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Review Article

A Review of Intelligent Transportation Systems in Existing Framework using IoT

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Abstract *- The Internet of Things (IoT) has become one of the most interesting information technology fields in the modern world. A wide scope is available for researcher in it. It is the backbone of a real-world environment where different communicable devices are interconnected through networking protocols. Bluetooth, zegbee, Wireless Fidelity (wi-fi), Message Queuing Telemetry Transport (MQTT), Constrained Application Protocol (CoAP) & Data Distribution Services (DDS) are some different IoT protocols & data protocols. In simple words, Iot is a means of establishing a connection between computer to computer or other electronic devices worldwide through servers and some dedicated routers. IoT is used in many fields like smart cities, Health monitoring by wearable gazettes, Smart grids, smart retail, smart farming, intelligent transportation system, and so on. The modern-day world has a huge number of problems when using vehicles. Using IoT technology, anyone can easily fetch the data from the vehicles, forward it to the correct servers & conveniently solve traffic problems. IoT is playing a crucial role in managing the traffic of smart cities. Moreover, such wireless communication increases the vulnerability of ITS networks to security threats. Additionally, discuss future options to optimize the security-to-cost ratio for ITS applications.*

Keywords *- IoT, WSN, RFID, Protocols, Smart devices, Artificial Intelligence.*

1. Introduction

Iot has become one of the most interesting & challenging fields in the current time situation. The Internet of things (IoT) connects the different electronic devices anytime, anywhere in the real-world environment. Physical devices are also used in living beings through wearable gazettes, which help monitor living beings. Smart grid, smart agriculture, intelligent transportation system, smart city, and smart retail are a few trending examples of IoT. In simple words, the Internet of things is a technology connected to the universe digitally through physical devices. The key sources of IoT are Wireless Sensor Networks (WSN), RFID (radio frequency identification) & GPS, which communicate between human to machine or machine to machine. IoT objects may cover a wide range from huge buildings to vehicles through a network with WSN. It consists of several base stations & multiple nodes (wireless sensors). These WSNs are used to monitor environmental conditions such as temperature & pressure. RFID (Radio Frequency Identification) is a wireless confounds device used for radio frequency waves to exchange data.
IoT gadgets are the Internet, Input & output devices, control Unit, power supply, and so on.

1.1. Applications 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.

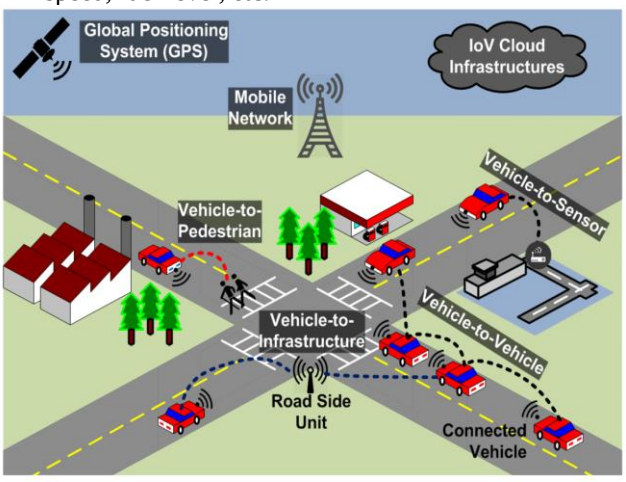

Fig. 1

- **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.
- **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.

2. 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 of 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.

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.

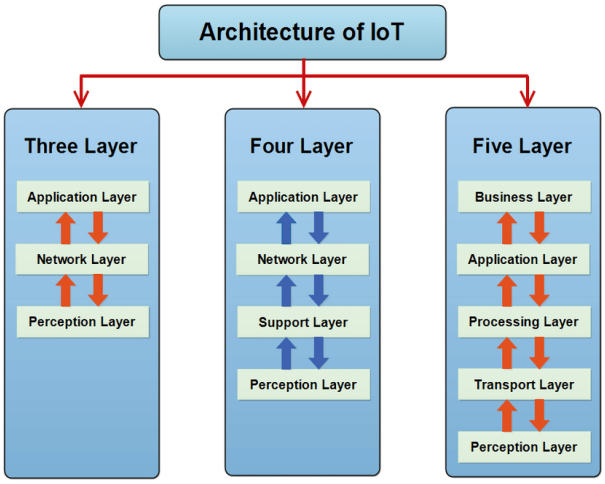

Fig. 2

Business layer: it is connected with the transport layer & store and analyze the data. It is used for business data from the application layer.

3. 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.

4. 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.

- **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 six-layered 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 in-depth 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 of the 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 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

Publication 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 for	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.

	finding Anomaly Type of Intrusion Detection in Wireless Sensor Network"				
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 System Security: Impact oriented Risk Assessment of in-Vehicle Networks."	Kavesh Bakhsh, Kevin Heaslip	Risk Assessment based on NIST SP 800-30 model.	Detecting and evaluating prioritize risk for the system operation and assets.	Uncertainty in-vehicle networks 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 Transportation 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 Transportation 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 Transportation System Resilience in the presence	Shofiq Ahmed, Kakan Dey	Proposed model based on Nguyen-Dupuis-Network system	System resilience performance in both CAV and non-CAV traffic environment	Interdependency of different phases & their respective nodes.

	of connected and Automated Vehicles."				
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 SDN-Based Networking."	Mehrdad Hajizadeh, Trung V. Phan	POCC Calculation	Attack scenarios on various potential factors	Time-consuming approach due to complexities

5. Conclusion & Key Challenges

The article provides an overview of A.I. and machine learning applications for developing ITS that can address transportation-related issues. A.I. & machine learning technologies address real-time transport challenges like road abnormalities, road accidents, streetlight energy consumption, inadequate infrastructure, safety, traffic congestion, & parking space availability. The future of IoT is unlimited with different fields in advanced technology. Consumers want to communicate with every electronic device through wi-fi, zig-bee & RFID. IoT protocols made it possible to connect the devices in air, land & sea. IoT has challenges like scalability, interoperability, privacy, security, complex designs, etc. Collaboration between various standards development groups will result in clarity for IoT futuristic Intelligent Transportation system. Data collection from connected sensors must be synchronized, another key challenge in smart transportation technology.

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