seconds then traffic light 1 and 2 will turn green and stays green for 20 seconds then traffic light 1 and 2 will turn yellow and stays yellow for 3 seconds then traffic light 1 and 2 will turn red and stays red, a 2 seconds clearance delay is needed here while all the traffic lights are red to make sure that there is no cars in the junction in case of turning cars, then traffic light 3 and 4 will turn green and stays green for 20 seconds then traffic light 3 and 4 will turn yellow and stays yellow for 3 seconds then traffic light 3 and 4 will turn red and stays red. This sequence will be repeated till there is a crowded road or an emergency vehicle enters any road.

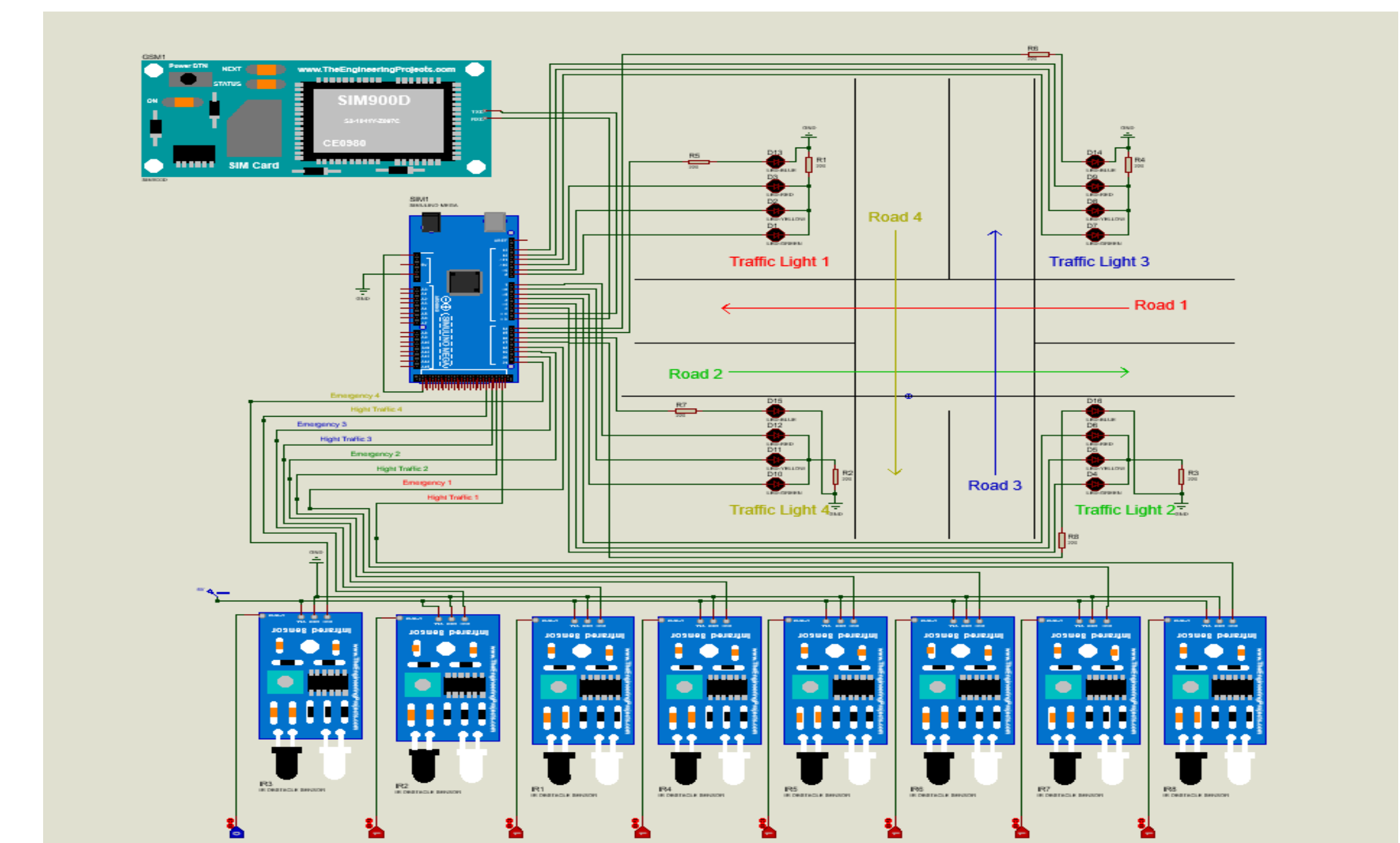
Rush smart traffic light system sequence

The smart traffic light system rush sequence will be enabled when more than 10 cars are waiting on one of the roads. As an example if there are crowded cars in road 1, the smart traffic light system will repeat the normal sequence but with different green time delay for the traffic light 3 and 4 which will be only 10 seconds green instead of 20 so it will allow more cars to pass in road 1 and 2 compared to the number of cars passing on road 3 and 4.

If the crowded cars are in road 3 or 4 traffic lights 1 and 2 will get a short green light time period of 10 seconds instead of 20 so it will allow more cars to pass on road 3 and 4 compared to the number of passing cars on road 1 and 2.

Emergency smart traffic light system sequence

The smart traffic light system emergency sequence will be working immediately if any emergency vehicle enters one of the roads, the road which has an emergency vehicle traffic light will turn green immediately and all the other traffic light of the other roads will turn red allowing the emergency vehicle to pass through the junction safely, after the emergency vehicle leaves the traffic light will operate normally again back to its normal sequence.



CONCLUSION AND RECOMMENDATIONS

In conclusion we could figure the differences between the traditional traffic light and the smart traffic light allowing us to know how efficient the smart traffic light is.

We discussed the Literature review on smart traffic system such as (smart traffic light switching and traffic density calculation using video processing - Smart Traffic Lights System for Emergency Response Vehicles - Optimization of smart traffic lights to prevent traffic congestion using fuzzy logic - Optimized Sensor Network and Multi-Agent Decision Support for Smart Traffic Light Management - Smart traffic light control system).

Also we illustrated the design of the smart traffic light including (Block diagram - Junction layout - Traffic lights phases and sequence description - Parts - Schematic - Flow Chart - Simplified code).

This project is based on a very effective way to improve traffic this adjusts the four-way traffic according to the traffic control barriers. This proposed system will be able to build a developed country with less traffic congestion and will also help the emergency vehicle to arrive in time to the destination. Therefore, this smart system will help us to control traffic in a more independent way.

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Abstract

Traditional traffic lights aren't that useful compared to Smart traffic lights due to its limitations to adapt with high traffic in some roads in rush hours. Traditional traffic lights are programmed with a fixed period to pass or stop the cars in roads whatever the traffic in this road. On the other hand, smart traffic light can adapt traffic so it can give the crowded roads a longer amount of time to pass more cars compared with the uncrowded roads which will allow a smooth traffic. Limitation for the traditional traffic light is how it handles situations of emergency since it cannot sense the emergency vehicles it will behave normally like there is no emergency. Smart traffic lights can sense the emergency vehicles and stop all the other roads except the emergency vehicle road so it can pass faster and smoothly. Also, Smart traffic lights can give a feedback for the traffic men in case of emergency by sending them a SMS on their phones so they can easily monitor and handle any case of emergency. A smart system is designed using Proetus software. A flow chart and block diagram of the design project are illustrated. The Arduino is used as a controller for the sensors, GSM system and RF system, The controlling of traffic signals operation is produced through two ways. The first one used the GSM unit and the second one used the infra-red remote sensing. Finally, the system is practically implemented and tested.

Key words:

Traditional traffic lights; Smart traffic lights; Fixed period; Adapt traffic; Situations of emergency; Feedback SMS; GSM unit; RF transmitter and receiver; Arduino.