



# IoT based real time traffic control using cloud computing

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## Abstract

The rapid increase in the number of vehicles has given rise to the traffic jam, which is a major problem these days. The effect of traffic jam also affects the operation of ambulance. To avoid the traffic jam for the ambulance, a new idea is developed. In this paper we propose a new concept to avoid traffic jam for the ambulance and thus saving the life of an individual. At first the ambulance is detected and the information about the arrival of the ambulance is sent to the next station. The ambulance will make siren only when it carries patient inside, so by detecting both the ambulance siren and the image taken from the acquisition device, the information is sent to the next point which is on the way to hospital. Announcement of the arrival of the ambulance is done. The CCTV camera is monitoring each vehicle on that road. If any vehicle doesn't abide by the announcement done, the image of the vehicle will be captured, and then by using the acquired image the number plate will be tracked and will be detected automatically by image processing. The vehicle information is sent to the police station, to take the necessary action. Thus the traffic control can be done and the way is cleared for the ambulance and life is saved. The processing is done using MATLAB and is verified.

**Keywords** Image processing · Object recognition · IoT · Cloud computing

## 1 Introduction

Road traffic control is one of the important and challenging areas which involve directing vehicular and pedestrian traffic around a construction zone, accident or other road disruption, thus ensuring the safety of emergency response teams, construction workers and the general public. Traffic control is an outdoor occupation, where an individual has to work night or day for long hours in all weathers, and is considered a dangerous occupation due to the high risk of being struck by passing vehicles [1–3]. Safety is very necessary for this kind of occupation and great care has to be taken. Traffic controller has to see all aspects and has to reduce the traffic jam which will affect the daily life of an

individual. The critical conditions are when a traffic jam occurs and there is a necessary to clear the traffic as an urgent work has to be carried out. The ambulance when got in traffic is a dangerous situation in which a patient might be forced to death as a result of late treatment, which is mainly due to traffic. Hence traffic control and clearance of traffic for the ambulance plays a very important role [4, 5].

Increasing road traffic, is a critical issue to be addressed in the current situation. In the emergency situations like exams for students, health issues, this problem may cost to life. This situation causing deaths on the roads, deaths due to late response for the accidents, motivated us to come up with an idea to monitor and control the traffic.

In this paper we propose a new concept to control and maintain the traffic using internet of things and cloud computing. The design is divided into several sections which will be briefed in upcoming sections. At first the existence of ambulance is verified by taking the real time video and processing the video using processing toolboxes and speech processing is also done in order to detect the siren of the ambulance [6–8]. Once the existence of the ambulance is confirmed then the information is passed on to the next station and announcement to clear the traffic is done [10, 11]. If any of the vehicles don't abide to the

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announcement made then, the vehicle breaking the rule is identified and number plate is segmented and number is obtained. From the database, the owner information is passed on to the nearest police station to take the necessary action [12]. The database about the vehicles not abiding the rules are maintained in the cloud and used for further processing. At first, we use detection algorithm to detect the presence of ambulance and we send the command to the next station via internet and at the station we announce and on the violation of the rule, we use number plate detection algorithms to detect the vehicle number and the owner and police is informed via internet and stored in the cloud. The following subsection will completely define the process involved.

## 2 Motivation

Increasing population has resulted in increasing number of vehicles on road. Due to this there exists a lot of traffic on road which will affect the daily life of an individual. Lot of time and effort is wasted by spending time on road. The patients struck in the traffic will have to suffer a lot and this may threat their life too. So many traffic control techniques have been developed and this motivated us to come up with this project wherein we can help the patients in the ambulance by clearing the traffic and thus saving the life of an individual. There are some people who will not follow the rules, this also made us to come up with this concept. In this paper we present iot based traffic control technique using computing technique which finds it application in saving the life of a patient by clearing the traffic for ambulance.

## 3 Problem definition

Traffic has created a loss to the mankind, by wasting time and efforts. At emergency, as it comes to the case of ambulance, this problem may cause severe issue. Manual or traffic control lights may not work effectively. Ambulance has to wait and may cause threat to the life of patient. Even if the traffic is cleared there are some violations of rules which we cannot control. Thus in the proposed system traffic control is done automatically with the help of iot and necessary action is taken against the violators of the rule.

## 4 Related work

The research work has been carried out in the field of traffic control. In [1] the detection of vehicle which demonstrates the hazardous traffic pattern, as in case of ambulance, has

been discussed. [1] also discusses upon the abnormal traffic situation and also the propagation of information. In this paper we propose a system to detect the ambulance in the traffic and make way for the ambulance and clear the traffic using digital image processing. [2] discusses about the automatic traffic surveillance system using digital image processing. In [2] the camera is used to take the picture of the road to identify the traffic density. Micro controllers are used to transfer the data to control the traffic light. Sensors are used to detect the number of vehicles. The camera output is given to the micro controller for the processing and traffic lights are controlled using micro controller. We employ vehicle detection to detect the presence of ambulance. The siren is detected using audio recognition algorithms. In [3] describes the low cost solution to speech recognition.

The increased traffic has caused so many problems, which will affect the daily life of an individual. Lot of time is wasted on road as a result of traffic and it's very important to control the traffic. Number of road accidents has also increased due to the traffic. The proposed system uses the detection of ambulance and reporting to the next station using cloud computing. Two machines are configured as server and client and data transfer is enabled.

So many works have been carried out in the field of traffic engineering. [4] presents the new system to detect the accident and report to the nearest service provider. Service provider arranges for the necessary help for the action to be taken. The system uses PIC micro controller for decision taking and controlling action. The transfer of data to the emergency service provider is accomplished by using the RF transceiver system.

In the proposed system data transfer is accomplished by using TCP/IP protocol. Once the data is transferred to the next station, the announcement regarding the arrival of the ambulance is done at the station. A camera keeps on monitoring the roadway. When any of the vehicles do not abide the announcement made then the number plate of the vehicle is noted and transferred to the nearest police station to take necessary action.

So many related works are carried to detect the number plate of the vehicles. [5] Describes the conversion of the video to text, to recognize the number plate. The process involves extraction of key frames from the video output from the camera. Segmentation and reorganization of the number plate is done in the later stages. The detected numbers are stored in the database, which can be used for the further processing.

The vehicle maintenance management system has been described in [6]. It deals with the data reception from the remote server and also to exchange data with common software. [6] also describes about the various architecture in common software.

Thus database about the vehicles which do not follow the announcement is maintained and can be used for further processing in future.

There are several algorithms for the detection of number plates is implemented based on searching algorithms [7]. Searching algorithms rely on the color information. The traffic is under the surveillance of the camera, which takes the continuous video of the traffic and monitors it. Moving vehicles can be detected using segmentation method, background subtraction, adaptive motion histogram [8–10]. Lane vehicle detection and moving vehicle detection using filtering techniques are discussed in [11] and [12]. There are several research solutions available for quick means of transportation available in the literature. Having separate lane for emergency conditions is one such solution, which may increase the congestion due to non-usability during normal operation.

Traffic has created lot of problem and has resulted in waste of time. Traffic has also caused increased stress of human beings. It is very necessary to come up with a solution for the problem of traffic. If emergency vehicles such as, ambulances, fire engines, get stuck in the traffic may lead to the severe problem. Thus in this we propose a system to monitor the traffic and facilitate the easy way to the ambulance.

## 5 Proposed system

The following section will provide the overview of the proposed system and working. Figure 1, shows the overview of the system, which includes an CCTV and an microphone, which continuously monitors the traffic and sends the information to the processor for further processing. The image processing algorithms are implemented to detect the presence of the ambulance and audio processing is done to detect the siren. Once when the vehicle is detected, necessary signal is transmitted to the next station through internet to indicate the arrival of the ambulance. The announcement of the ambulance arrival is notified by the speaker and all the vehicles are insisted to make way for the ambulance. A camera is installed to keep track of a vehicle which does not follow the announcement and image is captured and number plate is extracted and owner information is passed on the nearest police station through internet to take further actions. Minimum of one parameter is sufficient to identify the vehicle, that is the image of the vehicle. By this we can differentiate between the ambulance and other vehicles. To identify the vehicle who has not followed the announcement and inform it to nearest station, minimum information required is the number of vehicle.

## 6 System design and implementation

The proposed system is designed and implemented using matlab. Image processing algorithms are used to do the necessary processing at the station. Processing involved operations such as detection of the vehicle, data transfer number plate detection and reporting etc. MATLAB script is written and simulation results are obtained. For detection of the ambulance, image processing tool box are used and the open source codes are modified for the application. The data transfer between the two stations is demonstrated by using two computers which communicate through internet using TCP/IP. Cloud computing is used to store and control the information data and for further processing.

### 6.1 Ambulance detection and audio processing

In this paper, we use MATLAB to do image processing and audio processing. The presence of ambulance is detected by first recognizing the image. The following diagram shows the steps involved in the detection of ambulance. Here we employ thresholding, segmentation and template matching to find the presence of ambulance. The Fig. 2 shows the overview of process involved in the detection. The traffic is continually under observation by the CCTV

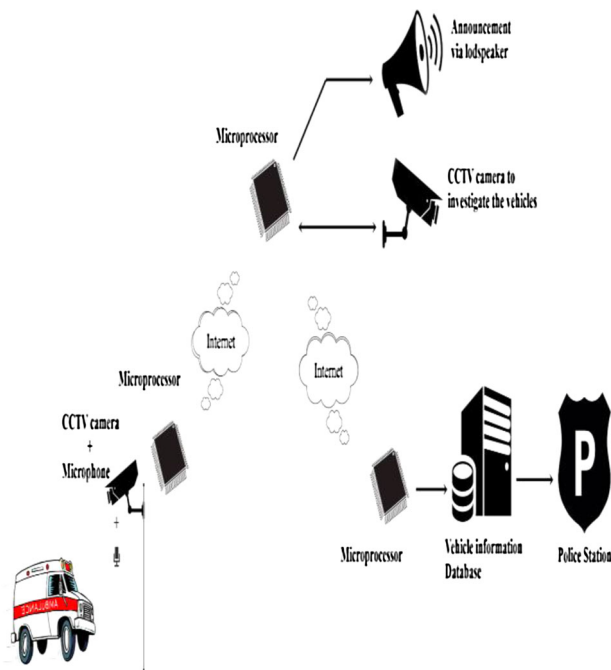


Fig. 1 Overview of the proposed system

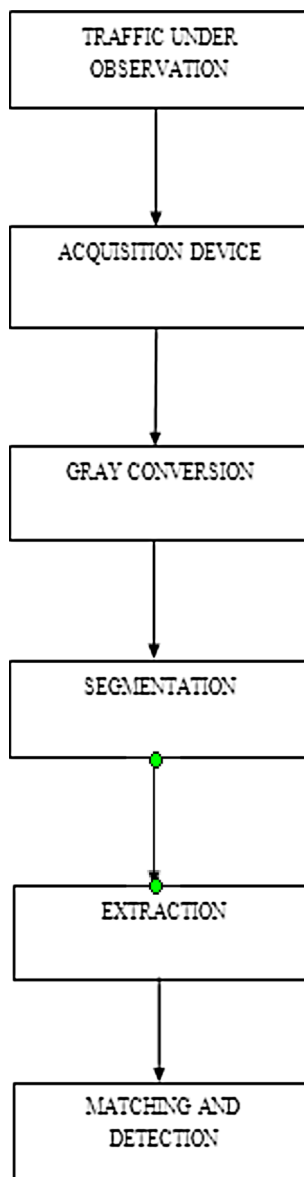


Fig. 2 Detection overview

attached in the station which takes the real time video of the traffic [13]. The videos are used to detect the presence of ambulance. The images extracted from the video, are in RGB format, which are converted to gray scale using the help of MATLAB commands. Thresholding based image segmentation is done in order to divide the main image into several image, which is typically employed for object reorganization. At the final stage the template matching is done in order to identify the required object.

The image from the camera is an color image which is converted to a gray image which is shown in the Fig. 3. In this case the image is taken from the internet for the convenience of demonstration.

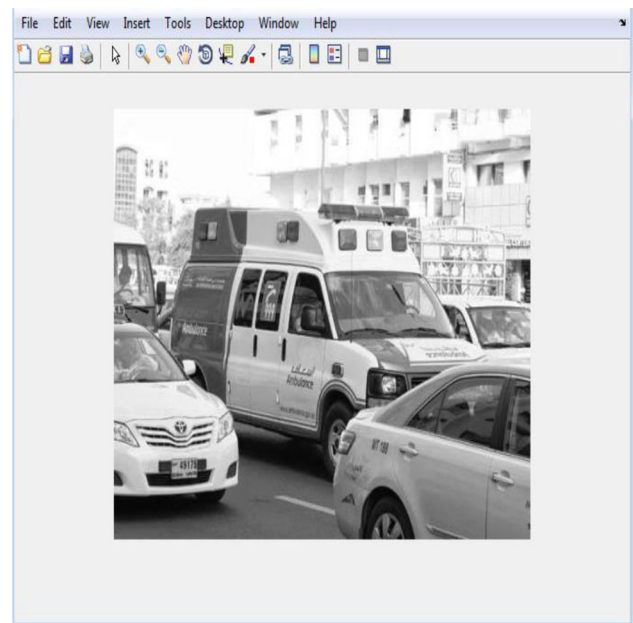


Fig. 3 Gray scale image showing the ambulance in traffic

Gray image is segmented using the threshold based segmentation with a threshold value of 50. Figure 4 shows the segmented image. Template matching is done in order to identify the ambulance in the traffic which is shown in Fig. 5.

Once the ambulance is detected, then the next step is to find whether it is carrying the patient in it or not. For this purpose, audio reorganization techniques are used to identify the presence of siren. If the ambulance is detected and siren is also detected then the information is passed

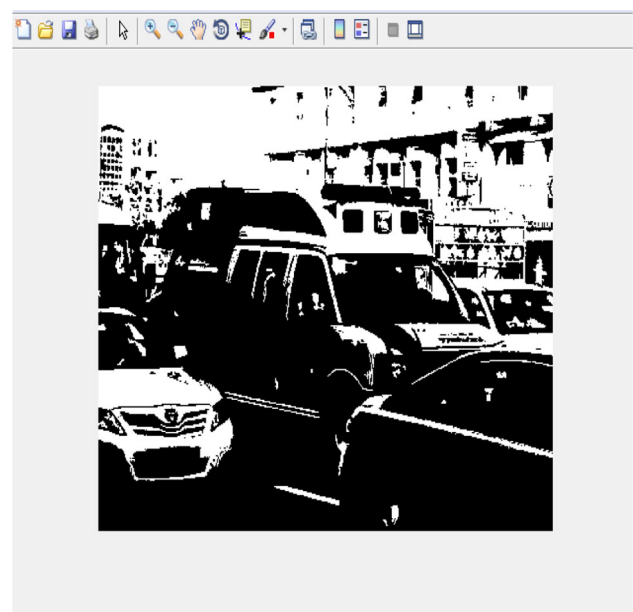


Fig. 4 Segmentation of the image

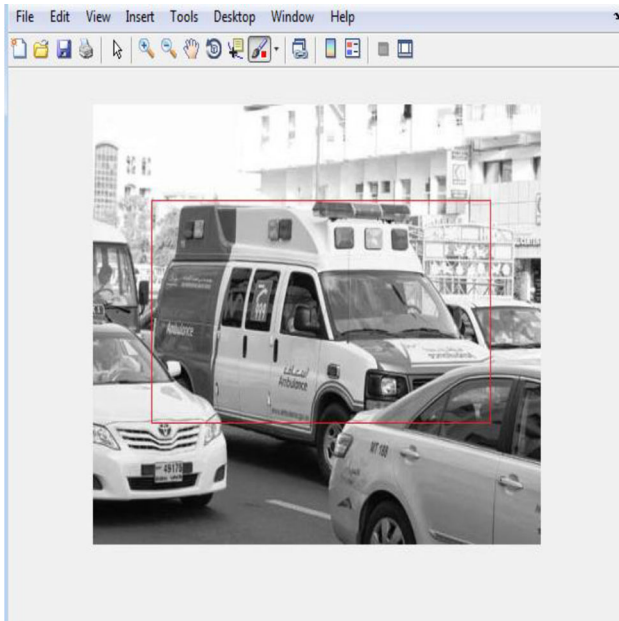


Fig. 5 Ambulance detection

from one station to other via internet with the help of cloud computing.

MATLAB script file is written for the implementation of vehicle detection and simulated. Figure 6 shows the sample code used for detection.

The pseudo code for ambulance detection is shown in the Fig. 7, where we employ both object detection and audio reorganization to detect the presence of ambulance.

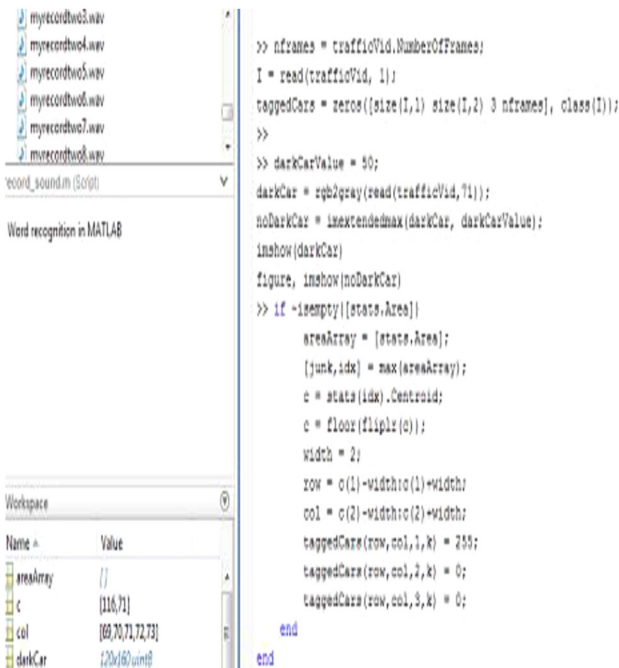


Fig. 6 Sample code used for detection

```
detection (frame, audio)
Count = 0;
{
    If (frame)
    {
        If (presence_ambulance (frame) ==TRUE)
        {
            Count=Count+1;
        }
    }
    If (audio)
    {
        If (audio_detect (audio)==SIREN)
        Count = Count + 1;

        If (count == 2)
        Count = 0;
        RETURN TRUE;
    }
}
```

Fig. 7 Pseudo code for ambulance detection

## 6.2 Number plate detection and extraction

The information regarding the vehicles which do not abide the announcement has to be recognized and reported. In order to keep trace of the each and every action we use a camera at station which continually capture video and is sent to the processing machine. If any violation of the rules is noticed, then the image is processed to obtain the information about the vehicles by extracting the number plate of the vehicle [14]. This section deals with identification and extraction of number plate.

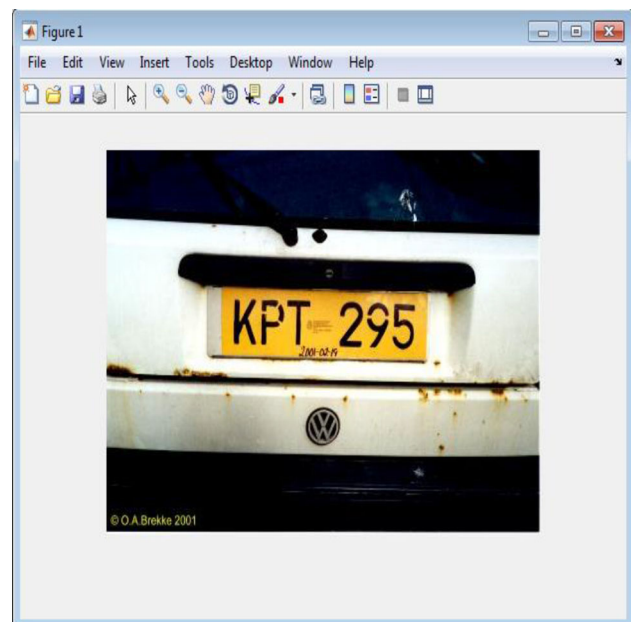


Fig. 8 Sample image



The Fig. 8 shows the color image captured by the camera, which will be the input to the processing system. The image is converted to gray image as shown in Fig. 9.

The noises in the image have to be removed before further processing. For the purpose of noise removal image is passed on to the noise removal filter. In this case median filter is used. The filtered image is enhanced and morphological gradient is applied for edge enhancement. Figure 10 shows the brightened edges with enhancement after applying the convolution.

Figure 11 shows the image of processed image from the previous stage with elimination of possible horizontal lines from the output image. Once all these processing is done then at the next stage all the regions of image are filled and thinning of the image is done in order to isolate the character. Figure 12 shows the final image after all the processing and is ready to extract each character and display the output.

The boxes are used to extract each and every character and compare with the trained set and are used to obtain the number. The number is displayed with the help of message box as shown in Fig. 13.

Once the number of the vehicle which do not abide the announcement at the station is found out, the next step is to forward the information to the nearest police station. The database is stored in the the form of text file in the cloud, which can be sent to the police station as in Fig. 14.

Many work has been carried out in order to detect the number plate based on different approach [15]. Famous approach is using morphological process [16].

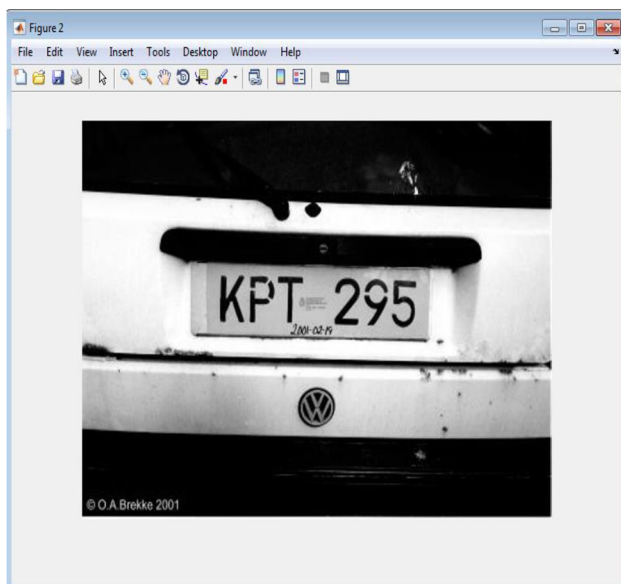


Fig. 9 Image in gray scale

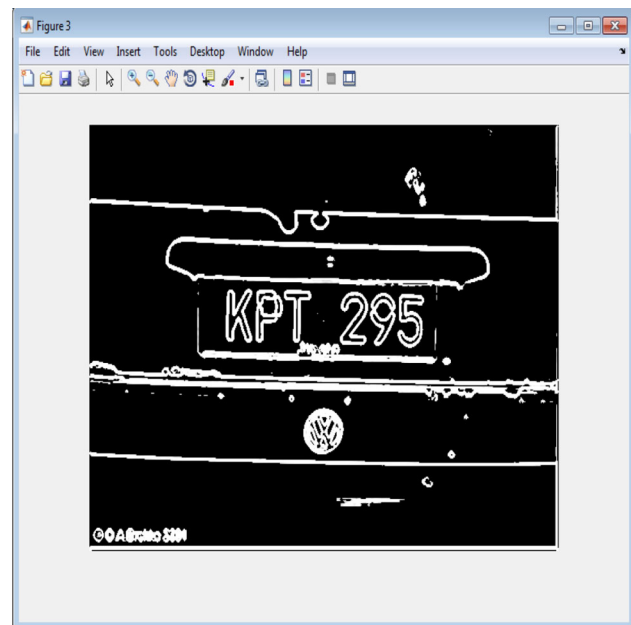


Fig. 10 Image with enhanced edges

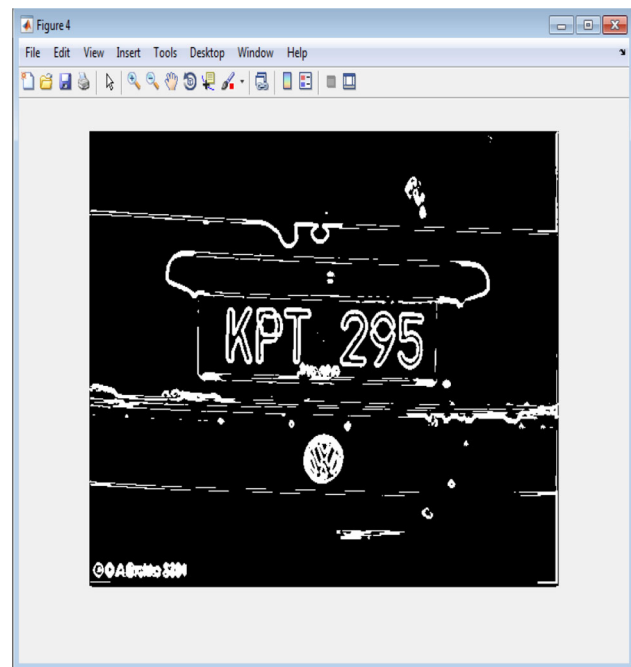


Fig. 11 Processed image

### 6.3 Data transfer between two station using internet: server-client setup and cloud computing

The information has to be transferred from one station to another station. This transfer of data is accomplished by setting up server and client machines. TCP/IP protocol stands for transmission control protocol/internet protocol,

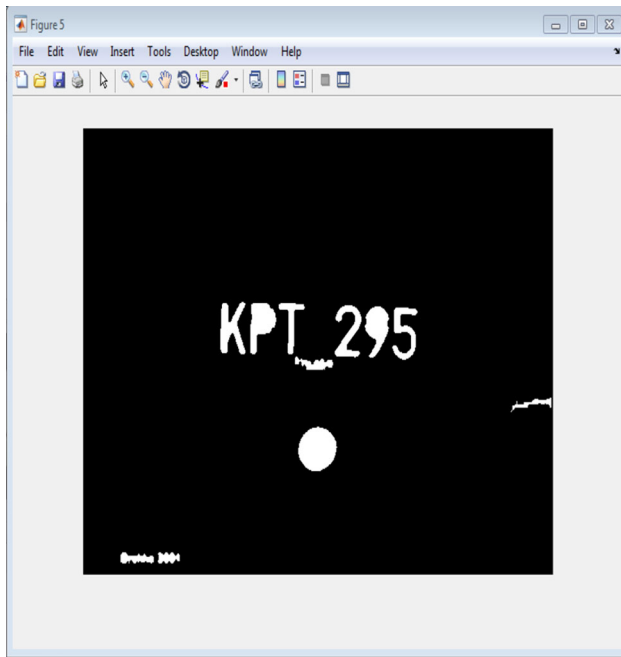


Fig. 12 Final image with number information

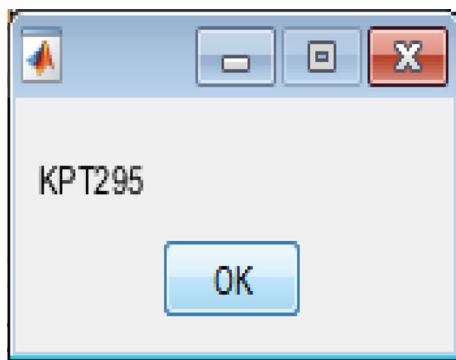


Fig. 13 Detected number of the vehicle

which is the basic protocol of the internet. We can send or receive messages from other computer with the help of TCP/IP protocol. TCP/IP protocol has two layers. The upper layer is called as transmission control protocol, which is responsible for assembling of the data packets. The lower layer is Internet layer which is responsible for handling of the address of the each packet where it is actually directed. In order to communicate between two entities, there is a need of protocol [17, 18]. Protocol refers to set of rules, where both the sender and receiver agree upon. In this we have used TCP/IP protocol to send message over internet. High data rate can be obtained by modification to the existing system [19, 20].

In our system we have employed this protocol for communication between two stations via internet. This system uses server–client configuration for the exchange of

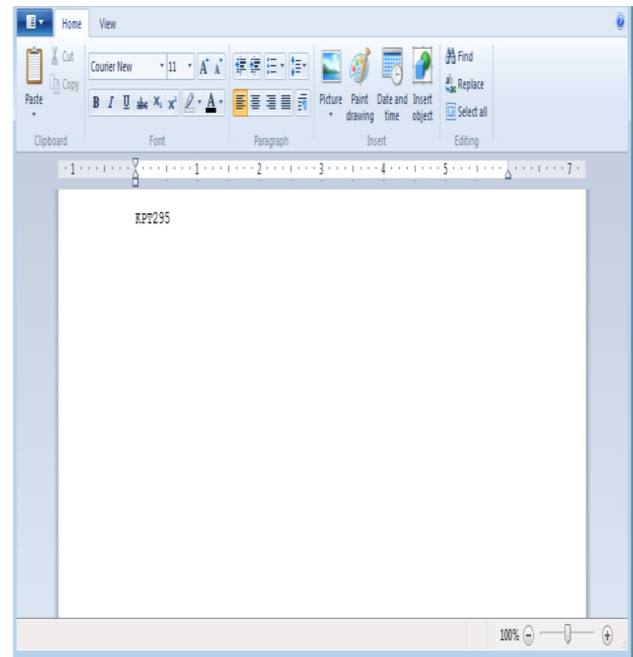


Fig. 14 Number saved as txt file

information. Machine A is configured as the server which sends the data from one station to the other.

Figure 15 shows the machine A configured to act as a server. Server set up is done using MATLAB server commands and graphical user interface is created to transfer the signal. Figure 16 shows the graphical user interface of the client which will be setup in the other station on machine B, for the reception of data.

Cloud computing is an internet based computing which provides shared data and resources available to other

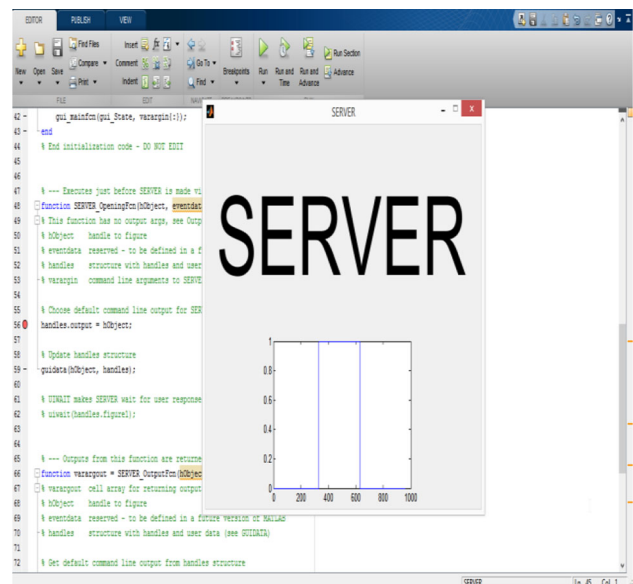


Fig. 15 Graphical user interface for server

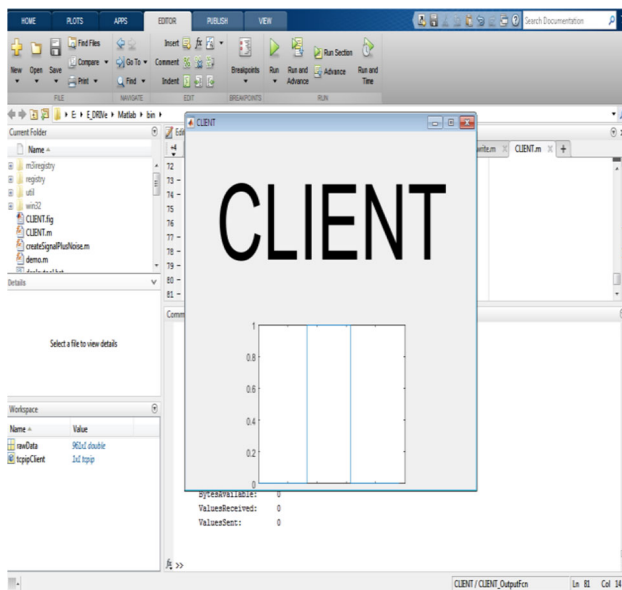


Fig. 16 Graphical user interface for client

system on demand. In cloud computing, servers storage and application are stored in the cloud, which can be accessed by different stations on demand. All the information is stored in the cloud, and whenever the information regarding any vehicle is needed, and then the data retrieval can be done with the help of getting accessed to the cloud on authentication. The acquired signaling data from the server is stored in the cloud using the internet. The client checks for the data available in the cloud and retrieves the data and processes it. Common area is shared between the server and client.

The experiment is conducted to transfer the data between the two stations. Two PC are configured for the same. One PC is programmed to act as a server and is configured in one station. Other PC is configured to act as a client, which is set up in the other station. The pulse of amplitude 1 volts is transferred from one station to another station via internet, indicating the presence of ambulance. Same set up is installed to send the information of vehicles which do not abide the announcement, to the nearest police station.

Figure 17 shows the machine A setup as server which is used to send the signal from one station to the other. Figure 18 shows the machine B, which is configured as client, which receives the signal from the server and do the necessary action.

Figure 19 shows the experimental setup of two machines which are configured as server/clients. Data is sent from server on detection of the event and client receives the data and does the necessary processing, required for further steps. Several DSP kits and FPGA kits are available in the market, which can be interface with camera,

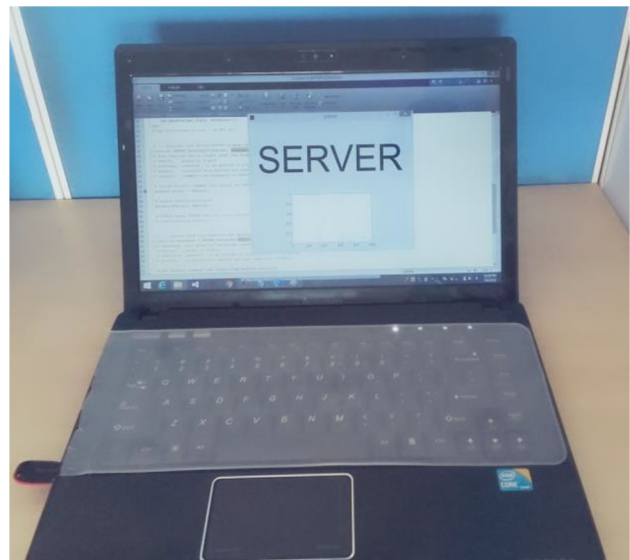


Fig. 17 Machine A configured as server

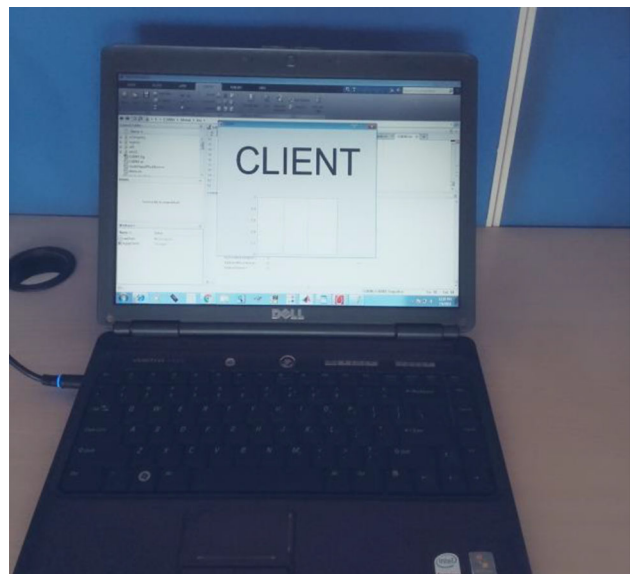


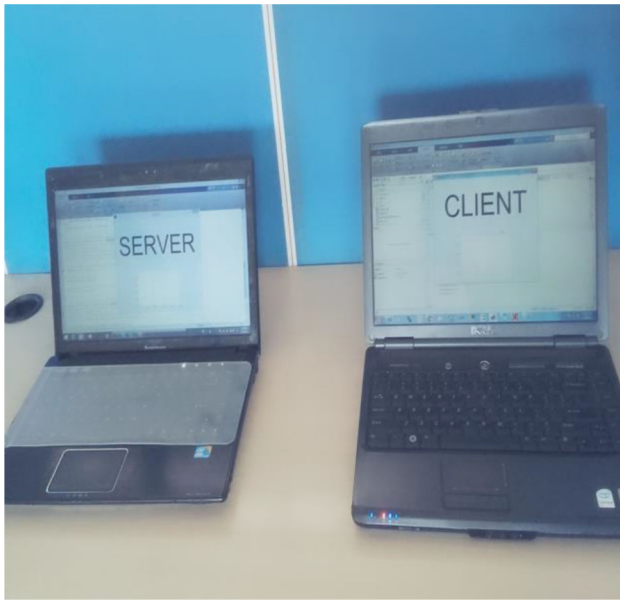
Fig. 18 Machine B configured as client

ethernet, etc. The scripts can be dumped on to the available hardware and can be installed easily in the field.

## 7 Conclusion

The increasing, population has given rise to the increased number of vehicles. Due to the increase in the number of vehicles, there exists a problem of traffic. Traffic is one of the major problems in developing nation. Thus there is a need for control of this traffic in very efficient way. In this paper we propose a system which helps the ambulance, which is stuck in the traffic to make its way. The patient





**Fig. 19** Server-client setup used to exchange information

inside the ambulance will be facing some severe problems, which has to be treated immediately. Due to the traffic, it is very difficult for the immediate treatment, as ambulance has to spend lot of time on road. Thus it will be a treat to the life of the individual in the ambulance. In this paper the design for ambulance detection is done and implemented using MATLAB. Once the ambulance detection is done then, the information is passed on to the next station, and announcement to clear the way for ambulance is done. There are many vehicles, which do not follow the announcement made and just neglect the situation. In order to eliminate this kind of behavior and take necessary action against the rule, violators, we have the separate system. This system continually keeps track of the vehicles and if found any violation, then the number plate detection of the vehicle is done. The number plate information is passed on to the police station and necessary action is taken against the owner of the vehicle by referring to the database of the vehicle.

The whole system is implemented using MATLAB and simulation is done. The data transfer between the two machines is done via internet using cloud computing and server–client is setup.

The proposed concept will greatly help in controlling of the traffic and also saves the life of an individual. Future scope include implementing the verified scripts on to the digital signal processors and deploy in the real traffic environment.

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