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Smart Traffic Control System and City Automation

Prof. Reena S. Satpute[1]
Computer Engineering
S.D.C.E, Selukate
Wardha, India.
reenasatpute@hotmail.com

Prof. Swapnil R. Telrandhe[2]
Computer Science & Engineering
S.S.G.M.C.E,
Shegaon, India.
telrandheswapnil@yahoo.com

Abstract - In this paper, we propose a smart traffic control and automation system for smart city. The system includes the self-managed signaling system, automated controlling system for traffic rule violation, task management system etc. for this system implementation the image processing system, RFID system and data mining technologies will used. The main aim of this system implementation is to avoid the harassment of traffic police and stop the corruption in police system.

By using RFID we can identify the vehicle, by using image processing we can control and automate the signal in that we are using thresholding, also some highbred algorithm will invent for smart signaling system and SVM is for taking smart decision.

Index Terms : RFID, threshold, SVM**.**

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1. INTRODUCTION

Internet of things is a booming technology in 21st technology, which is growing so rapidly, it is, estimated that by 2020, 26 billion devices will be connected to Internet according to Gartner. Different types of communication pattern exist and they are classified based on the type of transmitter and receiver. The most feasible communication pattern in IoT based Smart Traffic Management System to identify the Traffic Density is Device to Device Communication pattern in this context, where the density is sensed by data acquisition unit consisting of ultrasonic sensors and then transmitted to a Control Unit i.e., Raspberry Pi which processes the data and transmits the information to the users provided with an Android Application where they get a notification regarding the traffic density on that particular lane. By identifying the Traffic Density different applications involved in Smart Traffic Management System can be implemented like; Smart Traffic Light System, Lane Occupancy, Detection of pedestrians on footpaths and crosswalks, etc.[1].

Other methodologies like Inductive Loop Detection, Video Analysis, etc. can be used as data acquisition unit to identify traffic density. This system is not only for traffic density identification but also it will work for discipline maintaining in the traffic, which means the vehicles on the road will get monitored by the signal system and if any vehicle is breaking the traffic rule then the traffic control system will alert the vehicle driver by giving chalan or notice to home address or on email. Smart Traffic Control System will also be able to manage the signaling time. This means if one side of road is having heavy traffic but another side is having light one then smart system will activate at this time. The system will calculate the density by using camera and digital image processing then it will calculate the average timing to pass out the slot of stopped vehicles and according to condition of other slots timing of signals get managed which results in to low traffic load on road. Again another advantage is to reduce fuel consumption.

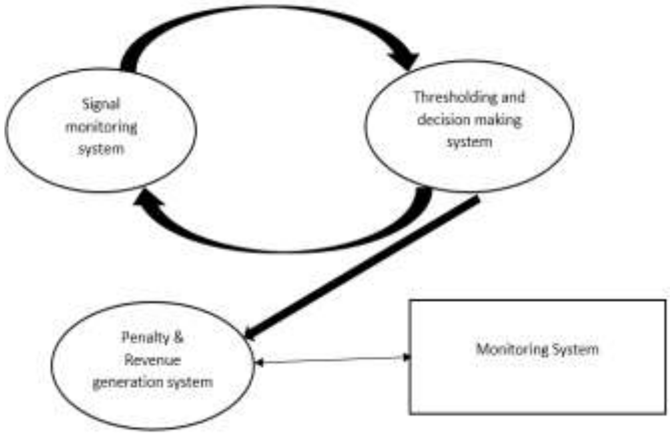

Fig. 1: Traffic Control System

A. SVM

The SVM is a supervised learning method. It is a good tool for data analysis and classification. SVM classifier has a fast learning speed even in large data. SVM is used for two or more class classification problems. Support Vector Machine is based on the conception of decision planes. A decision plane is one that separates between a set of items having dissimilar class memberships**.** The Classification and detection of brain tumor was done by using the Support Vector Machine technique. Classification is done to identify the tumor class present in the image. The use of SVM involves two basic steps of training and testing.

Linear SVM:

The training patterns are linearly divisible. That is, there exists a linear function of the form f(x) = w T x + b (1) such that for each training example xi, the function yields (f(x)) ≥ 0 if x for =+1, y and f (xi) < 0 for yi=-1.

In other words, training examples from the two different classes are separated by the hyper plane F(x) = w T x + b =0, where w is the unit vector and b is an invariable. For a given training set, while there may exist many hyper planes that maximize the separating margin between the two classes, the SVM classifier is based on the hyper plane that maximizes the separating margin between the two classes In other words, SVM finds the hyper plane that causes the largest separation between the decision function values for the "borderline" examples from the two classes. SVM classification with a hyper plane that minimizes the separating margin between the two classes. Support vectors are elements of the training set that lie on the boundary hyper planes of the two classes.

Non-Linear SVM

In the above discussed cases of SVM classifier also shown in Fig.2. Straight line or hyper plane is used to distinguish between two classes. But data sets or data points are always not separated by drawing a straight line between two classes [2, 3]. It can't be separable by using above SVMs discussed. So, Kernel functions are used with SVM classifier. Kernel function provides the bridge between from nonlinear to linear. Basic idea behind using kernel function is to map the low dimensional data into the high dimensional feature space where data points are linearly separable [4, 5].

A pattern gratitude network, which is a feed-backward network with tan sigmoid transfer functions in both the hidden layer and the output layer, is used. The network has only one output neuron, as there are 24 input vectors. The hidden layer neurons are 100 and the learning rate is 0.1. The momentum factor is 0.9 and total numbers of epochs are 500. The error is minimized by 0.001 and the performance of the classifier is evaluated by calculating accuracy.

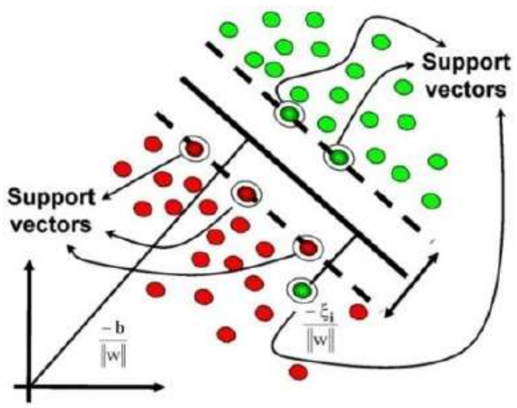

Fig. 2: The Classification Process of SVM

SVM are based on optimal hyper plane for linearly pair able patterns but can be complete to patterns that are not linearly divisible by transformations of unique data to map into new space. They are clearly based on a abstract model of learning and come with theoretical guarantees about their performance. They also have a modular design that allows one to separately apply and design their components and are not affected by local minima. Support vectors are the elements of the training set that would change the location of the dividing hyper plane if removed[6,7,8]. Support vectors are the grave elements of the training set. The problem of discovering the best hyper plane is an optimization problem and can be solved by optimization techniques.

Although there is not up till now a formal definition of "Smart City," it is widely accepted that the final aim is to make a better use of the public resources, increasing the quality of the services that offered to the citizens, while reducing the operational costs of the public administrations [9,10]. According to World Bank's estimates, in the case of investment unchanged, the development dividend can be increased by 2.5 to 3 times through the construction of smart city for a city with more than one million people[11]. According to one estimation, the specific effects of smart cities include: 10-fold return on the whole society, manufacturing productivity increased by 5%, the service sector.

2. METHODOLOGY

A. ACP Approach and PTMS

Urban transportation systems are typically complex systems. To utilize the research results from studying complex system and intelligence science is one of the difficult tasks. To address such problems in the management and control of transportation systems, such as new methods for the modeling, experiment, optimization and evaluation problems has become one hot topic [12]. Among them, ITS based on ACP approach, which promotes traditional traffic simulation to higher level and wider perspective, has grown maturity gradually both in research and applications and has been interested by the researchers throughout the world. The ACP approach can be described as the follows 3 steps :

1) By considering engineering, social, human and environmental factors together as a whole, synthesizing theoretical models, empirical models and data models, establishing the equivalent Artificial system for the actual system to address the model problem for complex systems (A);

2) Studying the interactions and evolution rules of the elements in the actual system by carrying out Computational experiments on the artificial system under both normal and abnormal conditions (C);

3) By connecting the artificial system and the actual system, carrying out Parallel execution by comparing and analyzing the behaviors of the two types of systems, referring and forecasting the future conditions, and adjusting the control and management Methods of the two systems accordingly (P).

Based on ACP approach, a new concept, parallel transportation management and control system, is proposed by Prof. Wang to resolve the optimization and evaluation problems in transportation Systems [13]. By connecting the actual transportation system and the artificial transportation systems, experiments can be carried on the artificial transportation and the optimization and evaluation can be implemented conveniently. The artificial transportation systems provide the hardware-in the-loop mechanism and general external interfaces, which enable the interactions between the actual devices and the artificial software modules. When the experiment is running in hardware-in-the-loop mode, the actual devices, such as signal controller and vehicle detector, can be embedded into the artificial transportation systems. In this mode, the actual detectors can access the traffic flow parameters in the artificial road network, and the actual controllers can send commands into the artificial transportation systems and influence its running status by changing the artificial traffic lights, and vice versa[8]. Besides generating MOEs for quantitative analysis, the execution process can also be replayed using 3D animation, which can show the movement process of vehicles in details both in space and time dimension.

B. Why is ACP for Transportation Systems?

The ACP approach was originally proposed in for the purpose of modeling, analysis, and control of complex systems, which have the following two essential characteristics:

• *Inseparability*. Intrinsically, with limited resources, the global behaviors of a complex system cannot be determined or explained by independent analysis of its component parts. Instead, the system as a whole determines how its parts behave.

• *Unpredictability*. Intrinsically, with limited resources, the global behaviors of a complex system cannot be determined or explained in advance at a large scope. The main feature of our method is that the optimization and evaluation are all based on the interactions between the actual transportation system and the artificial transportation systems. On one hand, comparing to using traditional simulation software or mathematics models, more factors can be modeled, thus reasonable scenarios can be generated, and higher reliability can be achieved. On the other hand, comparing to carrying out experiments using actual devices in field, the environment can be controlled and it is possible to carry out the experiments under abnormal conditions. Accordingly, the experimental cost can be reduced to a very low level and abundant results can be obtained easily. As a result, the feasibility and reliability of the experiments are improved.

As mentioned before, in order to obtain reliable result, computational experiments in various scenarios should be carried out. Besides traffic subsystem, the scenarios will also cover social and economic aspects, as transportation is connected with the environment tightly [15]. From micro activities, such as individuals' psychology and driving behavior, to macro phenomena, such as travel gross and travel distribution, all are influenced by the environment. The mechanisms by which environment influences traffic statuses are very complex and there are still many disputes about how to model the influences using a top-down reductionism method. However, for simple objects, such as individual vehicle and local traffic behavior, most of current conclusions about the influences that they receive from the environment are consentaneous. So if we set up models for simple micro objects and local behavior using these widely approved conclusions, the macro complex phenomena that emerged from these simple objects are also expected to be understandable and agreeable. This idea for modeling transportation system can be abstracted as simple-is-consistent and has been widely used in designing computational experiments based on ATS. It has been proved that, using this idea, ATS not only can model direct traffic-related activities, but also can generate difference traffic processes under various indirect facilities and activities conditions[14]. Thus, it provides us a natural way to study the influence of weather, legal, social and other involvements.

C. The New Generation of ITS Based on PTMS

In this background, a new generation of ITS, Transportation 5.0, is proposed by Prof. Wang in 2014. It is our belief that, though we are still in the early stage of CPS-based Transportation, it is time to promote the field of Computational Transportation as a research direction to integrate and lift the current work in computer simulation and computational analysis of transportation systems to a new generation, where powerful new computing methods, advanced sensing techniques, and big data in cyber, physical, and social spaces can be easily utilized—much like what has happened in computational mechanics, computational fluid dynamics, computational physics, computational chemistry, computational social studies, and many other computation. The architecture of the new generation of IT'S, which is a natural expansion and generalization of PTMS, is shown in Fig. 1.

Besides utilizing IoT and cloud computing technologies as the foundation, two characteristics are social transportation and agent-based systems. On one hand, Transportation is a direct result of human and social activities, thus, social and human dynamics must be considered an integral part of any effective transportation system design and operation and we must have social component explicitly represented in transportation research and development. On the other hand, the step from control algorithms to control agents is a natural development of control engineering in the age of connectivity and control will become an independent entity instead of an affiliated function in system design. Thus, the development of a theoretical framework for agent-based control systems will significantly advance knowledge of control engineering in this new age.

3. CLOUD AND SERVICES

Cloud computing caters to the idea of "local simple, remote complex" in parallel traffic systems and can help us to organize computing experiments for testing the performance of different traffic strategies. Thus, only the optimum traffic strategies will be used in urban-traffic control and management systems. This helps enhance urban-traffic management system performance and minimizes the system's hardware requirements to accelerate the popularization of parallel traffic systems. We propose urban-traffic management systems using intelligent traffic clouds to overcome the issues we've described so far. With the support of cloud computing technologies, it will go far beyond other multi agent traffic management systems, addressing issues such as infinite system scalability, an appropriate agent management scheme, reducing the upfront investment and risk for users, and minimizing the total cost of ownership. While carrying out the constructions of the actual system, the building of the artificial transportation system for Qingdao is also started[16].

According to the fifth census in 2010 in China, the population in the constructing area amount to 2 457 400.We generate travel plans for each individual in this area. In the artificial transportation system, each individual is modeled as one agent. The travel demand of one agent is generated based on his activity plan [17]. While all the agents are traveling and interacting in the virtual environment, the artificial transportation system grows up in a natural way. The distribution curves of the artificial population carrying out different activities in workday and weekend. Intuitively, It is also clear that the artificial traffic flows in weekend do not have morning or evening peak. Clearly, these results that generated by the artificial transportation systems have the same characteristics with the actual traffic flows [18].

4. CONCLUSION

In this paper, a new mechanism for the management and control of transportation systems, namely parallel transportation management and control system is proposed. The new mechanism is the result of the integration and fusion of latest advanced technologies, including social signal, agent control, IoT, etc. ACP approach involving modeling with artificial systems, analysis with computational experiments, and operation through parallel execution for control and management of complex systems, provide the solid theory foundation for the new mechanism. Social transportation and cloud computing platform are two important aspects of the new mechanism. Our research and development efforts are still in the initial stage, though some verification has been finished.

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