Analysis of Smart Sign Board Design for Road Safety using IoT

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Abstract

Traffic congestion is a major issue, particularly in urban areas where the number of vehicles on the road is continuing to rise considerably, amidst the delayed construction of road infrastructure. Researchers developed a number of traffic management systems to address this intractable issue. Despite the fact that there have been several studies on traffic management, there hasn't been enough done to examine the overall system for managing traffic on urban roads. This study aims to close the knowledge gap by providing fresh information about the current status of research into the complete Traffic Management System. The main goal is to give a comprehensive overview of the current methods suggested in the literature to address the issue of traffic congestion. Moreover, this work provides some ideas by which the road safety management can be done with the help of cloud services. As mobile technology becomes more extensively used, an evaluation approach for such smart transportation innovation strategies is explored with the help of mobile app. Therefore, based on the current research perspective, this survey offers a useful perspective on the deployment of IoT in the smart traffic management system.

Keywords: Cloud, sensors, sign boards, mobile web application

1. Introduction

In this present era, there are many problems in luxurious, comfortable, and fast-paced lives. One of the most serious issues is traffic congestion. It reduces both individual and societal efficiency by wasting valuable time waiting at traffic signal intersections. The main causes of traffic congestion in urban areas are the large number of vehicles, the low structure, and the inconsistent distribution of the traffic signalling system. However, the traditional traffic management system has not only found to be ineffective in accompanying the

increased number of vehicles with the use of police control and traffic light systems, but also incompetent in dealing with this increase in traffic on road systems. A phenomenon in transportation known as traffic congestion may involve large crowds, slowed vehicle speeds, and even lengthy vehicle queue. When there is a high demand for traffic, the interaction of the moving cars slows down the flow of traffic, which eventually leads to congestion.

1.1 Importance of Traffic Monitoring

For emerging nations that are overpopulated, road accidents have recently become a national calamity. The overspeed of vehicles ignoring the posted speed limit is one of the major causes of accidents in sensitive public areas like schools, colleges, hospitals, etc. and acute turning locations. By not reducing their vehicle speed in these delicate public areas, drivers put the lives of passengers, pedestrians, and other drivers at danger. The suggested system's primary goal is to run the vehicles at a safe speed in vital areas while reducing the potential danger of unintentional accidents and casualties. This project establishes a system to notify the driver about the speed limitations in particular regions and to automatically reduce the speed of cars in sensitive public zones. As a result, changing traffic lights on a regular basis is not a viable solution, and an Internet of Things (IoT) -based traffic control system is required to integrate with the existing traffic management system. As the population grows, so will the need for public transportation, which will exacerbate the problem. Furthermore, the safety and security of traffic mobility and pedestrian walkability are critical to improving all aspects of the traffic management system. The IoT-based traffic system which takes into account all these factors, is welcomed as a substitute for overcoming the limitations of the existing traffic system.

2. Related Works

In [1], queue detectors buried in the roads of Cambridge City's smart traffic management system detected traffic jams and sent information to the central control unit, which makes the appropriate decisions. Due to networking concerns, the centralised nature of the system may cause it to lag. The technology will not work in Pakistan since there are various types of traffic, including cycles and donkey carts that do not have number plates, according to the researcher who employed security cameras to identify traffic and OCR to identify the vehicles through number plate recognition. A VANET-based effective navigation system for ambulances was presented by Shekher et al., in [2] to handle the issue of determining the quickest route to the destination to avoid unanticipated traffic jams based on

real-time traffic information updates and historical data. Real-time traffic data and GPS integration led to the suggestion of a dynamic routing system. A metro rail network and a road transportation system were also included in the system to help ambulances navigate in real-world situations. To achieve a sustainable Intelligent Transportation System (ITS), a sensor integration technique has been planned for all cars in [3]. Sensor fusing was used to assure safety and security in various ITS components as well as traffic vehicle control to ensure a planned traffic regulation.

At crossings that are connected to one another by a network and are less than one kilometre apart, network management methods are utilised. Information on the transport situation from every network intersection is needed to calculate the control parameters. The coordination of the traffic lights in a certain control region is provided by network rigid control. The software suites created by the British Laboratory of Transport Research are among the most well-known and commonly used traffic control tools in the world. They are employed in more than 110 nations for several analyses and modelling projects. Using the software applications VISSIM and AIMSUN, engineers can also optimise stationary traffic signal switching routines in existing micromodels. In the case of a high amplitude of the instantaneous values of traffic flow intensity, hard control algorithms that are based on the assumption of repeatable traffic situations in the same hours of the day or days of the week cannot handle the situation, which will cause a sky rocketing queue and the ability to block the adjacent intersections. [3].

Table 1. Outcome with different technologies

References	Technology used	Drawbacks
Sabeen Javaid et al. [1]	Queue Detectors and OCR	Since data are centralized, network issues will happen.
L. Sumia et al. [2]	VANET based effective navigation systems	Difficult to implement in different kind of traffic.
Dmitry Elkin et al. [4]	Software applications VISSIM and AIMSUN	The algorithm used is determined at the network level.
Alberto Attilio Brincat [11]	CNN (Convolutional Neural Network)	Implementation needs a lot of practice to establish in real time.
Recommended method	Cloud connected with web application along with different types of sensors.	
Benefits of the recommended method	This intelligent connected sign boards integrated with web app will update automatically by using Python IDLE software.	

Novelty of this work: The user is notified of all potential road and traffic-related issues via a web application, which includes alerts and warnings.

3. Recommended Procedure

The speed limits and road signage in use today are static. However, under specific circumstances, the signs may be modified. If the road signs are digitised, situations may be considered when there are detours due to traffic congestion or accidents and adjust the signs accordingly. This proposal suggests a system that uses digital sign boards with constantly changing signs. Rainfall causes the roads to become slick, and the speed restriction is lowered. There is a web application that allows to enter information about road detours, accident-prone regions, and informational sign boards. Python IDLE is the required software for executing this idea.
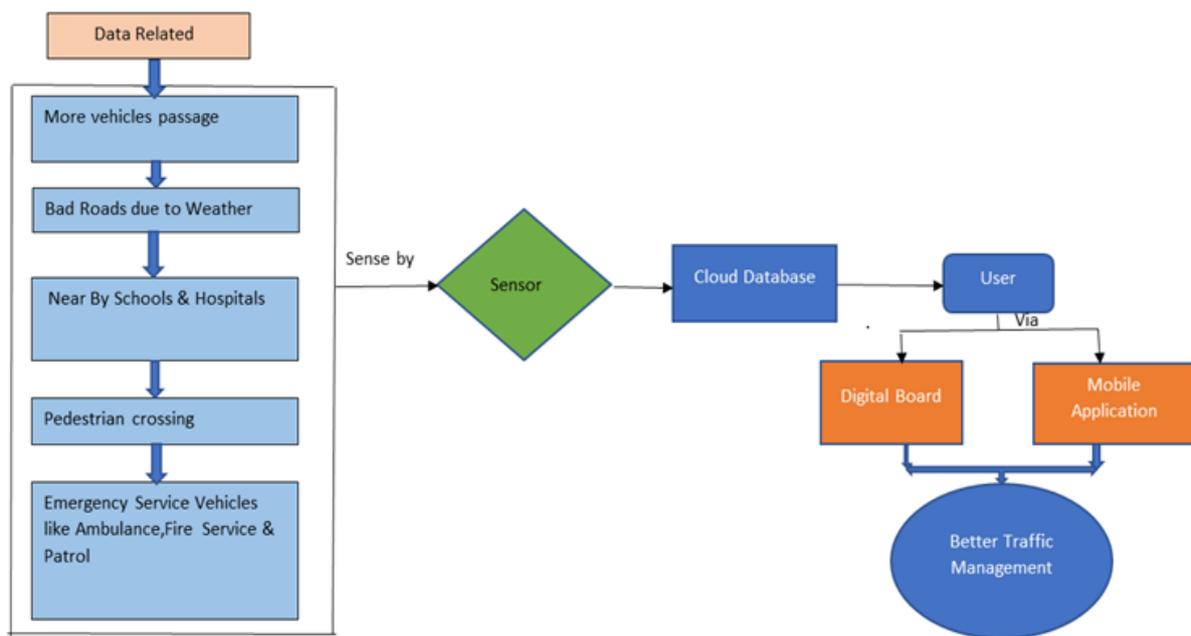

Figure 1. Flow Chart for IoT Based Traffic Management System

3.1 System needed

RAM must be with 4GB Processor. The configuration must be OS-Windows/Linux/MAC. Smart connected sign boards are used to replace static sign boards. These intelligent connected sign boards update automatically. The following are the steps to be followed: Learning about the Watson IoT platform is required. A connection is established with IoT devices, data are exchanged, and the results are shown on the Watson IoT platform. It is necessary to become familiar with the Open Weather Map API Service. Finally, the idea

of a sign with smart connectivity for road safety involves developing a web application that enables the user to interact with the device.

The IBM IoT platform receives the road sign values from Node-RED Web UI. By detecting traffic and road conditions with the use of sensors, the web application shows users the situation of roads due to weather conditions as well as other warning and alarm indicators. It is vital to create and configure IBM Cloud Services as well as IBM Watson IoT Platform. This web application will give all the notifications related to road safety. The optimum condition can be accomplished with the aid of road safety sensors, which use sensors like radar, LIDAR, ABS sensors, and odometry to measure the speed of moving cars. Sensors are compatible with the vehicles, determining every vehicle's speed and transmitting it to the cloud database, which in turn sends the notifications to the driver through digital sign boards and mobile application.

3.2 Road speed limit

Numerous traffic systems have fixed signal durations and sequences, which are only ideal for regular, stable traffic and not for erratic flow. When digital boards are placed over the traditional sign boards, the following modifications may take place. The sensors identify when the speed of the vehicle exceeds the safety limit, and transfer the information right away to the cloud, where it is promptly sent to the driver via the web application as a warning signal.

3.3 Congestion of traffic

Employees, school children, and other travellers are facing a major trouble in travelling due to the congested traffic, and they are reaching their workplaces late. Traffic is now a major problem in urban cities. IoT technology can be used to avoid this and have a happy journey. As all vehicles are connected to the cloud and equipped with compatible sensors, detection is simple, and if a location is about to become overly congested due to traffic, a notification is sent to the drivers via the web application. Given that the user receives all notifications via a web application, they have the option to take another route to enjoy a stress-free journey.

3.4 Slippery roads due to bad weather

Road conditions may be dangerous when there is terrible weather or as a result of bad weather. This situation leads to many accidents, and sensors like ABS sensors will be helpful

in this scenario. However, this scenario can be completely avoided when the information about the slick road condition is already shown in the digital sign board as well as the web application so that the driver can take a different route.

3.5 Safety of old aged people and children

While crossing roads, schoolchildren and elderly people are confronted with a potentially fatal situation. A life-threatening situation is being experienced by school children and old people as they cross the roads. In order to prevent this, sensors are used. The indications of old people and schoolchildren are displayed at precisely the right times through digital sign boards, and it is also announced via a web application as a warning sign to reduce the speed of the vehicle.
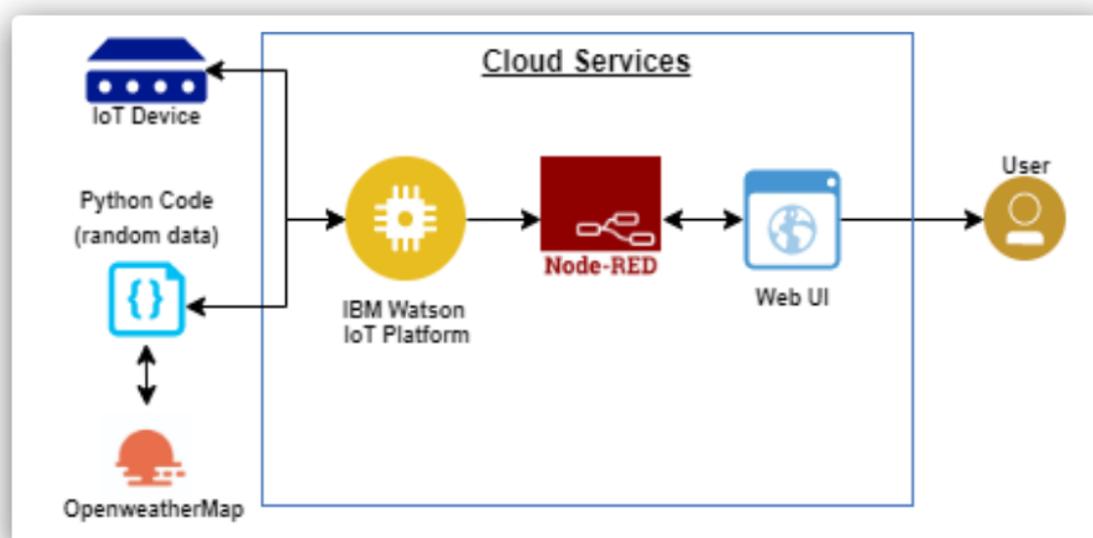

Figure 2. Technological architecture for IoT based smart connectivity system

Everything normally connects to the internet in a modern, computerised, and interconnected society. One such technology that links actual physical objects to the internet is the IoT. When the things or gadgets are placed on a digital platform, they can be effectively controlled at any time and from any location. To address the inadequacies of the current traffic signal management system, an IoT-based traffic signal monitoring system that monitors and regulates signal timing must be installed.

When IoT is integrated with traffic signal monitoring systems, it can perform crucial tasks like real-time surveillance and vehicle recognition, which involves monitoring vehicles employing sensors and estimating the number of vehicles that pass through the signals. When

an IoT-based smart traffic signal monitoring system is installed at the signals, it enables the observation of vehicle movement using cameras, RFID readers, wireless sensors, and other parts.
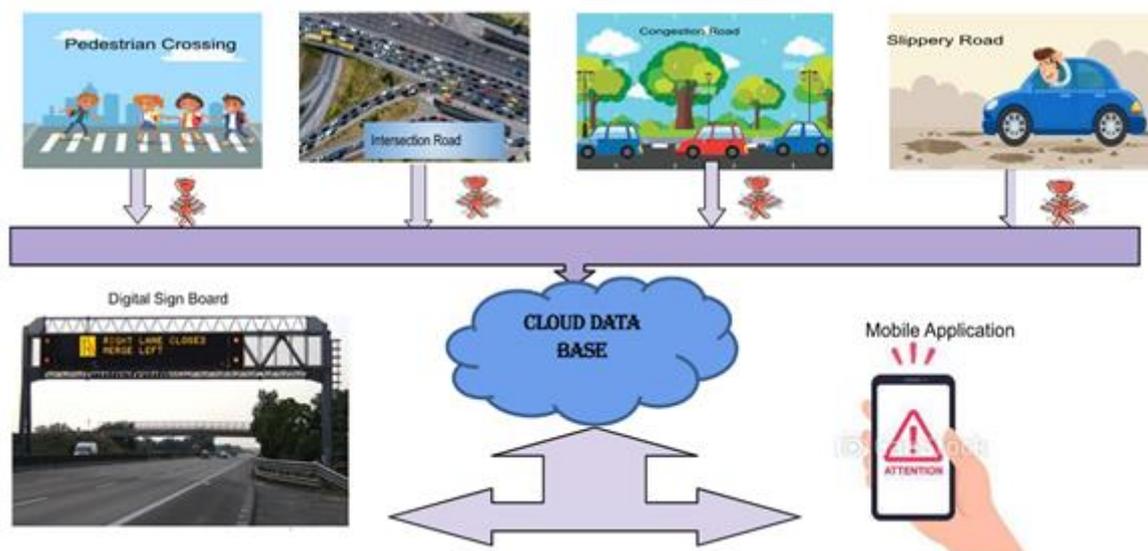

Figure 3. IoT based traffic management

Vehicles are equipped with RFID tags that store information about them. It is possible to identify other automobiles using the tag. The versatility of IoT-based smart connection for improved road safety is what sets it apart from other solutions. This flexibility allows it to guide drivers based on the conditions of the roads they are travelling on. IoT based digital sign board assists the user in easily making the optimal choice, whereas the conventional traffic light follows the same static pattern.

4. Expected Outcome

By applying the idea of using digital sign boards and web applications for notifying shared devices, the Internet of Things is used to improve driving safety and vehicle control. The goal is to use IoT-based sensors at an intersection in a downtown area to deploy machine learning. These sensors record data about the number of pedestrians and the traffic movement and send to the central hub. In order to understand traffic patterns and make future predictions, the system uses machine learning data-driven techniques.

Also, the law enforcement agency can improve the traffic security system by using the city's roadside data monitoring and camera surveillance systems. The presence of the video court surveillance system throughout the city reduces traffic control violence. Additionally, if

an accident occurs on the road, the administrative authorities can swiftly assist the victim. Real-time traffic data is used by the IoT-based control system to adjust the traffic signals and manage traffic loads. Many kinds of sensors can be employed like ABS sensors, weather sensors, LIDAR, RADAR, odometry, RFID and so on to achieve the better traffic management. The mounted sensors and cameras at critical traffic junctions gather data on the amount of traffic on the roadways and redirect traffic by frequently adjusting the traffic signals.

In order to reduce traffic congestion at the junction region, the traffic controller begins to operate the traffic signal from a suitable distance using big data analysis from the stored data. The weather sensors which are placed near traffic signals also control the digital traffic sign board to direct the vehicle routing appropriately because the vehicle density varies depending on the weather and the traffic hours. The web application will also notify if any pedestrians cross the roads or when there is congested traffic which will greatly reduce unwanted waiting time in traffic. Despite being more expensive to implement, the cost of the suggested model is inferior when compared to the lives of the innocent people.

5. Conclusion

This paper has examined the advantages of using IoT for managing traffic safety through mobile applications and digital sign boards. Despite the fact that many countries do not use IoT for road safety, it is essential to integrate it into traffic management in order to reduce fatalities caused by traffic accidents and to preserve societal tranquillity. Some of the benefits that might be realised, including the safety of pedestrians, the decrease in traffic-related confusion, the prevention of traffic-related stress and anxiety, and delays in getting to work have been discussed in this work. Therefore, this suggested approach is essential to achieve a world free of traffic congestion, which could prevent fatalities caused by traffic.

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