AI Based Wireless Sensor Networks in Real Time Traffic Monitoring using Spherical Grid Routing Protocol

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***Abstract*— the crucial part of the smart traffic management mechanism has been a collective power stream of vehicles, including cars and bicycles. A tourist's stream varies through the day, so it is very important to adopt this Traffic Control Approach to gain a versatile charge of the time of traffic lighting. The Internet of Things, an integration of Wireless Sensor Networks, has nearly every part of life (WSNs). A smart city is a new concept, and it is introduced through smart nodes such as smart parking, health centers, smart infrastructure, and banking in the real world. In this article, using a smart city wireless sensor network, we have presented an adaptive traffic management system. Our device has various nodes in the area, including routes, artifacts, and traffic signals, and each node is connected, and each node shares the traffic rate with the vehicle info. In terms of distance and time, they also have faster and more traffic-free paths. This paper introduces and analyses a novel configuration of a wireless sensor network system using WSN-Spherical grid routing for traffic jam detection and avoidance. We propose to investigate how techniques of artificial intelligence (AI) can be used to help wireless sensors accurately capture a measure of interest within the sensor network constraints. A machine that is also used for the control and surveillance of traffic. The main principle of this paper is to provide a routing-based framework to provide useful real-time information to avoid congestion and minimize delays and to use its metrics to measure network performance.**

***Keywords*— Emergency vehicles; smart city; Traffic; intelligent traffic monitoring system**

I. INTRODUCTION

Each part of the sensor node in the Wireless Sensor Network (WSN) consists mainly of sensors, processors, memory and radio transceivers. Depending on the application concerned, each sensor node is responsible for sensing input attributes such as temperature, humidity, or pressure and forwarding the sensed data to the destination using optimized energy-efficient routing routes. The general WSN structure as seen in Figure 1. In Wireless Sensor Network implementations, there are currently several algorithms for routing sensor-sensed data. Sensor nodes can be used more reliably to execute a particular role for connectivity purposes with the effective use of their energy in different domains depending on the need & use of resources. As a consequence, WSN is commonly used in environmental inspection, remote control device, nuclear source identification, agricultural & farming activities, telephone, military and surveillance.

Traffic delays and vast numbers of collisions are becoming increasingly traumatic in urban and regional areas, leading to drastic impacts on the economy, public health and the environment. As seen in figure 1, existing traffic control system solutions detect vehicles in predefined locations. Wireless sensor networks (WSNs), which are made of cheap and compact sensors that connect wirelessly and feel the ambient world, are more advanced in embedded systems and wireless technologies. This technology has great potential to solve the current Intelligent Traffic System challenges (ITS). With WSN, data can be sensed, interpreted and transmitted using various types of motes to optimally handle dynamic scenarios and allow real-time adaptive traffic control systems. Information of interest includes location, state of traffic, local weather, photos, acceleration, etc.

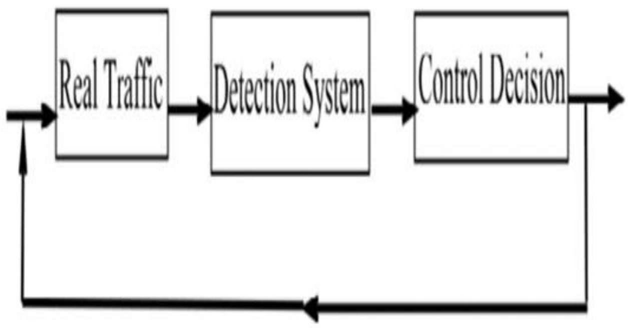

Figure 1. Mote System Process

II. PROBLEM STATEMENT

Focusing now on the implementation of ITS, consumer's typically just need to know a rough approximation of traffic, e.g. four-level data: no traffic, low density, medium density, high density or traffic jam. Any of the systems currently suggested in these situations are too sophisticated and costly because they are conscious of vehicle identification, Counting and measurement of other parameters which are not included in this paper. With these basic 4 levels of knowledge, in order to avoid crowded roads or congestion, it would be appropriate to be able to make a correct decision on which path to take and thus obtain the final objective of avoiding congestion. The main concept in this paper is to include an easy but effective routing scheme based on the WSN-Spherical grid to provide valuable information in real time to avoid congestion and minimize delays.

III. RELATED WORK

Traditional community traffic management technique is inadequate to address reliable data storage and query needs in real time with both the fast output of traffic and the highly productive system strike processes. The way of monitoring

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visitors to a large-scale network web network has therefore become an important challenge for community stability management [1]. The author points out that while NetFlow is a brand-new system monitoring application that has four main purposes: it can use File Overcome to accumulate NetFlow in real-time; it transfers the data based on Logstash; it also keeps the data from Elasticsearch, analyzes and shows the data in real time via Logstash; Our strategy will be effective in responding to 100 million NetFlow responses, the experimental findings suggest. It should meet the criteria of real-time surveillance in order to obtain a large system-focused traffic and provide the basis for the system security controller [2]. We will only see two or maybe more than just two machines in a structure; depending on the topology used, just about any computer can communicate to each other. For example, at a straightforward point-to-point topology, only two devices will talk to each other, as well as at a net topology, each single device can talk to the product [3] together. It warns the planner that the handshake feature is running when the system is coupled with a new device. If a car (symbolized using a node) joins a system, the very same solution is placed in a way so it will become part of it. Just as cars have different registration rates, a particular MAC address is used by nearly every node in a machine [4]. Whenever a current device connects the system or, for example, the car reaches the reach of different cars, then the telling is generated to see their system's various participants. The traffic congestion has been attributed to some high numbers of cars on the street, and the range of cars on the trail is increasing regular. It will become important to organize the visitor stream in the manner of a science approach. The system nodes need sensible assumptions in order to use a traffic jam to get around the road. The emphasis of this paper is on a focused traffic control framework that uses social media to effectively restrict travelers' roads and avoid any accidents or mishaps [5].

IV. PROPOSED ALGORITHM

A standard situation is seen where there is a road where, using four sensors, the length of the line of cars, that is, traffic density, is calculated and thus a four-level calculation is obtained. Also drawn is the access point (AP). This AP can collect input from the last sensor when a mobile network such as General Packet Radio Service (GPRS), Universal Mobile Telecommunications System (UMTS), or Long Term Evolution (LTE) is linked to the central station (LTE). It should be remembered that a multihop transmission mechanism is used for the system where motes connect with the motes in their neighborhood and it can be accessed with only the closest motes to the AP. This section is applied by a computer in our prototype, but it may also be inserted into the AP. As seen in Figure 2, the plan is to install this device on all roads where surveillance is needed.

.Figure 2. Mote installed across roadside using WSN

A sound warning unit installed on an emergency vehicle, a sound signal monitoring unit mounted on a non-emergency vehicle, and a monitor unit remotely placed on a non-emergency vehicle are used in the emergency vehicle detection system to warn the driver of an incoming emergency vehicle. As seen in figure 3, the sound signal-producing unit has a sound generator for the creation and transmission of a sound signal. A switch is used in conjunction with a siren to control the operation of the sound generator.

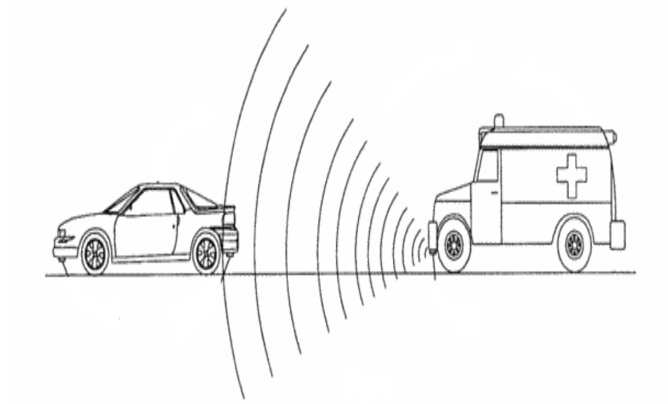

Figure 3. Sound signal being transmitted

Upon detection of a signal, the sound signal detection unit has at least one sound transducer to track sound signals and create an electrical current. To equate the currents from the transducers to pre-programmed patterns using Artificial Intelligence, a signal comparator is attached to the sound transducers. A signal output encoder attached to the signal comparator generates an encoded signal if there is a similar pattern and transmits the encoded signal via a transmitter to a remotely located display device. To equate the encoded signal to known patterns and enable at least one illumination system upon recognition of a matching pattern, the display unit has a receiver for collecting the encoded signal and transmitting it to a signal comparator.

The Urban Traffic Management System (UTMS) seen in Figure 4 refers to a system that incorporates sensor systems, cellular communications, data processing techniques and specialized technology to reduce traffic congestion, travel time, fuel consumption and priority-based signalling. The

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Traffic Management Centre (TMC) uses the Spherical Grid Routing Protocol (SGRP) algorithm to collect data for emergency vehicles from sensors and automatically transfers signals to the emergency vehicle. In figure 4, the diagram of a standard Traffic Control Centre is presented.

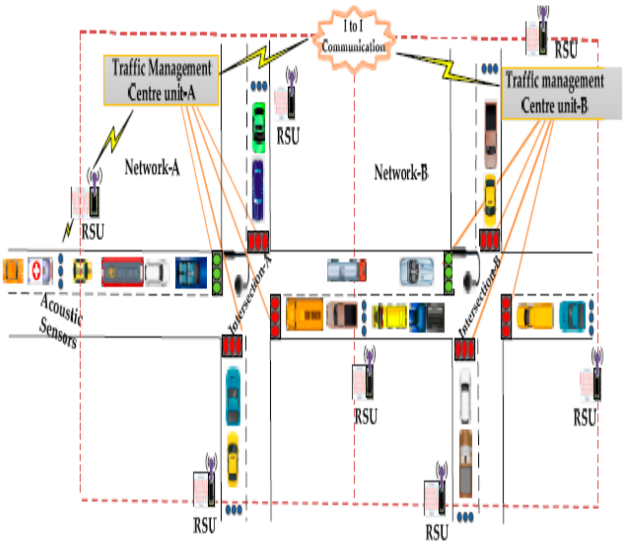

Figure 4. Architecture of a Traffic Control System [16]

The acoustic sensors receive and forward the siren signals to the Road Side Unit (RSU). A frequency measurement controller (Arduino UNO) to track emergency vehicles is included in the Road Side Unit (RSU). The RSU gathers from the acoustic sensors the siren signals and forwards them to the frequency measurement controller. Via the siren frequencies, the dispatcher identifies the emergency vehicle. The controller tracks the siren signal frequencies and determines the sum of the frequencies measured. The frequency meter sends a warning signal to the traffic signal controller (Arduino Mega) whether the frequency is between the yelp and wail levels. On receipt of emergency vehicle intelligence, the traffic signal controller stops the set sequence and light duration algorithm and executes the emergency vehicle dispatching algorithm. The data collection module receives and forwards data from all RSUs to the Traffic Signal Control Module (TSCM). The TSCM has two units, namely the traffic analysis unit and the handler of the traffic signal (Adriano mega). The camera sensor collects the real-time traffic footage and feeds the traffic processing unit to store and interpret the raw traffic data. The traffic controller unit gets data from the traffic analysis unit, such as size, velocity, traffic density, vehicle count, etc. The controller implements and sends its decision to traffic lights with the suggested algorithm. The machine continues its usual service, i.e. the set series and the light duration algorithm, after the passage of an emergency car. We address distance measuring procedures, vehicle counting processes, a distance-based algorithm for dispatching emergency vehicles, and the simulation environment below.

V. SIMULATION RESULTS

The feasibility of deploying an intelligent and dynamic traffic management system is investigated, which gathers priority information from vehicles using visual sensing techniques, provides the calculated information to the TMC with less delay using the PE-MAC protocol and uses this information to efficiently control traffic signals and thus emergency vehicles through the creation of a NS-2 builds and simulates the VANET model for the urban traffic management system seen in Figure 4. The parameters of the simulation are given in Table I. Figure 5 shows the network animator (NAM) of the built VANET simulation.

TABLE I. SIMULATION PARAMETERS

Parameter	Value
Network Area	1000 m × 1000 m
Propagation model	Propagation/Two Ray ground
Network interface type	Physical/wirelessphy
Interface queue	Queue/Droptail/Priqueue
Channel type	Channel/Wireless channel
Antenna	Antenna/OmniAntenna
Visualization tool	NAM, Tracing
Routing protocol	SGRP
MCA layer	IEEE 802.11p
Transmission rate	10 Kbps
Traffic type	CBN
Radio delay	14 m
Link layer type	LL
Packet Size	512 bytes
IFQ length	45
Initial Energy	90 J
Nodes Count	5 to 100
Speed	10, 15, 25 and 30 m/s

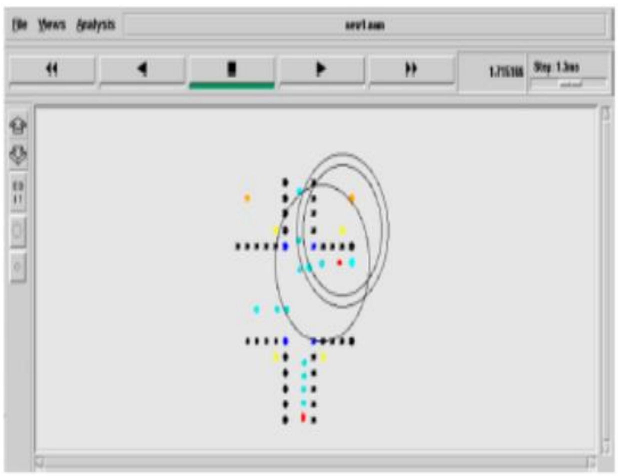

Figure 5. NAM of VANET simulation

The VANET model simulation for the urban traffic management scheme running under the proposed protocol is conducted in NS2 with node numbers ranging from 5 to 100. The findings of the simulation indicate the efficiency of the algorithm proposed. The scale of the network or the number of nodes indicates its effect on the average end-to-end delay, remaining energy, throughput, average end-to-end delay.

Simulation Results of Vehicle Counting and Distance Measurement Techniques

Using an AI-based digital camera rig, they captured road traffic footage of emergency vehicles. Defining a detection area is the following step. Thresholding, a process of image segmentation that distinguishes the foreground pixels from the background pixels, is the next step. To track and count the vehicles, the detection zone identified earlier is used. The bounding box emerges around the moving vehicle once a vehicle approaches the detection area. Techniques for distance calculation allow one to locate the closest rescue vehicle to the intersection. The distance between the emergency vehicle and the intersection was measured using MATLAB's Euclidean distance, Manhattan distance, and Canberra distance techniques.

Figure 6. Vehicle Counting and Distance Measurement data

VI. CONCLUSION AND FUTURE WORK

Today, the smart traffic system is a hot topic in large cities, especially when identifying future smart cities. An method to coordinating emergency vehicles in traffic has been presented in this article. The technique uses visual sensing techniques, car counting and time dependent warning transmission within the sensor network to incorporate the calculation of distance between the emergency vehicle and intersections. The proposed AI-based traffic control system for emergency vehicles using the Spherical Grid Routing Protocol (SGRP) is simulated using Network Simulator 2 and performance metrics are analyzed as transmitted packet, packet retrieved, packet transmission ratio, average throughput and residual energy average. In order to monitor road traffic and smooth flow of emergency vehicles, the AI based system is introduced. The planned work has the potential to provide to provide free way to the emergency vehicles along with reduce the congestion at traffic signal junctions. The new system will be combined in simple steps with the present traffic signal system to control and clear the way for emergency vehicles. In simulation environments, the proposed work using the SGRP protocol is planned and tested to track and manage real-time traffic and plan emergency vehicles in traffic. In poor weather and heavy traffic conditions, more study can be conducted on distance measurement.

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