

Agentic AI Powered Intelligent Traffic Controlling System Adopted in Smart Cities: A Study

Nilanjan Das¹, Shashi Kant Gupta²

¹Post-Doctoral Researcher, Lincoln University College, Petaling Jaya, Selangor Darul Ehsan-47301, Malaysia, email id: pdf.nilanjan@lincoln.edu.my

²Adjunct Professor, Lincoln University College, Petaling Jaya, Selangor Darul Ehsan-47301, Malaysia, email id: shashigupta@lincoln.edu.my

Abstract

Controlling high traffic in the advance cities is pivotal tasks for seamless traffic management. Advancement of traffic management is highly essential to reduce congestion, pollution, and maintain consistent traffic flow to make communication faster. Cities are continuously growing due to the advantages of living standards and future prospects. Advance ICT based technologies integrated in traffic control to effectively control traffic. In this era Artificial Intelligence, become technological revolution and innovation. AI Integration helps to transform the traffic control system autonomous and intelligent. Agentic AI is advanced AI technology that make changes in advancement of traffic control system. Agentic AI in traffic control system reduce complexity of workflow and make in this study various issues and factor of traffics has been analyse. This paper comprehensively investigates implementation of intelligent traffic control system using Agentic AI in smart cities.

Keywords: Intelligent Traffic Control, Smart Traffic Management System, Artificial Intelligence, Agentic AI, Smart City

Introduction

Smart cities are the sustainable development of urbanization with emerging technologies connection [2]. Due to the rapid growth of populations in the cities at presents and in future, main issues in urbanization are pollution, resources limitations, and services demand [9]. Internet of Things helps to make sustainable urban ecosystem [1]. A four layer architecture such as sensing, transmission, data management, application are the significant in development of effective IoT enable solutions in smart cities expansion [9],[5]. In comparison with digital cities smart cities are enable urban system to make decision automatically, add perception, intelligent [7]. Development of seamless transportation and mobility is in high demands to make sustainable and efficient transportation and mobility in smart cities. Smart Traffic Control System is the major domain in smart cities to maintain seamless roadside traffic management and traffic flow consistently inside the cities. Artificial Intelligence and IoT technologies integration in construction of the Intelligent Traffic Control system infrastructure overcome the barriers in traffic management in smart and advance cities. But, Agentic AI in intelligent traffic control system is new and innovative approach to enhancement of traffic control system in smart cities development. In this paper, we focussed on the Agentic AI based approaches in development of intelligent traffic control systems. This paper investigates cases of Agentic AI based solution in Intelligent Traffic Control System and its enhancement. Limitations, challenges and future potentialities of Agentic AI in smart traffic management in smart cities are analysed in this paper.

Objectives of the Work

Followings are the core objectives of this study entitled as “Agentic AI Powered Intelligent Traffic Control System in Smart Cities: A Study”--

- To study about how traffic control system improved in addition with emerging technologies.

- To explore Agentic Artificial Intelligence and its impacts on the traffic control system implementation in smart cities.
- To investigate the applications, architecture, and development strategies of Agentic AI based smart traffic management in smart cities.
- To study the challenges, limitations in implementation of Agentic AI in smart traffic management system in smart cities.

Advancement and Future of Smart City

To extent smart cities efficiency, liability, resilience, and sustainability, smart cities are continuously progressing with integrated technologies such as IoT, 5G/6G, big data, AI, and edge computing. As per the experiments, there is large population growth up to 70% of global population in the year 2050. Climate changes, demand for best services, resources constraints are the factors in smart cities development. Human centric design with technological balancing advancing with governance, privacy, inclusion and equity extended in future for advancement of futuristic smart city. Various infrastructural development of smart cities progress extended in future. Core and key technologies become advancing continuously. Innovative technologies inclusion transform smart cities as more efficient, advance and sustainable.

Foundation of Agentic AI

Agentic Artificial Intelligence is the AI oriented system that act as degree of autonomy to engage in meet goals, decision making, use tools, plan multi step processes, with very minimum human intervention [6]. Unlike traditional generative AI, Agentic AI acts same as proactive assistant or like colleague. It responses on its environment, it reasons about how to obtain objectives, it acts, it monitor the results, and it iterates. According to the foundations level of Agentic AI, Transformers, Autoencoders, vision transformer, diffusion, Large Language models are introduced. Agentic AI era begins after the invention of Large Language model in the year of 2017, then also the Reinforcement Learning inclusion extent the agentic AI era. There for Large Language Model (LLM) and Reinforcement Learning (RL) are the pillars of Agentic AI. Innovation of prompt engineering begins the journey of Agentic AI in the year of 2020. Prompt engineering helps to create thinking by precisely developing prompt and it helps to increase the chain of thought process to split complex tasks into multiple tasks by the agents.

Intelligent Traffic Control System

In the smart cities, effective intelligent traffic system is required to control the heavy traffics in road junction point, crossing, and roadsides. In limited infrastructure based smart cities in developing countries, there is various complexities and issues to build up the intelligent traffic control system. Internet of Things, AI, Cloud Computing, and Block Chain are the technologies integrated in intelligent traffic control system solutions development [10]. Integrated intelligent system build with wireless sensor network (WSN) and allied technologies to observe road traffic density at intersection or junction, and in the parking areas at roadsides. Intelligent Traffic Management System model implemented with the integration of Internet of Things, Cloud Computing and Data Analytics [10]. Where, IoT systems used for collection of real time data by the sensors and cloud computing platform used for data storage and processing in association with data analytics that generate insights as efficient traffic solutions. Various challenges in terms of rapid urbanization and continuous vehicle growth are pollution, congestion, accident, delays, and insufficient resources used in traditional traffic control systems. Intelligent Traffic Control system solutions is developed to overcome the issues such as urban traffic congestion, inefficiencies and traditional fixed signalling systems of traditional traffic control system. This system solution build with sensors deployed at road side for monitoring traffic, there is graph based model helps to identify shortest route dynamically, and its guide driver for better route selection. Proposed model on intelligent traffic control system based on the adaptive signal control on the basis of real-time conditions, emergency prioritizations and in association with RFID security features [7].

Agentic Artificial Intelligence in Intelligent Traffic Control

Artificial Intelligence integrated with the other allied technologies in intelligent traffic control system to make autonomous decision making system [9]. Therefore, Artificial Intelligence has significant contribution for developing smart and intelligent autonomous decision making solutions for traffic management. As the agentic AI is the emerging technology and it has bright prospects as futuristic technology, it implemented in advancement of the traffic control system. As this agentic AI technology is new and innovative technology, research and development continuing and there is significant prospects of agentic AI. Autonomous AI with Large Language Model (LLM) and Retrieval Augmented Generation (RAG) models are used in this context to develop the solutions. Agentic AI framework is applied in autonomous traffic control and management system and it is adopted to transform the traditional traffic management system to the intelligent traffic management system. Multi Agent System an area of the distribute Artificial Intelligent System, implemented in the urban traffic signal controlling. This system work with multiple AI agents where one agent acquire the knowledge about the local traffic conditions such as vehicle queues, and flows of traffic and directly coordinate with other agent for the global optimization. Multi Agent System (MAS) enable traffic control system to provide support in decentralized and scalable control that respond in real time, enhance the communication and coordination across the intersection, enhances overall network performances, and decreases the delays [4]. Therefore, Multi Agent System has the futuristics opportunities in enhancement of intelligent traffic control system [3].

Conclusion

Advance traffic controlling system is emerging in association with advance technologies including IoT, AI, edge and cloud computing. Apart from these key technologies other technologies integration make more efficient systems of traffic control such as integration of block chain and metaverse technologies, quantum computing. These technologies are the future of the advance intelligent traffic control system. Therefore, as the continuous evolution of the technologies, systems shifted towards more robust and efficient in future. For the sustainability issues in the cities, planned traffic controlling system is needed to incorporate in the system. Artificial Intelligence take major part to enhance the intelligent traffic control system. Agentic AI is recent innovation of the AI technologies, it play leadership role in improvement of the traffic controlling system. To improve the traffic management system in the smart cities, enhance the speed of faster communication, and keep the sustainability of the environment, the system must be extended with innovative technologies.

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