JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

A NOVEL METHOD FOR MANAGING ROAD TRAFFIC IN REAL TIME USING INTELLIGENT TRANSPORTATION SYSTEM

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Abstract***: The number of cars and trucks driving around on the roads has seen a precipitous rise during the last several decades. Congestion on the roads is becoming an increasingly widespread issue that affects everyone's day-to-day lives. The manual regulation of traffic by the officers of the traffic police has not been shown to be an effective method. Also, the predetermined time that was supposed to be established for the signal under all conditions (low and high traffic density) was not successful in solving this issue. A concept is given that makes use of the Internet of Things (IoT) to successfully tackle the difficulties that were previously discussed. Computing that is based on the internet is accomplished via the use of the cloud. This allows for the delivery of various services, including server, storage, and application, which are used for traffic management. The number of cars and the level of congestion at the junctions of a road are monitored by a network of sensors, and rerouting decisions are made on the basis of the traffic density on the lanes of a road.***

Keywords: ***IoT, Sensors, Microcontroller, TP, RFID.***

I. INTRODUCTION

The transportation system is intertwined with many aspects of our lives. To the extent that we are reliant on it in concerns pertaining to our everyday lives, it is a crucial component in the revival of the country's economy and society. Transportation facilitates the movement of millions of people, goods, machines, liquids, and tools in addition to monetary resources from one location to another. The Transportation Problems (TP) is the common term for an entire category of problems in which traffic and transportation play a crucial role. Resources, places, and transit modes make up the three main categories of TP's general parameters.

Sensor systems are large, distant networks composed of light, low-effort sensors that collect and distribute vital information [6]. Checking and regulating physical circumstances from a greater distance and with more precision is made possible with the help of remote sensor systems. When remote sensors and organising innovations are linked with GIS innovation, different areas of a city can be examined, and automobiles with excessive emissions may be discovered immediately. This is a significant step toward reducing urban pollution.

Despite this, it has become more difficult to identify viable modes of transportation due to the growth in population as well as the significant increase in the number of transportation options. Additionally, roads that are clogged with industrial activities, cargo, and traffic pose a great deal of issues for the average user, as well as for institutions and the government. Additionally, one of the challenges presented by the internet of things in congested areas is the difficulty in gathering data from individual vehicles without duplicating efforts. The following is a list of issues pertaining to transportation and traffic:

- Difficulty in acquiring real-time data of the transportation system and monitoring the flow of traffic while employing
- The difficulty in deciding the best course of action, particularly during high-volume times.
- Difficulty in determining the location of traffic hazards.
- The challenge of determining the sources of the massive amount of pollution caused by automobiles and their emissions.
- The difficulty in identifying the link between the amount of gasoline used and the emissions produced by the vehicle.

In recent years, “there has been a growing interest for resolving traffic concerns by providing excellent strategies that are based on the Internet of Things (IoT). Also, monitoring traffic in order to detect environmental pollution brought on by vehicle exhaust through the integration of a Geographical Information System (GIS), Electrochemical Toxic Gas Sensors, Wireless Sensor Networks (WSN), and the application of a Radio Frequency Identification (RFID) [4]. Additionally, exhaust from motor vehicles is a major contributor to not just environmental pollution but also noise pollution. Methane (CH4), hydrocarbons (HC), carbon dioxide (CO2), carbon monoxide (CO), nitrous oxide (N2O), nitrogen oxides (NOx), and particulate matter (PM) are all examples of gases that may contribute to environmental pollution” [5]. Particulate matter (PM) is also included in this category. Noise emission refers to the sound that is created by automobiles when they are operating on the road, particularly during periods of congestion. Keeping track of all of those different types of pollutants and emissions is not a simple task.

Identify and vehicle numbers are the source of a myriad of problems, including the waste of time and fuel, air and sound pollution, and even the risk of death from emergency vehicles that get stranded. In this research, the Internet of Things (IOT) and data analytics play important roles in the development of a traffic management system that operates in real time (TMS)[11].

II. LITERATURE SURVEY

This section discusses the research that has already been done on ITS systems that are being used in various countries, the route calculation method for “Advanced Traveler Information System” (ATIS), and vehicle identification utilising IOT for “Advanced Traffic Management System” (ATMS). Case studies of certain nations that make use of ITS may be seen below.

Septia Redisa Sriratnasari et.al (IEEE, 2019), analysed and implemented Jakarta's visitors' control system It was one of a number of strategic techniques that were tested and adopted in Jakarta. Inaugurated on January 2nd, 2019, it has been going on since before the 2018 Asian Games. This resulted in outstanding, though hectic, public transit for the first three months following the changeover[1]. Jakarta's transformation into a smart city may in part be achieved through improving public transportation. Smart cities may benefit from the development of intelligent transportation systems. Data collecting through the participation of people and other stakeholders is an important part of what it means to be "smart" in today's society. "Smart towns" are urbanised communities that have merged statistics and communication technology into their day-to-day government in order to meet the aims of increasing production, improving the quality of public services, and increasing the general well-being of the community. Indonesia's main cities, such as Jakarta, Surabaya, and Bandung, have already started implementing smart city ideas. The Ministry of Transportation in the transportation sector supports the notion of an intelligent city or an intelligent city coupled with the usage of ITS (Intelligent Transport System) software. Toll bills are collected using a unique On-Board Unit device (OBU) in the “Electronic Toll Collecting System” (ETCS), which controls traffic density indicators in real time, “Bus Rapid Transit” (BRT), “Bus Information Management System” (BIMS), which provides real time bus arrival statistics, and Movie and Trafi, which includes an incorporation of an OBU[1].

Seyed Morsal Ghavami (2019), the multimodal network's web-based ATIS system has been built. For the fuzzy bi-criteria multimodal network, he presents a modified version of the shortest route solution. Using open geospatial consortium (OGC) web services, users may access heterogeneous and scattered data from several organisations. Web feature services (WFS) were allocated to each mode of transportation and the relevant data was collected and transformed to a standard data format such as geographic mark-up language (GML)[3]. A web processing service was used to do fuzzy bi-criteria k-shortest-path analysis (WPS). Fuzzy set theory and fuzzy decision tables are used in conjunction with an online map service to show the shortest paths between two points on a digital map. Because of sequential data conversions and communication infrastructure limitations, OGC standards might break down when dealing with big data collections. A solution proposed by the author would be to collect data from various sources, send it to the central server, and then update it at regular intervals. Another option is to put urban data sources in an XML data file, which will allow for quicker data retrieval, querying, and transmission[3].

Ceder and Yu Jiang (2019), focused on developing techniques for route directing public transportation utilising smartphone apps to gather real-time information that is available to the general public on how to plan travel[15]. A k-weighted strategy is used both to determine the shortest route possible and to determine which paths lead to the shortest destination. Within the framework of the k-shortest route guidance algorithm that has been presented, weighted trip costs for a variety of public transportation attributes are estimated. When compared to shortest route methods that use the conventional shortest path algorithm, k-weighted short paths have an average decrease in the most essential feature of each traveller of 12.3 percent, and JND-based short paths have an average decrease of 13.4 percent. Both of these figures are lower than the shortest route methods using the conventional shortest path algorithm[15].

Paolo Delle Site (2018), was produced from the fixed-point states of an assignment procedure that occurred on a daily basis. The inclusion of inertia effects in route choosing is one of the steps that MUE takes beyond what is currently considered the state of the art. Other milestones include the “simultaneous consideration of predictive and static ATIS”. This study presents the first application of a thorough equilibrium model to a genuine network, albeit one that is on a small size, in order to evaluate the effects of ATIS market penetration and inertia. Study subjects are divided into three categories according to the types of traffic information they have access to: those who have predictive information, those who have static information and are complying, and those who do not have access to ATIS and are noncompliant. For the purposes of this study, a heuristic technique was used to calculate the traffic flows, route travel, and route travel[4]. The method will provide a series of route flows that are viable, meaning that they will fulfil both the demand and the non-negativity requirements. A linear-in-the-inaccuracy compliance rate function has been considered for both the model and the applications presented in the study in order to keep things as simple as possible. The calibrations of the compliance rate function as well as the investigation of the effects of additional compliance rate parameters and functions on MUE are tasks that will be carried out in further research[4].

Mariagrazia Dotoli (2018), ATIS's efforts to assist effective travel planning in a multimodal setting are the focus of this article. Novel Advanced Traveller Information System (ATIS) based on new, multi-agent system architecture was proposed by him for co-modal passengers' transportation. Passengers' travel plans may be tracked and managed using this technology on numerous transportation modes. A distributed framework for multi-agent systems was selected because of its ability to break the task of trip planning into smaller, more manageable tasks[5]. Carpooling and public transportation may be used in tandem in order to maximise service penetration, which isn't possible when using just one mode of transportation. Co-modal optimization allows for this service penetration. Because of the co-modal optimization, both private and public services may be used. The shortest route in this topic is one that employs the fewest feasible vertices to link two points. One technique to find the fastest route between these two locations is to add up the weights of the edges on the path and then calculate the length of that path as a result. As a result, the shortest route is the one that has the lowest weight between two points in the route's itinerary. Dijkstra's technique is used directly to maximise locally essential characteristics such as trip duration, total travel cost, and so on since it is considered an optimization problem of a very small scale. Several operators are hesitant and not yet ready to communicate their data inside the same information system because of possible legal and political ramifications. ATIS may not be suitable for large-scale usage because of these limitations, and the inability to update data may be considered a fault of the system[5].

Abida Sharif, Mudassar Khalil et.al (IEEE, 2017), These authors describe an STS model based on real-time traffic data that is both more cost efficient and more equipped to provide service in the future. At 500-meter intervals, sensors are placed in the middle of the road to identify vehicles. People's real-time traffic data may be collected and sent through the Internet of Things (IOT). Big Data analytics are based on real-time streaming data. There are several ways to use predictive analytics to measure traffic flow and give viable solutions. It's simple to use features like the app-based traffic updates and the current road-based vehicle strength. The internet of things may be used to acquire data on automobiles that are equipped with these technologies. This kit incorporates all of the latest sensors and capabilities offered by Intel.

When we connected all of the sensors together, we ran a series of tests to discover which location on the road was most effective. Keep the sensors close together even if you don't get improved results. Up to five sensors may be linked together using an Internet of Things kit. They can talk with one another and share information by being connected to a network. It continues to search for vehicles and enter new data into the enormous data storage and processing system.. This procedure also yields information about the sensor's identification. Each item of data should be properly analysed and computed. Many factors must be taken into account when determining the strength of individual sensors and the addition of new sensor inputs, as well as the ability to leave vehicle data on the road. Cars may be detected every 500 metres using a low-cost sensor at intervals of 500 metres[6].

Mohammad Hossein (2017), the architecture of the Interactive Traveller Information System (ATIS) (ITIS). This configuration allows for communication in both directions between the ITS system and the final user. Smartphone This design collects useful data from moving vehicles by using acceleration sensors, global positioning systems (GPS), and cameras. ITIS uses cellular communication networks to relay data on a vehicle's position as well as information about the driver's behaviour. The user will always be presented with the most up-to-date and efficient path to take after the server has received all of this information. This layout scales up quite well, both in terms of how it is used and how well it performs. In this scenario, the use of the system may be beneficial to all drivers, and all drivers are permitted to make use of it. The need that all drivers use smartphones, which would call for significant amounts of computing on the server side, is one of the problems with the system that is now in place. The lack of any established methodology for the assignment of traffic is another key shortcoming of the system[7].

Abdel Fattah (2017), the time-dependent shortest route method was suggested for the purpose of determining the shortest path. It is dependent on the "closeness" of the node to the destination node, which is determined via a heuristic technique. When an algorithm is being used, the virtual route acts as a conductor for both the search space and the parameter. Calculating a virtual route, which is basically a Euclidean distance between the source and the destination, with the aim of reducing the search space is the primary criterion for determining whether or not a technique is optimum. This criterion determines whether or not a method is optimal[8].

Liao, Chun-Hsiung et.al (2015), had covered the fundamental principles of the many techniques that may be used to route selection. “Examples of such methods include the advanced vehicle control system (AVCS), the advanced traffic management system (ATMS), vehicle routing problems (VRP), network assignments, and the route choice model”. These examples are all very well-known. It is useful to develop an effective traffic system via individual-foundation issue solving, and the route choice problem is one of the contributing factors. The influence of traffic information on the routes chosen by travellers is an essential component that has been included into work linked to this topic throughout the course of the last several years. In this work, the notion of a Bayesian is applied to the route choice issue that arises when travellers are attempting to maximise the degree of pleasure they get from their route choices. In this study, a Bayesian model is used to analyse the influence that this heterogeneity has on the routes that travellers choose to take. It was his contention that the usage of ATIS brings to light certain differences in the sorts of travellers and their ideas[9].

Xipeng Zhang et. al (2015), worked on an “Intelligent Path Guidance System” (IRGS) that further offers the shortest possible route based on data. The IRGS system was broken down into four sections: A system for collecting data on the road network. System for Collecting Data on Roadways These are simple sensors that collect data on the road network, such as the number of vehicles currently on a certain route. They are used. The Car Mounted Terminal System includes a GPS module and a GIS module and is mounted in the user's car. The desired destination may only be provided by the user from inside this component. A Traffic Guidance Data Communication Subsystem: “Vehicle Mounted Terminal System and Road Network Data Collection System are connected by this component's responsibilities”. Every single one of these communications was made using a wireless channel. The Data Communication Subsystem helps this component acquire data from the Vehicle Mounted Terminal System and the Road Network Data Collection System. The Route Optimizing Subsystem may then utilise this information. In addition, it provides a list of the most efficient routes. This system uses the Bellman-Ford technique to find the quickest path to the user's destination. In order to guide the driver, the shortest route approach might be used. Improved road infrastructure use, reduced traffic congestion, and enhanced network performance are all possible outcomes from IRGS deployment[10].

Jianqiang Wang' (2014), An innovative technique that makes use of graded information feedback to increase accuracy and latency in information feedback was shown with the help of ATIS-based two-route systems. In the strategy that is being given, the flux mean velocity and density data are utilised as inputs for the fuzzy C-means clustering method, which is then used to detect the traffic situations. The findings of the previous cluster centres were utilised to find out where the real-time traffic was on the road, and based on those results, the ideal routes were selected and picked. Using a VDR model and a two-route scenario, a fuzzy algorithm is used to identify which of the two routes is the best one to take. This technique is helpful in calculating the path that will take the least amount of time to go. The author places a major focus on researching graded traffic data and analysing the GIF approach in the context of a scenario involving two routes[11].

Praveen Kumar (2014), the objective of this system was to be a part of the web-based geographic information system (GIS). As a component of current web-based public transportation systems that use geographic information systems (GIS), this system is designed (GIS). As part of the ATIS Web GIS-based system, users have access to GIS capabilities over the internet, as well as geographical data that was utilised to build the system's functionality. It has also been possible to construct an algorithm for route planning by integrating online GIS with an algorithm based on the Ant system. An ant system was used to develop the procedure. The purpose of this approach is to find the quickest route between the different bus stops that have been provided. Using Map Server, an open-source online map server, this research describes an ant system algorithm that was used to identify the shortest path in Chandigarh, India, using the approach that was created for the web GIS based ATIS system. For the study region of Chandigarh, India, the ATIS system was built. The Chandigarh urban study zone in India provided the idea for the ATIS system's development. There is a three-tiered logical architecture utilised to give GIS capabilities to users through the internet that is examined in this paper. The same researchers that did the prior investigation were involved in this study. The ant system with pheromone intensity that was used to find the quickest path was developed in C# and connected with the ATIS web page's features. This was carried out in an effort to discover the quickest route. The present technique uses a mathematical approach to pheromone intensity; the inclusion of artificial intelligence has the ability to increase wiser efficacy[12].

III. STUDY OF INTERNET OF THING

The term "Internet of Things" (IoT) refers to a worldview in which everyday things are outfitted with sensors, actuators, and processors so that they may communicate with one another in order to satisfy a pressing need[16][17]. Another description of The Internet of Things (IoT) is the system of physical goods or "things" fitted with gadgets, programming, sensors, and system networks, which allows these objects to acquire and exchange information. There is no question that the Internet of Things is not a single invention; rather, it is a collection of several innovations that collaborate with one another side by side Figure 1.

Figure 1: IoT overview

Internet of Things: How IoT Works

According to, in much the same way that the Internet has changed the way we work and communicate with one another by interfacing us through the World Wide Web (WWW), the Internet of Things plans to take this connectivity to another level by connecting a multitude of devices all at once to the internet in order to simplify interactions between machines and between machines and humans. The Internet of Things is made up of a number of different components, the most important of which are the sensors and devices, the connection, the data processing, and the user interface (Figure 2).

The vehicle tracking system makes it simple to employ rout sensors and intelligent display systems, both of which assist drivers in determining the most efficient path across the city for parking their vehicles. The benefits of this administration are various; for example, the shorter amount of time it takes a vehicle to locate a parking place results in a reduced CO output from the vehicle, less troubles with traffic, and ultimately happier inhabitants. The IoT foundation is truly able to control the parking facility for motor vehicles[25][26].

We can also understand the "electronic confirmation arrangement of stopping and finding spaces reserved for residents or disabled people, such as NFC (Near Field Communication) or RFID (Radio Frequency identifiers), see (Figure 2)[27], which provides a superior help to residents who can utilise those openings and as an effective instrument to recognise any infringement quickly" (Figure 2).

Figure 2: Vehicle Tracking

IV. DIFFERENT METHODOLOGY

Traffic simulator

SUMO, which stands for "Simulation of Urban Mobility," is a small traffic recreation package that is available as open source and is widely used in a variety of projects involving the management of transportation and automotive systems [30]. In SUMO, the process of developing vehicles is often imitated using line techniques, and individual vehicles are transferred between these lines. In a similar vein, SUMO provides very fine-grained control over the cars that are connected to the system through the Traffic Control Interface (TraCI). TraCI is an acronym that stands for "street traffic and system test systems interlinking strategy." It gives us the ability to monitor the progression of cars while the simulation is being conducted. Through the use of TraCI, we are able to recoup values like as the speed of the vehicle and the amount of gasoline it consumes, as well as manage their statuses such as changes in speed and route. SUMO is a driving practise modelling system that may be used for any purpose and has the goal of controlling any huge amount of vehicle flow. In order to prevent an accident or going through a red light, heading would be carried out in a manner that is compliant with very restrictive physical limits[31].

Traffic Analysis Zone

A geocoded trip request's smoothed thickness surface is used to determine how the TAZ should be configured. The computation intends to keep the amount of data that is lost to a minimum while yet maintaining a consistent depiction of the beginning point and the end aim of each journey. Worked edges are defined by their discrete representations via zones, and the focus is on the trade-off between quantifiable exactness, geological error, and the level intra-Zone excursions of the succeeding origin-Destination (OD) grid. Through zones, they are reduced to their most basic form[30].

The cloud stores all of the information that is included in the database, which includes details on users, vehicles, traffic offences, the appropriate speed limit for each road, the locations of each vehicle and road, and so on. The information needed to identify and approve these vehicles, as well as keep track of their conditions, maximum speed, driving range, and other safety precautions, is kept in the network of these vehicles. In order for the authorities to effectively monitor car registrations, available users, incoming applications, traffic violence and offence, as well as traffic flow, they are provided with premium perks. On the event that a VIP patrol or any other unavoidable closures in the road take place, these authorities have the ability to access and change the blockage of routes, allowing users to choose an alternative path. The notice is used to inform all potential commuters near the closed route, allowing for congestion to be avoided as a result. The currently logged user will be penalised according to the governance fines for committing traffic offences such as riding a motorcycle without wearing a helmet, exceeding the safe speed limit, and other similar offences that can be captured through devices that identify the number plate of the vehicle. Signal lights, digital speed metre boards, and other such items are also included among the many traffic gadgets. These may be altered according to the current state of traffic on the road that is being considered or the route that is being commuted. On the basis of the network of sensors and vehicles that are used in the IOT module, a rerouting algorithm has been developed in order to divert ambulances to low congestion positions[21][22].

Real network with real data about transportation

Data and a road network are needed for anybody working on a traffic simulation. We do not need to use the real data in order to run simulations of traffic and transportation models. And suppose the number of cars, their data, and their itineraries from one end of the network to the other, all while keeping in mind that we are working with an actual street arrangement that was imported from OpenStreetMap (OSM).To get the OSM map, we go to the site https://www.openstreetmap.org.[28].

Once we have the routes network of a genuine traffic zone using SUMO, we will continue. In a similar fashion, employing a Quadcopter to differentiate and monitor the traffic conditions near there is recommended. We can either create the management of traffic using TraCI and SUMO, or we can acquire reports for decision-makers. Both of these alternatives are available to us. For the purpose of producing reports, this thesis makes use of an expert system that operates on data and analysis. An expert system is analogous to a computer programme, and this computer programme is an Artificial Intelligence (AI) programme [19][20].

V. CONCLUSIONS

A fresh approach to dealing on traffic and transportation issues as part of an intelligent strategy was given in this research report. In order to extract information pertaining to transportation, we built our system with the goal of working with actual data while simultaneously using a simulation software. We were able to establish a network of a real region using our new system, as well as give journeys on this network. In addition, we were able to calculate the direction that trips on the network took as well as the number of cars that were on each trip. In our system, we were able to get information that was difficult to obtain in the actual traffic environment, in particular for a significant number of cars. This was particularly true for situations in which there was heavy congestion. We are able to gather information on the routes that were taken to go from the origin to the final destination, including which edges were traversed along the way. In addition, our system tracked the data of every car connected to the network and gathered information on things like GPS, speed, and time, which we referred to as Floating Car Data (FCD). In addition to that, we were given the emissions that were produced by the cars during the real simulation phase, as well as the lane change files and the raw vehicle position dumper.

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