

Adaptive Timers for Emergency Vehicles and Pollution Detector Using Li-Fi

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Abstract—Vehicles have turned into an indispensable part of each one's life. The well-ordered rising number of transport organizations is making a huge number of issues in traveling. The crisis vehicles like fire engines and ambulance are failing to reach in time makes humankind and financial setbacks too. Circumstances and conditions request the utilization of motor vehicles in the quick-paced city life. Air Pollution is one of the primary effects of the traffic. As a solution, Adaptive timers allowing to a crisis vehicle to achieve the emergency clinic on schedule and the pollution detector are introduced using Li-Fi. The Li-Fi technology gives a completely new layer of remote network within existing wireless networks. The term Li-Fi indicates to visible light communication-(VLC) that utilizes light source as way to deliver high rated speed communication in a manner likely to Wi-Fi. Here, signal will turn green whenever ambulance enters the respective lane. Li-Fi technology utilizes Visible Light Communication (VLC) protocol. The system will update the live information of location on a global server about where the Emergency vehicle is located at that instance. In turn, the driver gets acknowledgment from the hospital where the doctor is available. Using the sensor MH-Z19 module Carbon level is also indicated which is emitting from the vehicle. Thus, helps in knowing the air quality in the environment and the vehicle condition as well. The Proposed system makes the ambulance to reach on time. Thus, reduces the waiting time of vehicle in heavy traffic. Li-Fi delivers finer bandwidth, connectivity, efficiency and security more than the Wi-Fi. It has achieved greater speeds larger than ~1 Gbps under the laboratory conditions.

Keywords— Traffic, Emergency vehicle, Li-fi technology, Arduino, MH-Z19 module, Pollution.

I. INTRODUCTION

Our country is facing problems regarding horrible road or traffic congestion in its cities for the past decade. Major need for development is the Transportation. The progressively expanding number of transport services is yielding huge number of problems in transportation and travelling. The authentic emergency services like fire engines and ambulance also fails to reach in time creates humanity and financial losses as well. It is a testing time for families of patients or the people who were being transported in ambulances or fire safety.

One of the vital issues faced by ambulances is volume traffic. Because of heavy traffic, the ambulances get stuck in traffic for more durations which causes harm to patient's life that one can often see in day today life. The basic action of every rescue vehicle services is emergency pre-medical aid, though they basically give an emergency reactions and transfer of patient on behalf of the medical section. They give quick responses to health services and considerably contributes to phone sorting and health

services by telephone through subtle communications framework. In recent times it has become apparent that growing health systems pressures cannot be resolved solely by adding resources, however should even be referred with extremely new ways of delivery services. On the off chance that emergency vehicle administrations can create towards an out-of-medical clinic, clinical consideration administration instead of simply pre-emergency clinic clinical consideration, they could generously add to usefulness of the wellbeing framework. This could be through progressively proficient exchange of patient data. The volume of air contamination effects and wellbeing dangers to on and close street people that will happens because of again blockages in the traffic, for ex., Monday to Friday peak hour traffic. Repeating blockage in traffic can result in reshaped and constant exposures, and an expansion in long haul wellbeing dangers. Widening of traffic clog each and every single year is causing widening of air pollution and contamination, squandering of time and the efficiency and leads to sicknesses, for example, and respiratory illnesses. Pollution because of engorged traffic congestion is several times larger as compared to pollution caused by just in the case of slow flowing traffic. Sometimes, greenhouse gas emissions and pollutants were concerning fourfold the maximum amount as once the 60 kmph average speed. It ends up in the air and setting pollution. As an increase in the temperature of combustion, the productivity of transformation to CO₂ and water increments. Be that as it may, fuel impurities like NO₂ is oxidized by nitrogen. At high temperatures, environmental Nitrogen - N₂ is similarly oxidized to NO₂, consequently at greater speeds and loads, NO₂ generation rules. Additionally, the expense of fathoming or decreasing traffic B clog is huge. Notwithstanding, ignoring the narrow road issue would widen the social problems among natives. Every one of these issues broadly adds to issues related to traffic. To start with, drivers, when they stuck in the heavy traffic blockage, are confronting a higher danger of arriving late at their goal, causing extraordinary dimensions of pressure. The pressure may further change into restlessness, imprudence, and thus increment the event rate of traffic mishaps and other social issues. To overcome this, the system with effective results needs to be implemented. A programmed or automated traffic sign control system dependent on the location of the emergency vehicle is a proficient framework.

The problem of crisis vehicle stalling out in a road turned parking lot can be drawn to by guaranteeing that the path in which the crisis vehicle is going is plain. That is nothing but, the entry of the emergency vehicle is to be conveyed to the

closest traffic signal, so it will turn the light green and henceforth clears the traffic.

II. LITERATURE SURVEY

Traffic research has the aim to optimize traffic flow of goods and people. Many ambulance drivers said that [1] patients from adjoining districts who wanted to come to the city's government hospitals for treatment chose to get admitted in private hospitals on the outskirts after hearing about the traffic jam. As the measure of road users consistently raises, and assets given by current structures are obliged, smart control of traffic may transform into a huge issue later on. In any case, a couple of impediments to the utilization of intelligent traffic control exist. Keeping away from blocked traffic conditions is accepted to be helpful to both condition and also to economy of the country, yet improved traffic-stream may similarly incite an extension looked for after. There are a couple of models for traffic diversion. The Traffic blockage can moreover be realized by huge Red-light deferrals, etc. The deferral of specific light is hard coded in the surge hour gridlock light and it isn't liable to traffic.

Countdown timers: Traffic signal Timer is a gadget created and produced so as to expand the security in rush hour gridlock by showing the rest of the season of red or green light.

Traffic lights are having been fixed everywhere throughout the globe in countless urban areas. Traffic light controlling allows a proper route to the street clients by making use of lights in ordinary hues like Red, Yellow, and Green. Traffic light control system makes use of an overall shading code that is, a specific shading request to empower shading acknowledgment for the persons who are visually challenged. The picture handling method uses to control traffic jam in Litmus. It is increasingly reliable in identifying vehicle nearness since it utilizes genuine traffic pictures. This framework can be improved with different cameras set along a roadway having high lucidity. It expands the cost efficiency as additional expense requires for the camera with amazing gear to process the caught edges. Distinctive correspondence shows like RFID, GSM, IR, and ZigBee, so on have been involved to execute emergency vehicle-based traffic control. In any case, the above strategies can't be used nowadays for various reasons. The correspondence systems based on GSM has been generally used for cellular correspondence. Despite the fact that basic foundation for GSM is accessible, the merits of this invention for V-2-V correspondence needs greater transmission capacity. RFID based V2V communication do not require line of sight. RFID based traffic control can able to detect emergency vehicles on the off chance that it is in the recurrence scope of the traffic control. IR based crisis vehicle recognition is temperamental as IR sign require viewable pathway and daylight can cause obstruction with signals of IR. In any case, to execute V2V correspondence or traffic the board using Zig-Bee incorporates constraints on the amount of centres per controller. A secure communication is offered diverged from RFID. This is reasonably productive appeared differently in relation to Zig-Bee. It doesn't use the

blocked 2.4-GHz repeat like Zig-Bee. In this proposed paper, Li-Fi based V2V correspondence system is realized. For air pollution monitoring, the fundamental rule of method of electrochemical gas detection is the electro synthetic response explicitly reaction of oxidation-decrease in the sensor. An electrical sign relative to the convergence of the gas particle is created by the response between the sensor and the gas atoms. The sensor is comprise of three fundamental electrodes, these are Working Electrode_(WE) and Reference Electrode_(RE) and a Counter Electrode_(CE) which is utilized to give an outside driving voltage [10]. These three terminals are independently sent into the electrolyte inside the sensor. For recognizing and improving the selectivity to a particular sort of gas, various kinds of layers, electrolyte and working terminals are utilized. Consistently, there have been a couple of rules made by the Government to manage and reduce the surge from vehicles; most by far of them being incapable at the proportional. The standards and the timetable for use are set by the Central Pollution Control Board under the Ministry of Environment and Forests. Bharat stage release measures are radiation checks sorted out by the Government of India to coordinate the yield of Air Pollutants from inside start engine equipment, including motor vehicles. In our country, crisis vehicles like firefighting vehicles or ambulance were not ready to reach their destination on time because of overwhelming traffic so, numerous lives have been lost. An efficient and feasible traffic management system can be executed utilizing Li-Fi technology. compare and Examinations have been done to evaluated toxins, influence capacity, execution cost, run level of casualness, etc., which are given in unimaginable structure to straightforward simple correlation. furthermore, joins a model which is air defilement identification and checking using micro-controller and Wi-Fi module [10]. There is a strategy for dull smoke system which accumulates the particulate issue - (PM) on a channel over 24-hour time period anyway a size explicit bay. A reflecto-meter is used to check the obscurity of the channel which is changed over to the PM's mass obsession [9].

III. IMPLEMENTATION

The system uses the junction signal timers according to the entry of the emergency vehicles in the lane. Using the Li-Fi technology, it transmits the data from ambulance to traffic junction. This system senses the change in traffic signals around the traffic and changes the timer suitably by sending the signals to the timer control system. The controlling of flow of the traffic leads to increase or decrease in the traffic density, So, it also depends on the traffic signal timer. Due to this process, an irregular delay causes in the traffic while transit in the cities. Currently, the control systems of traffic in India has drawback in the sensing networks and intelligence. Here, LED bulbs are considered as the major resource of light, because, the lights such as fluorescent lights have demonstrated themselves to be wasteful as far as consumption of energy and luminosity when contrasted with LEDs. Their power can be adjusted at high speeds. This property is misused in Li-Fi innovation.

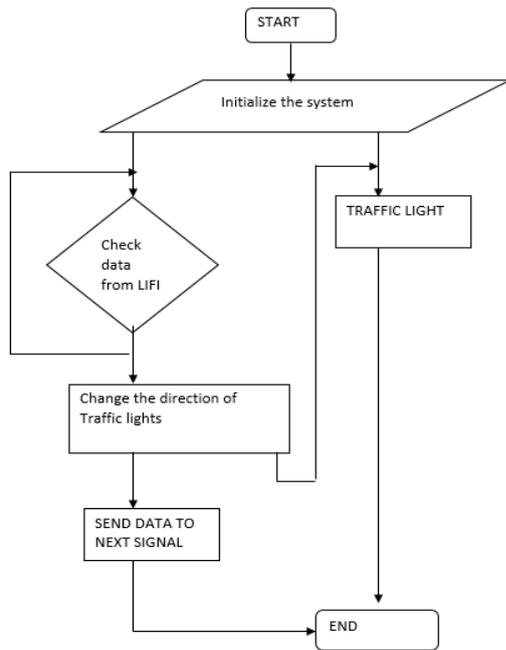


Fig 1: Flowchart of Traffic signal control for Emergency vehicles

A. *Li-Fi Technology*

Li-Fi represents Light Fidelity, this innovation is extremely trending was proposed by Harald Haas, the German physicist in Global Talk on Visible Light Communication - (VLC) i.e., TED (Technology, Entertainment, Design) in 2011. The Li-Fi is basically, a wireless optical networking technology. For transmission of information that utilizes light Emitting diodes-(LEDs). The title Li-Fi refers to visible light communication- (VLC) technology that uses light as a main source to transfer high-speed information in a manner exactly like Wi-Fi. Its IEEE standard is IEEE 802.15.7. The IEEE 802.15.7 (Li-Fi) is a greater-speed, bidirectional and technology of completely networked wireless communication based standard just like Wi-Fi's IEEE 802.11. Basically, in a setup, it comprises of a light source (LED) which is utilized as a emitter and a photodiode utilized as a collector. The LED source is explicitly taking for the rapid transmission of information. The LED by exchanging ON or OFF at an incredibly high rate. The position ON demonstrates parallel 1 and the OFF position shows 0. Advanced information is comprised with simply these two-fold qualities of 0's and 1's and therefore information can be transmitted by simply turning the ON/OFF of the LED. The photo-detector or photo-diode is utilized to detect these adjustments in province of LED and translate the information got which is then transmitted further.

B. *Flow Chart*

Let's consider the scenario with Li-Fi technology based adaptive junction timers control for Emergency vehicles.

Here, Li-Fi transmitter which is implemented in an emergency vehicle that is in ambulance. As in when it enters a heavy and congested traffic lane, then it sends a message as alerting like "n" or "e" (Respective characters as per the direction). The traffic signal control system will receives the alerting message. On receiving the message of alert, the signal control does turn the timer signal green.

The respective character as a message is forwarded to the next signal so that the route will be cleared in next lane to pass the Ambulance. Whenever an Ambulance enters a lane, the microcontroller will send the message as per the direction through serial communication to the UDN amplifier. The message is then sent through the LASER/LED to the receiver. Here the receiver side is referred as the traffic signal control board. In receiver section, there will be a photo transistor which receives the message through light. This is the transmission through Li-Fi.

Once after receiving the message as the respective character, the traffic signal for the particular lane of the Ambulance is turned to green so that Ambulance can move further. The message received is then forwarded to the further traffic control signal of another junction to make an alternate way before the Ambulance comes reach the particular lane or junction as shown in the figure 1. In a contamination marker framework, the examination of the level of the poison is finished by the microcontroller by the stipulated dimension permitted by the legislature. At the point when the contamination dimension of surpasses the breaking point benchmarks, it demonstrates in the web application that is, the individual will become more acquainted with the carbon outflow subtleties. It likewise refreshes the subtleties of the vehicle in the database of the particular experts where all the data and insights about the individual vehicle will be accessible. Additionally, that can be found in web application.

C. *UART Serial communication*

In a media transmission and information transmission, serial correspondence is the option towards sending data of one piece at any given time, successively, over a communication channel or transport of PC. This is such as opposed to parallel communication, where a set of bits are sent in once, on a connection with a parallel channels. Serial communication is made use for each and every long-haul communication and most of all PC system, where the link expense and synchronization which troubles make Parallel Communication unreasonable. Sequential communication is ended up progressively regular even at fewer distance, as improved sign trustworthiness, transmission speed in more up-to-date sequential innovations have started to make the parallel transport's excess bit of leeway of straightforwardness (no requirement for serializer and reserialize, or SerDes) and to overwhelm its weaknesses (clock slant, interconnect thickness).

a. **Register configurations:**

For UART peripheral these following registers are must be configured.

- PCON register: Power Control Register. It controls the power down of the processor

- SCON register: It's an 8 - bit register for configuring Serial Control Reg.
- TCON register: Timer Control Register. It is meant for the Baud rate generator
- TMOD register: Timer Mode Control for the Baud rate generator
- SBUFF register: Serial Buffer will hold the data to be received and the data transmitted.

b. Mode - 1:

In this mode of selection, through the TXD pin 8 bits are transmitted and through the RXD pin it is received as shown in the following table: a Start bit is 0 always, a Stop bit is 1 always, and 8 data bits in that LSB as a first. To initialize data, receive only Start bit is used, while the Stop bit is written to the RB-8 bit of the SCON reg automatically.

SM0	SM1	Operation
0	0	Mode 0
0	1	Mode 1
1	0	Mode 2
1	1	Mode 0

Table 1: Serial port modes of operation

D. Transmission (Txn) and reception (Rxn) process in scon register

- Transmission (Txn)– Serial information transmission starts whenever information is written to SBUF. To transmit information to the serial data network, Pin P3.1 (Alternate function bit TXD) is used. Upon transmission of information, TI is set to 1. This means that SBUF is empty in order to send another byte.

- Reception (Rxn)– The START bit (logic-0) on the RXD pin starts the data reception. The two conditions as must be met: bit REN should be enabled REN=1 and RI bit should be logic-0 (RI=0) bit. Both of them will be stored in the SCON register. The RI bit is auto updates and set to 1 upon data reception is complete. The determination of Baud Rate in this mode is done by the timer 1 overflow.

The system shown in the below figure 2 is the block diagram of the pollution detector. The detector of smoke will detect the pollutants such as CO, NOx, so on. continuously. The microcontroller does compares the levels of pollutants with the stipulated levels that are allowed by the government. When the level of pollutant exceeds the limits of standardization, it helps in taking the vehicle for well maintenance and one should take their vehicle to servicing.

E. Arduino UNO:

This module has digital pins, 14 of which are used as PWM outputs, 4 UART Hardware Serial ports, Analog inputs of 16, a crystal oscillator OF 16 MHz, a power jack, a reset button and an icsp header. This module comes at the transmitter section. The MH-Z19 module is connected to this and the switches for ambulance will be connected to this

module.

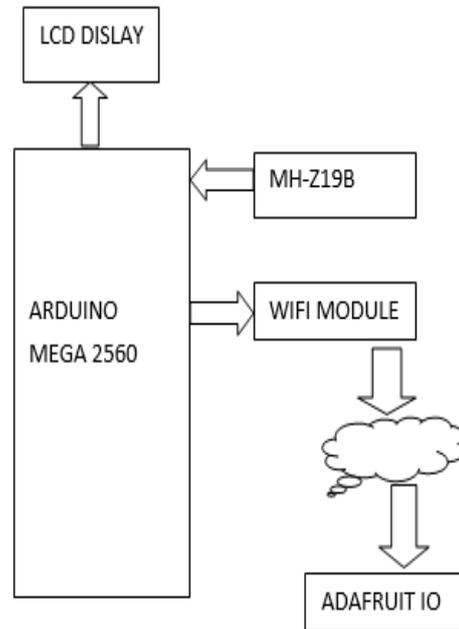


Fig 2: Block diagram of Pollution detector

F. MH-Z19B NDIR CO2 Module:

It is an infrared gas module of a typical kind, small in size, utilizing non-dispersive infrared -(NDIR) standard to identify the presence of CO2 noticeable all around, with great selectivity, non-oxygen reliant and has a long-life span.

Colour coding	AQI Range Index	O3 (ppb)	CO (ppm)	NO2 (ppb)	PM10 (ug/m3)
Good	0-100	0-50	0-1.7	0-42	0-100
Moderate	101-200	50-98	1.8-10.3	43-94	101-150
Poor (Unhealthy for sensitive group)	201-300	99-118	10.4-14.7	95-295	151-350
Very Poor	301-400	119-392	14.8-30.2	296-667	351-420
Very unhealthy	401-Above	393-Above	30.3-Above	668-Above	421-Above

Table 2: Range of the AQI

Worked in temperature pay, and it has PWM output and UART output as well. It is created by the integration of developing infrared retaining gas recognition technology, exactness optical circuit plan, and unrivaled circuit structure.

The system includes Arduino MEGA controller, MH-Z19B module, WIFI module, and 16 x 2 LCD display. Whenever the pollutants detected by the sensor, it will send the data to Arduino UNO controller. The controller will send the data to Wi-Fi module, from where the data is sent to the server. Node MCU V3: It is an open-source firmware and advancement pack that assumes a crucial job in designing the claim IoT item utilizing a couple of Lua script. Adafuit.io: This is a cloud administration which means one can interface with it over the Internet. It's implied basically for putting away and afterward recovering information. It peruses the sensor information and presentations the information continuously, on the web.

G. Node MCU V3:

It is an open source firmware and advancement pack that assumes a crucial job in designing the claim IoT item utilizing a couple of Lua script. This refers to the Wi-Fi module in the proposed system. Which helps in updating the information to global server and the acknowledgment from the hospital to driver. The carbon level also be updated through this wi-fi module as well.

H. Adafuit.io:

This is a cloud administration which means one can interface with it over the Internet. It's implied basically for putting away and afterward recovering information. It peruses the sensor information and presentations the information continuously, on the web.

I. Experiment:

The proposed system is tested with the two-wheeler (with no load) for the pollution detector in order to check the carbon emission from the two-wheeler. The setup which includes MH-Z19 module with the range of 2000-5000 ppm. The emission of the level of carbon pollutant from the vehicle is 160 ppm. As per the color-coding table mention in Table 2, the emission range of the pollutant is in a moderate level of range.

- *Advantages of making use of li-fi in the traffic control system:*

There are mainly four advantages in using Li-Fi in implementing this system. They are:

1. *Capacity* : Spectrum of visible light used by Li-Fi for communication is 10000 times greater than that of radio spectrum. And much of the visible light spectrum can be utilized in many ways.
2. *Availability* : The Radio waves which is an electromagnetic waves, are utilized for a wireless correspondence in data transmission. There are radio base stations nearly 1.4 million which are utilized for radio communication. And yet there are vehicles nearly 1.2 billion on street. In this manner, here there can utilization of the LED head and tail lights of any

vehicle to do the transmission of information and gathering.

3. *Efficiency* : The normal power utilization of a cell base station is 2-6 kW. In which just 5 percent of power is utilized for information transmission. Though, the headlights of vehicles utilize 3w for each light as rated. Accordingly, Li-Fi based traffic framework is undeniably progressively better when thought about than cell-based traffic the executives framework.
 4. *Cost*: As per a study, to have cellular network coverage of 100 percent in India, we might need to spend 3100 million INR at-least. Then again, cost of changing over any LED source of light into a Li-Fi module would be under 1000 INR. Even though, ZigBee and Wi-Fi would cost roughly the equivalent, the radio range they use for communication is narrowed.
 5. *Safety*: Visible light range is used by the Li-Fi communication technology which has no unsafe impact on the human beings not at all like X-rays, Gamma beams, Ultraviolet rays and so forth which even reason changes at the cellular level.
- *Disadvantages of making use of li-fi in the traffic control system:*

Alongside the merits in utilizing Li-Fi in this framework there are a few drawbacks related in its use.

- i. The vehicle Laser lights should be kept ON during the day for Li-Fi to work yet the power can be kept up at the very least level.
- ii. Li-Fi module works productively when the transmitter and recipient are put in LOS (Line of Sight). The slight deviation from the position can prompt miscommunication.
- iii. Sometimes, especially during day-time the sunlight can be interfere in communication of Li-Fi. Likewise, other sources of light, for example, ordinary lights, may likewise intrude on the Li-Fi communication.

RESULTS

The proposed system results in reducing the time to wait of the ambulance in the dense traffic. Since the Li-Fi technology is used, the updating of the information the global system or server is at higher speeds. The response from the hospital which makes the ambulance to reach the destination more quickly. The patients can be treated within the proper time as well. Thus, making saving rate of patients high or more.

The Transmitter and receiver section are shown below:

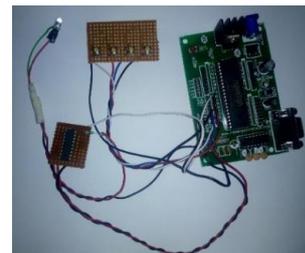


Fig 3: Transmitter section

The transmitter section which includes switches which refers for the direction of each lane and Receiver section includes the traffic lights in junction

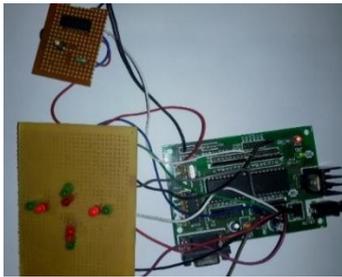


Fig 4: Receiver section

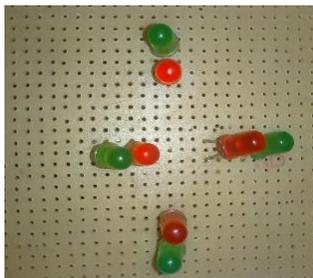


Fig 5: Adaptive timers

The above figure 5 shows the shifting of the timers as per the ambulance enters in the respective lane. The switching of signal lights will be normal in the regular of traffic. As in when the ambulance enters the lane, the signal adapts the green signal for the respective lane. Thus, reduces the waiting time of the ambulance in dense traffic. The pollution detector indicates the level of emission of the carbon content from the vehicles as shown in the figure 6. The above figure shows when there is no detection of carbon from the vehicle.



Fig 6: Response from the Hospital 1 by the toggle switch

2019/06/13 1:58:40pm	CARBON LEVEL: 14
2019/06/13 1:58:30pm	CARBON LEVEL: 14
2019/06/13 1:56:59pm	CARBON LEVEL: 1972
2019/06/13 1:56:44pm	PREMISSION FROM AREA 2
2019/06/13 1:56:41pm	PREMISSION FROM AREA 1

Fig 7: Logs of the response and carbon levels

The above figure 6 and 7 shows that the logs of carbon levels of the vehicles. Also it updates the availability of the hospital by acknowledging the permission to the ambulance by indicating the availability of the doctor to treat the patient in-time. When it detects the carbon it will update Carbon level.

CONCLUSION

India is eventually heading into the most exceedingly terrible season for air contamination, a season where the nation's famously low quality turns out to be significantly increasingly toxic. The essential job of all rescue vehicle administrations is pre-emergency clinic medical consideration. Despite the factor, the most part, give both crisis reaction and patient exchange in the interest of the wellbeing part. By incorporating system into rescue vehicle to signal timers, thereby reduction in waiting time of the rescue vehicle and the hospitals leads to expanding the effectiveness, and giving a chance to an emergency vehicle to reach the hospital on time. With this system the carbon emission from the vehicles can be detected as well which leads to a healthy environment and the well being of the vehicles can also be maintained.

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