Chapter 77
Communication Improvement and Traffic Control Based on V2I in Smart City Framework

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ABSTRACT

This article describes how soft computing techniques are tolerant of imprecision, intended on approximation, focus on uncertainty and are based on partial truth. Current real-world problems pertaining to congested traffic is pervasively imprecise and therefore design of smart traffic control system is a challenging issue. Due to the increasing rate of vehicles at traffic points in smart cities, it creates unexpected delays during transit, chances of accidents are higher, unnecessary fuel consumption is an issue, and unhygienic environment due to pollution also degrades the health condition of general people in a normal city scenario. To avoid such problems many smart cities are currently implementing improved traffic control systems that work on the principle of traffic automation to prevent these issues. The basic challenge lies in the usage of real-time analytics performed with online traffic information and correctly applying it to some traffic flow. In this research article, an enhanced traffic management system called SCICS (Soft Computing based Intelligent Communication System) has been proposed which uses swarm intelligence as a soft computing technique with intelligent communication between smart vehicles and traffic points using the vehicle to infrastructure (V2I) concept of VANET. It uses an improved route diversion mechanism with implemented logic in nanorobots. Under a vehicular ad-hoc network (VANET) scenario, the communication between intelligent vehicles and infrastructure points takes place through nanorobots in a collaborative way. Simulation carried out using Ns2 simulator shows encouraging results in terms of better performance to control the traffic.

DOI: 10.4018/978-1-7998-1754-3.ch077

1. INTRODUCTION

Basic characteristics of designing an improved traffic control system includes connecting traffic signals and traffic control centres with GIS enabled digital road map of the town using intelligent computational power of data analytics (Singh, Vishnu & Mohan, 2016) as a key module. In this context, the basic challenge lies in usage of real time analytics on online traffic information and correctly applying it to some basic traffic flow (Yuan et al., 2015; Lv et al., 2016). Data analytics tools (Puiu et al., 2016; Fotopoulou et al., 2016) takes data from the Traffic Management System (Singh et al., 2016) and using GIS mapping under real time support they provide useful information to the drivers in the vehicles and help reducing the traffic congestion. Additionally, basic tourist information such as visiting places, parking area and distance are also projected in real time basis on large digital screens installed at city centres (Kumar, Vasilakos, & Rodrigues, 2017) entrance points to guide the drivers towards their destination. This helps to save fuel and finally to save a lot of time spent in searching various visiting places (Ianuale, Schiavon, & Capobianco, 2016). The smart living style in metro cities (Kumar, et al., 2017) is also fulfilled as the environment becomes pollution free and more hygienic (Alshawish, Alfagih, & Musbah, 2016).

Soft computing techniques are tolerant of imprecision, uncertainty, approximation and partial truth. As the human mind can assess the probability of some event in chances, similarly soft computing methodologies also use some intelligent based techniques to assess real time problem with analytical models (Shamshirband et al., 2015). Basic components of soft computing includes Machine Learning, probabilistic reasoning, Swarm Intelligence such as Ant Colony Optimization & PSO (Particle Swarm Optimization), ANN (Artificial Neural Network, Fuzzy Logic and Evolutionary Computing (Huang, 2016). Swarm Intelligence is one of the constituent of Artificial Intelligence (Huang, 2016). In the proposed approach an Intelligent Swarm Smart Controller (ISSC) module embedded in nano robot has been designed to function during decision making in a smart traffic control system to divert vehicles in other direction at some stage of heavy traffic jam at traffic points. Depending on the traffic density a congestion level is set by the proposed algorithm and accordingly vehicles are re-directed towards less congested routes of other neighbor traffic points.

Swarm intelligence provides an intelligent approach to optimization problems in distributed manner. Its logic is embedded in nanorobots to collaboratively perform distributed tasks intelligently. The umbrella term swarm intelligence refers to the effort taken to design algorithm inspired by cooperative behavior of social insect colonies and other animals. Swarm intelligence helps us to find solution of distributed optimization problems in such a way that centralized control of global model is not required. In Vehicular Ad-hoc Networks challenge lies in application areas such as determining an alternate suitable route availability during congestion in the network. There are some appropriate algorithms which show that biologically inspired concepts provide a significant performance over traditional approaches. In the context of smart traffic control in the proposed approach, large number of nano robots are coordinated in decentralized and distributed manner at the junction points where an intelligent logic has to be applied regarding any critical decision in traffic points. Such controlling points include estimation of total number of vehicles, checking congestion status, arrival of new vehicles, decision to be taken for re-routing the vehicle in other direction or to continue in the same route, what should be the best strategy to decide how many stop points should be there in congested traffic, to control information regarding other traffic points etc. The idea used here is that multiple number of simple nanorobots which act as micro-controllers at various points can do complex decision-making logic in a collaborative and distributed way in a group. In swarm intelligence, the collaborative behaviour of social insects, such as