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A Review of Intelligent Transportation Systems using IoT

Mahesh Madanlal Das and Shailesh Yadav
Late Bhausaheb Hiray S.S. Trust's Hiray Institute of Computer Application, Mumbai University,
mumbaidasmahesh336@gmail.com

Abstract: *The Internet of Things (IoT) has become one of the most interesting areas of information technology different communication devices are interconnected by network protocols. (wifi), Message Queuing Telemetry Transfer (MQTT), Constrained Application Protocol (CoAP) and data sharing Services (DDS) are a number of different IoT protocols and data protocols, connection between computers and other electronic devices around the world through servers and some special devices. There are a huge number of problems in today's world With IoT technology, anyone can easily get data from vehicles and transfer it to the right servers IoT plays a crucial role in traffic management in smart cities. such wireless communication increases the vulnerability of ITS networks to security threats. opportunities to optimize the relationship between information security and cost of ITS applications.*

Keywords: IoT, WSN, RFID, Protocols, Smart devices, Artificial Intelligence.

I. INTRODUCTION

IOT has become one of the most interesting and challenging areas in the current situation. Internet the internet of things (IoT) connects various electronic devices at any time, in any real environment. Physical devices are also used for portable entities leaves that help observe living things. smart grid, smart agriculture, smart transport system, smart city and smart retail are some trending examples of IoT. in Simply put, IoT is technology connected to the universe digitally through physical devices. The main sources of IoT are wireless sensor networks (WSN), RFID (Radio Frequency Identification) and GPS, that communicate between man and machine put in the machine. IoT objects can include a wide range of huge from buildings to vehicles through a WSN network. This consists of several base stations and several nodes (wireless sensors). These WSN IDs are used to monitor the environment conditions such as temperature and pressure. RFID (radio Frequency Identification) is a wireless obfuscation device used to exchange information with radio frequencies. IoT devices are internet, input and output devices, control Device, power Supply etc.

1.1 Application Of IOT

When talking about the applications of IoT, smart cities are probably the first thing to think about is essential. Some more applications in this are listed below:

- **Smart Home:** It is the most attractive & interesting field of IoT. According to a survey, smart homes ranked 1st in all applications of IoT. The equipment in a smart home is all networked and may be controlled from one central location—a smartphone, tablet, laptop, or gaming console.
- **Health Monitoring:**IOT makes it easy for medical doctors to monitor the health of / patients through implantable wearable gadgets.
- **Smart Transport Services:** Smart transportation can be realized based on continuous monitoring of parameters like motor temperature, air pressure, speed, fuel level, etc.
- **Manufacturing & Supply Chain:** Monitoring each phase of an item's life cycle can result in better and more efficient manufacturing and supply chain techniques.
- **Smart Farming:** It includes precision Agriculture and automated irrigation. It solved the drought situation for irrigation.
- **Smart Metering System:** It includes communication between different meters of general use (for instance, gas or power meters) and a base station.

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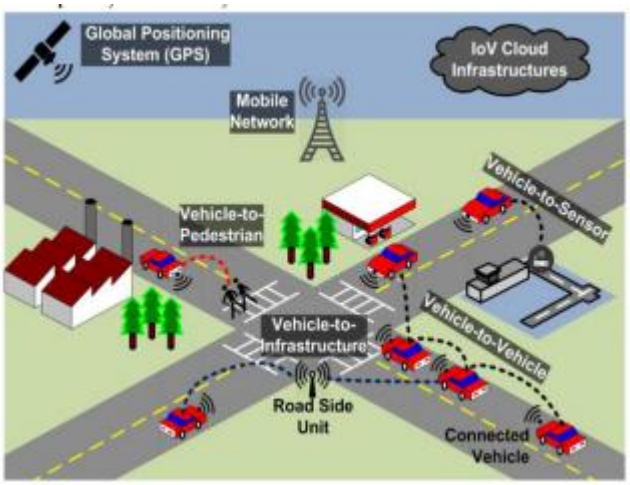
- **Smart grid:** It deals with the consumption & utilization pattern of consumers and provides better efficiency and economical usage of electrical power consumption. Simply it is the mode of maximum utilization of power supply by IoT.



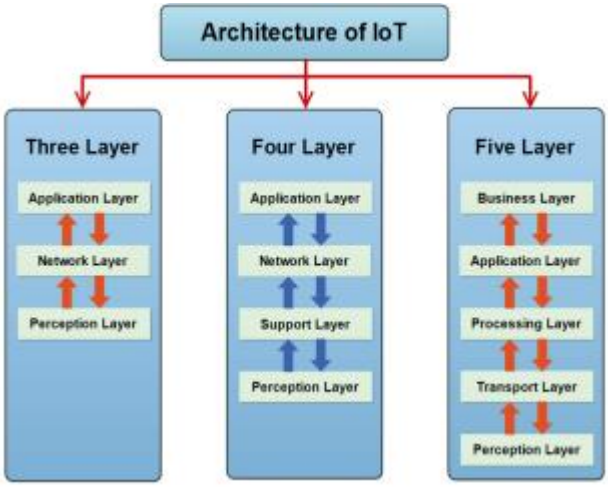
II. ARCHITECTURE OF IOT

According to research, IoT has 3 layers of architecture communicated by the followed process. Layers are communicated in sequential order.

- Perception Layer
- Network Layer
- Application Layer

All these layers are interconnected and operate to achieve a particular goal. The key challenge in this architecture is communication, information extraction & planning for further process.

- **Perception layer:** it collects the data/useful information from all the input devices WSN (e.g., temperature, pressure) convert into a digital setup. The perception layer, also called the brain of IoT's Architecture, can analyze things and manipulate them to achieve a goal. It also provides security to Data or information between the application layer & perception layer.



- **Network Layer:** According to current communication-based technology, researchers have concluded that the network layer is the most progressive layer of traditional IoT architecture. The network layer is the basic layer of IoT that is efficient in facilitating the information for applicable procedures. IoT also manages all types of data processing tasks. The network layer also certifies individual addressing and routing potential to the unified combination of innumerable gadgets in a unique common network.

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- **Application Layer:** it is the top layer of IoT's architecture. It is a layer that works as a bridge between user and application. User can personalize their needs according to /her requirements. It is used in highly intelligent applications which can predict disasters, health monitoring, and soil monitoring for agriculture purposes. In simple words, it can provide facilities according to user needs. The new researcher also included two new layers in this layer. The business layer & service management layer are under it.

III. INTELLIGENT TRANSPORTATION SYSTEM

An intelligent transportation system is said to integrate different fields like civil, mechanical & electrical to improve transportation. The main feature of ITS is to develop, analyze, integrate, and human effort to achieve road safety, driver safety, and a time-saving environment with a futuristic approach. Smart cities can't be possible without ITS. Smart transportation provides a faster and easier way of traveling through electronics, wireless, and communication technologies. There is a wide scope of information and communications mechanics that permits the development of ITS. Examples include GPS, fiber optics, laser sensors, digital map databases, and display technologies. Traffic Management Centre (TMC) is the key unit of ITS. All types of data provided by the vehicle sensing hardware collected and analyzed by the TMC generate accurate information and are further forwarded back to the travelers. IoT technology has several ways to communicate or forward the messages to the server with wireless or wireline, e.g., fiber optics and electronic toll Collection for commercial vehicles. The traffic-related statistics can be issued differently to improve transportation utility, environmental quality, and safety. Examples are radio, television telephones, computers, variable message signs, car radios, cellular telephones, laptop computers, and hand-held digital devices. Through this information, drivers can route guidance, allowing the user to make minute-by-minute pre-planned decisions. In the preceding section, Artificial Intelligence in ITS would use society to develop a smart transport network. This software will give individuals intelligent & convenient travel options. With ongoing innovations in A.I. & learning procedures, it predicted that A.I. would eventually take over the entire world in the coming years.

IV. LITERATURE REVIEW

- **Lan Liu et al.** [1] have compared Six different classical models based on improved classification performance, e.g., Random forest, Long and short memory (LSTM), etc., with the Data set sampling Technique DSSTE. With this model, researchers also conclude that Deep learning execution is better than machine learning.
- **D. González et al.** [2] have presented a review of motion planning techniques implemented in the smart vehicle's literature. His research teammates contributed to motion planning in this work, and contrast among these techniques is also presented. e.g (RRT Family Polynomials, Dijkstra etc.)
- **A. Abadi et al.** [3] have presented Traffic flow prediction for smart transportation networks with bounded traffic data reported. He used the Monte Carlo simulation Experiment to account for random effects uncertainties. His forecast algorithm adjusts to the changes and modifies its prediction outputs with better exactness. The prime limitation of this research work is the lack of a sufficient number of facts during usual and proceeding traffic situations to execute additional tests.
- **A. Mukhtar et al.** [18] have proposed a model for Vehicle detection techniques for Collision Avoidance Systems. The author starts with execution differentiation of sensors, concluding that operative sensors effort well under dissimilar weather conditions and face recognition issues. The author also linked relative speed amongst vehicles close to it.
- **Nawal Alsaffar et al.** [19] have proposed the RC5 encryption algorithm used as a security approach to defend privacy in an Intelligent Transportation system. The researcher used the simulation Quartus Prime Lite Edition 18 RC5 algorithm tool with Field programmable gateway arrays (FPGA) for simulation. The aim is to validate hardware applications of RC5 and ensure it is acceptable for Intelligent Transportation. The simulation output assured the performance of the proposed algorithm.
- **Mr. Nilesh et al.** [3] research paper detailed discussion of a smart transportation literature review from an Indian viewpoint. Research on Smart Transportation Systems detailed review, observed and assess its relevance in today's substitute environment. The author also highlighted a less synchronized traffic signal network with the potency of traffic; the congestion issue becomes more significant.

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- **S. Ahmed et al.** [8] have proposed transportation system's execution is analytical to tragedy feedback such as draining operation before disasters, saving operations, and retrieval undertaking during and after succeeding disasters. Resilience of the transportation system represents the vital solidity of the system to retrieve from undesirable outcomes.
- **Mehrdad Hajizadeh et al.** [9] have proposed a novel approach that integrates security estimation abstractions (mostly put in separately) in a combined procedure yielding evaluate of attack framework success probabilities for similar attacker types. On behalf of these results, researchers can signify appropriate countermeasures decisions to avoid or reduce security attacks.
- **L. Zhu et al.** [10] has studied Big data analytics applications in Intelligent transportation system counting road traffic accidents investigation, Transportation service plan, Traffic prediction, and transportation management control. He also applied supervised, and unsupervised learning algorithms also carry out for guessing analysis.
- **Muath Obaidat et al.** [5] research paper proposed a six-layer security architecture top to bottom "application security, cloud security, information transmission security, gateway information security, internal communication security, and end device security." Most importantly, such a type of security architecture explains what a security function has to be implemented to achieve the security requirements.
- **Y. U. Devi et al.** [4] research paper highlighted the study of key disputes and the emergence of the Internet of vehicles. The author also explained the present investigation ways in connected vehicles. Combining the different elements of IoT designed to connect vehicles is a huge task. Data collection from the sensors and other connected devices must be synchronized constantly.
- **S. Paiva et al.** [6] have presented a survey of the present smart transportation system, the idea of smart transportation, and currently undefended in such types of devices. Security concerns and scenarios are also highlighted. This research highlights the significance and needs for securing these smart devices, and the upcoming tendency in Intelligent Transportation systems is also recommended. Although smart Transportation telecommunication already supplies appropriate transportation and maritime services, the author highlighted the scope of improvement in these services from the end-user side.
- **S. Parkinson et al.** [7] have reviewed many papers and concluded that a huge volume of openly informal literature is evaluated and classified construct on the vulnerabilities pointed out and mitigation methodology developed. This research work highlighted that more studies are reactive, and friendly adversaries' hackers often discover vulnerabilities.
- **Haichun Jhang et al.** [12] have proposed a network tool assessment named CANsec, drawn for assessment methodology. CANsec worked on assessing vectors following the attack and target area with the Internet of Vehicles Networks (IVNs). This tool was practically implemented for IVNs Security on ford vehicles with positive results.
- **K. N. Qureshi et al.** [13] have proposed a model of sixlayered architecture based on different protocols stack and network elements, cloud services, data acquisition analytics, and security based on a detection & prevention system. This research paper also highlighted the existing challenges & future scope to draw the latest combined models.
- **E. Arnold et al.** [17] research paper focused on an indepth analysis of unidentified confirmation schemes applied by five pseudonymity techniques. Due to the expected dynamics of vehicles, anonymity is required but not enough to thwart trace an attack that focuses on the drivers' location side view.
- **A WaiH et al.** [22] presented examples of how A.I. algorithms can help enhance the commercial & economic of the transport area in the prospect. In the future, A.I. will be able to optimize the utilization of roadways for faster travel. The application of new and better algorithms will result in the provision of distinct and distinctive route possibilities for every group of travelers. For instance, postal delivery vehicles will take a different choice than regular travelers. It will significantly reduce fuel costs and travel time.
- **Sil R et al.** [23]Pattern recognition & natural language processing (NLP) techniques are commonly utilized in the transportation sector. For a few decades, such algorithms should be useful in identifying & anticipating congestion problems some days ahead ofthe anticipated travel. For example, such algorithms ought to be possible to perceive & estimate traffic jams in the case of a huge concertos football game in the town, utilizing

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media & internet feedback. It must expand on its findings & offer other facts such as the expected time for the traffic congestion to clear, the predicted train delay, & the purpose for the delay.

- **J. Harvey et al.** [15] research paper provides transparency to Intelligent Transportation System surety by the common explanation of security challenges & survey solutions to decrease the possibility of attacks on ITS. Network segmentation, Unified threat management gateways & encryption technologies are four types of security challenges included by the author.
- **G. Krummenacher et al.** [16] have proposed a method of detecting defective wheels of railway transport. This classification procedure assured extension of the reliability of the railway transport framework decreased the price of shipment train operation, and retained extra expenses on noise preservation estimation.
- **H. Uddin et al.** [24] The Internet of Things enables real-time data extraction. It enables gadgets to be operated in various ways without requiring extensive human engagement. IoT devices have created a novel infrastructure for daily traffic management. To detect its surroundings, wireless network technology was deployed. Additionally, this shows IoT presented as a means of investigation. The generation of large data from IoT devices has aided in the planning & development of a city & environment.

Table 1. Existing Work on ITS and Analysis

Year	Title of the Paper	Author(s)	Technique/Tool used	Description	Research gap/ Limitation
2021	"Intrusion detection of Imbalanced Network Traffic Based on Machine Learning and Deep Learning."	Lan Liu, Pengchen Wang, Jun Lin	Par posed DSSTE Algorithm to handle class imbalance network Traffic	Comparison of 24 existing classical models (NSL-KDD, LSTM, SVM, Alex Net, etc.) with parposed model DSSTE	Need to apply directly deep learning model for feature extraction on real network traffic data
2020	"Supervised Machine learning classification Algorithmic Approach forfinding Anomaly Type of Intrusion Detection in Wireless Sensor Network"	Ashwani B Bhale, S.S. Manivannan	NSLKDD modified version KDD99 data set algorithm used with other existing algorithms	Support Vector Machine (SVM) has the highest correctness comparatively other algorithms	The multiclass classification was not used, which improved more accuracy of the result.
2020	"Privacy and Security challenges in Smart and sustainable mobility."	Sara Paiva, Mohd Abdul Ahmad	ITS phases, Data collection, transmission & analysis.	A detailed review of Existing Smart Transportation.	Vulnerable security breaches between Fog and Edge Computing framework.
2020	"Internet of Vehicles: Key Technologies, network model, Solutions and challenges with future aspects."	Kashifnasir Qureshi	Protocol based on a six-layered design stack and network elements, cloud services & big Data Analytics.	Threat Assessment System (TAS), Smart Intrusion Detection (SID),	IoV Networks are a big challenge for multiple communication layers.
2020	"Intelligent Transportation	Kavesh Bakhsh, Kevin	Risk Assessment	Detecting and evaluating prioritize	Uncertainty in-vehicle networks

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	System Security: Impact oriented Risk Assessment of in-Vehicle Networks."	Heaslip	based on NIST SP 800-30 model.	risk for the system operation and assets.	complicated the detection and evaluation of prioritized risks.
2020	"A practical in-vehicle controller Area Network Security Evaluation Tool CANsec."	Haichun Zhang	Mapping between Four types of Attack Vectors.	Simulates malicious attacks & evaluates the security risk.	Failure in the main bus causes serious risks.
2019	"Big Data Analytics in Intelligent Transportatio n Systems."	Li Zhu Yu Yige Wang Bin Ning	Supervised and Unsupervised Learning Algorithms	Vast Volume of Data Handling	Irrelevant input feature data give inaccurate results.
2019	"Application of RC5 for IoT devices in Smart Transportatio n System."	Nawal Alsaffar, Wael Elmedany	RC5 Algorithm	The encryption Algorithm used security techniques for privacy in ITS	Secure only with adequate rounds.
2019	"Evaluation of Transportatio n System Resilience in the presenceof connected and Automated Vehicles."	Shofiq Ahmed, Kakan Dey	Proposed model based on NguyenDupuis-Network system	System resilience performance in both CAV and non-CAV traffic environment	Interdependency of different phases & their respective nodes.
2018	"Wheel Defect Detection With Machine Learning."	Gabriel Krummenacher	Time Series & Deep CNN	Automatically detect the wheel defect through CNN	High complexity due to Design and multiple Algorithms.
2018	"Probability Analysis of Successful Cyber Attacks in SDNBased Networking."	Mehrdad Hajizadeh, Trung V. Phan	POCC Calculation	Attack scenarios on various potential factors	Time-consuming approach due to complexities

V. CONCLUSION & KEY CHALLENGES

The article provides an overview of A.I. and machine learning applications to develop intelligent transportation systems that can solve traffic problems. Artificial intelligence and machine learning technologies solve real-time traffic problems such as road abnormalities, traffic accidents, energy consumption of street lights, inadequate infrastructure, security, traffic congestion and parking. The future of IoT is limitless in various high-tech fields. Consumers want to communicate with all electronic devices via wi-fi, zig-bee and RFID. IoT protocols have made it possible to connect devices in the air, land and sea. IoT has challenges like scalability, interoperability, privacy, security, complex designs, etc. Collaboration between development teams of different standards brings clarity to the futuristic intelligent transportation system of IoT. Data collection from connected sensors must be synchronized, which is another major challenge in smart transportation technology.

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