Chapter 8
Internet of Things and Fog Computing Applications in Intelligent Transportation Systems

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ABSTRACT

Self-driving vehicles such as autonomous cars are manufactured mostly with smart sensors and IoT devices with artificial intelligence (AI) techniques. In most of the cases, smart sensors are networked with IoT devices to transmit the data in real-time. IoT devices transmit the sensor data to the processing unit to do necessary actions based on sensor output data. The processing unit executes the tasks based on pre-defined instructions given to the processor with embedded and AI coding techniques. Continuous streaming of sensors raw data to the processing unit and for cloud storage are creating a huge load on cloud devices or on servers. In order to reduce the amount of stream data load on the cloud, fog computing, or fogging technology, helps a lot. Fogging is nothing but the pre-processing of the data before deploying it into the cloud. In fog environment, data optimization and analytical techniques take place as a part of data processing in a data hub on IoT devices or in a gateway.

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INTRODUCTION

Intelligent Transportation Systems (ITS) developed in various paths. Since the middle of 1980's the study and development of Autonomous cars (Popularly known as Self-driving cars or Driverless cars) has started. Many Research centers, Vehicle Manufacturers and Universities took part in the design and development of Autonomous cars around the world. Since the last two decades, recent advancements in the technologies changing the path of autonomous cars to the top-notch position. In last decade advancement in automation technologies creating a huge impact on Autonomous cars development. Technologies related to ITS namely embedded systems, Internet of Things, Artificial intelligence, Cloud computing and Fog computing. Some autonomous cars were popular within their development era like UniBw Munich (E. D. Dickmanns et al., 1987), Navlab's Mobile platform (C. Thorpe et al., 1991) and Daimler-Benz's cars "Vamp" and "VITA-2" (J. Becker et al., 2014) etc.

The Defense Advanced Research Projects Agency (DARPA) organized three competitions to analyze the autonomous car's development in the last decade (M. Buehler et al., 2007), (M. Buehler et al., 2009). The key phase of autonomous cars development described in SAE International (Society of Automotive Engineers) publications. That is about the classification system based on the intervention rate of the human driver and the amount of attentiveness required by them. Here six levels of driving automation described. Later all research surveys and publications mainly focused on DAPRA competitions and respective modifications with SAE level references (Elrob et al., 2018), (SAE International, 2016).

Let's come to present and future scenarios of the Automobile industry development phase. "Self-driving cars will hit roads by 2025 with the complete integrated Autonomous System". Google was the first initiative to introduce driverless cars in 2018 (Driveless-Future.com). In every automobile industry manufacturers are trying to release self-driving cars with fully integrated autonomous structure in the future. In a recent survey by IEEE, upcoming 20 years, most of the vehicles will be autonomous (Approx. 75%). Advancements for the technologies like embedded systems, Internet of Things (IoT), Sensors, Artificial Intelligence (AI), Cloud Computing and Fog computing concepts were the key elements in the development of Autonomous Cars.

The authors (Tian, J et al., 2018) described about the evolution of intelligent vehicles from grid to autonomous level. They explained about advancements in autonomous vehicles design functional aspects like Internet connected vehicles, Vehicular Fog computing and Cloud networking methods etc. They explained in detail computing systems functional properties. The authors (Botta, A et.al., 2019) proposed alternative architectures for pure cloud systems especially in the robotic