

The Internet of Things: An Opportunity for Transportation and Logistics

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Abstract—This paper discusses the opportunities of a new and emerging technology i.e. the internet of things (IoT) in transportation and logistics sector. Need for IoT, architecture of IoT to address various complex issues is described. Applications where IoT could place a prominent role in transportation sector also highlighted in the study. Along with the benefits few related works in transportation and logistics were clearly discussed.

Keywords—IoT, the internet of things, transportation, logistics, IoT applications.

I. INTRODUCTION

In the process of development, transportation sector plays a crucial role. Need for transportation depends on many aspects like supply of goods, passenger mobility, logistics etc. Hence, the transportation becomes an essential and integral element in linking clients to supply chain team by a means of logistics. Logistics can be broadly said as the service, which means “providing availability of the right product, in right conditions, in right amounts, in right place, in right time, with right cost and for a right customer” [1]. In a system, few specific operations can only be executed until and unless the individual elements are together. If the elements of such system are separated then the operation may not have fruitful benefits. Logistics is used to link various activities or the works which can unite together to finish proper product or usable good. Hence, effective management of logistic activity is needed to execute the things in a smooth way and in controlled manner. [2] This can only be achieved with the proper planning and effective utilization of in transportation services. This indeed helps in the business development and strong business network linking the globally available raw material supplier to the end user. But however, the present day transportation is facing lot of problems in terms of security, accountability, service reliability, conveniences, issues in navigation, cost for service etc. This problems are directly having an impact on the development activity of transportation sector. Hence, a thought for using information and communication systems is evolved. This could be of the internet of things (IoT). This paper discusses about the IoT and its architecture for transportation and logistics sector. It also outlines the various possible opportunities.

II. THE INTERNET OF THINGS (IoT)

The Internet of Things is an advanced technology focusing on broader perspective in providing solutions to engineering problems. IoT is an embodiment of both information and

communication technologies linked to specific application. In IoT whatever may be the application, few sensing instruments that includes both the nano and micro sized electro-mechanical equipment’s are present. This helps in the data collection and which will transferred to cloud through internet with the help wireless technologies. This allows the user to understand about the various parameters and their impacts etc. and to take proper decisions that would benefit the system operation [3]. Fig. 1 shows the schematic view of the IoT technology in transportation and its functioning.

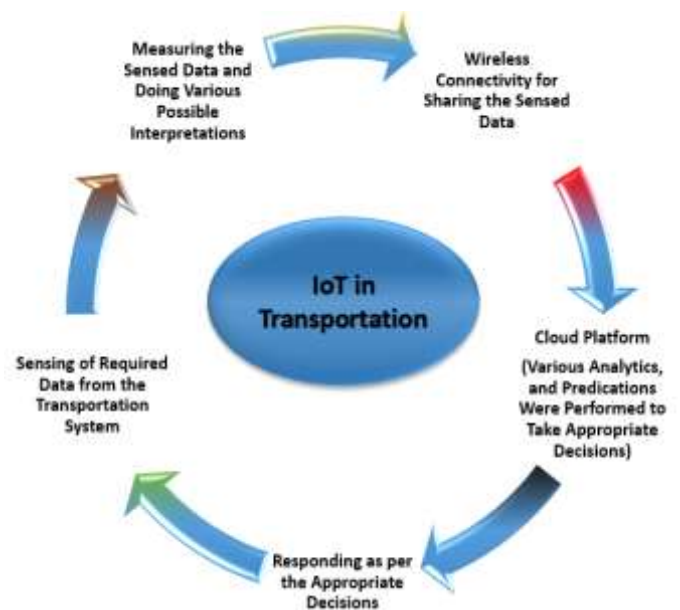


Fig. 1. IoT functioning process.

III. IOT ARCHITECTURE FOR TRANSPORTATION SYSTEM

IoT architecture for transportation system consists of five different layer. These layers includes the application layer, sensing layer, communication layer, service layer, and infrastructure layer [4] see in Fig. 2. Transportation is mainly used for shifting a thing or living being from one place to another place. In the daily life transportation is involved in so many activities like shifting goods, shifting people, either on road or water or air ways. Transportation system as a study area involves the study of so many parameters.

All these parameters should be sensed and transferred to service layer through a proper communication channel.



Fig. 2. IoT System Architecture.

From the service layer appropriate decisions were taken for controlling the system as per the requirement. The relevant and sensed data is stored in the infrastructure layer.

TABLE I. IOT SYSTEM ARCHITECTURE REQUIREMENTS FOR TRANSPORTATION APPLICATION [4]

Layers	Requirements/Components/Tasks to be Executed
Application Layer	Goods, Junctions, Terminals, Service Areas, People, Roads, Vehicles
Sensing Layer	Parking Detection, Compass Terminals, Camera, Fee Collection, Environment Monitoring, Vehicle Monitoring, Logistics Tracking, Microwave Detection, Passenger Flow Detection
Communication Layer	3G/4G/5G Network, Wi-Fi, Wired Network, Optical Fiber, Public and Private Network
Service Layer	Logistics Service Platform, Passenger Vehicle Platform, Fleet Vehicle Service Platform, Highway Integrated Platform, Intelligent Travelling Service Platform
Infrastructure Layer	GIS Mapping Service, Cloud Computing, Cloud Storage, Big Data

A. Application Layer

Application layers is the one where different tasks to be monitored as per the clients requirements. In the case transportation, application layers involves the tasks related to people, vehicles, roads, goods and other services, traffic etc.

B. Sensing Layer

Sensing layer is the one that has an interaction between the application layers to the vehicle captains by means of an electronic devices called sensors network. These sensors and other devices were incorporated with the vehicle or at the application place. Many of the electronic components or gadgets need to be used, these includes: CC TV, Cameras, sensors, RFIDs, microwave technology, infrared technology, image or text readers etc.

C. Communication Layer

Communication layer, one of most important layers in the IoT systems. This layers acts as Information Bridge between the sensor layers and the service layers. This layer helps in the data transmission from sensor layer to the service layer by means of 3G/4G/5G Network, Wi-Fi, Wired Network, Optical Fiber, Public and Private Network. The most important factors

to be considered for developing this layer are security issues. Apart from this issues related data transfer speeds, data transfer transparency, reliability to be considered. The more reliable and strong communication network gives the better service.

D. Service Layer

Service layer is the one which performs the activities required by the application layer or the as per the clients requirements. Service layer gets the detailed information from sensor layer through the communication layers. The obtained information is processed in many ways and different analytics were performed various computing tools.

E. Infrastructure Layer

Infrastructure layer is the one which creates the technology required for performing the various services. These includes the GIS mapping service, cloud computing platform, cloud storage, big data analytics tools etc. This layer mainly allows the improvements required for performing the reliable services.

IV. IOT OPPORTUNITIES FOR TRANSPORTATION AND LOGISTICS

The internet of things has numerous opportunities in transportation and logistics sector [5]. These opportunities includes in various application or needs of a transportation system. Using IoT vehicles can be monitored with respect to their movement, location, whether it is running or stopped, or at any risk etc. All these aspects can be monitored intelligently using the IoT systems. In most cases, vehicles are used for logistics purpose or for carrying any heavy loads which are packed inside the truck. During such times, it is very important to measure the indoor conditions of the truck like temperature, humidity, light conditions etc. Apart from the payment service near the tolls or any parking places can be automated with the vehicle tracking number and the driver id number etc. IoT also helps in the guidance and navigation control systems of the vehicles (road transport, air transport, water transport)

Transportation governance is highly possible with the use of IoT. Here various vehicles can be monitored by means of a central control connected through the network. This also helps in managing the imports and exports of materials and goods. It also offers a live and integrative services for monitoring the delivery status indicating the location using GIS mapping. IoT could help in monitoring the traffic and gives the suggestions to take other lines. Refer to Fig. 3 for IoT applications.

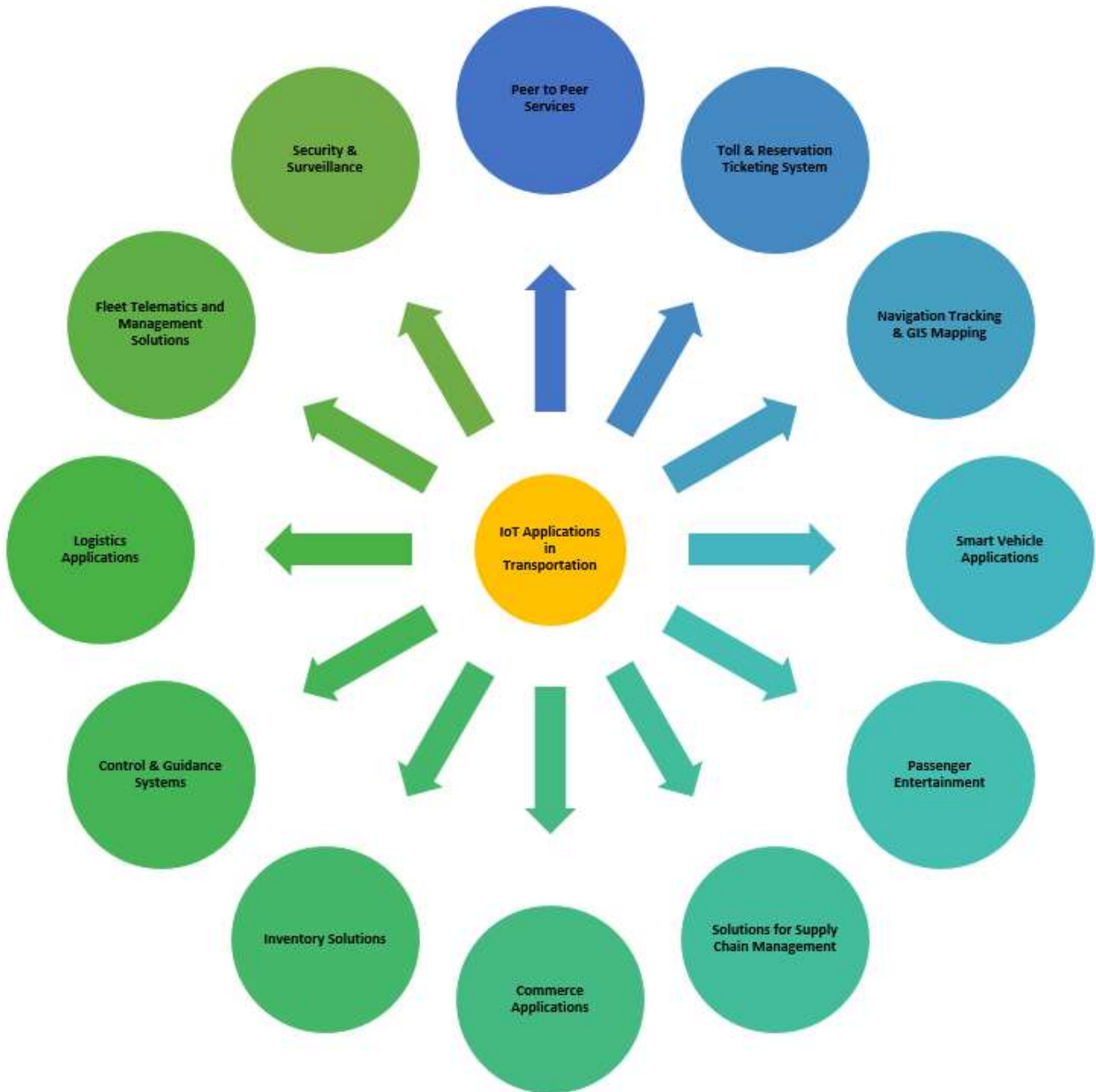


Fig. 3. IoT Applications in Transportation

V. BENEFITS OF INTEGRATING IOT IN TRANSPORTATION

IoT technology when integrated with transportation system, many benefits are possible. These benefits includes [5]:

- Distance to be travelled by the vehicle is optimized giving the benefits by reducing the fuel consumptions leading to the better profits.
- Optimizing or diverting the routes is possible during the deadly and dangerous conditions.
- Through centrally controlled network, a service can be operated based on the demand.
- Public safety is possible through a control of traffic based on the vehicle count.
- Goods and material exports imports, purchase and other shipping details can be maintained effectively.
- Improves the revenue of the transportation and logistics company owners.

VI. DISCUSSIONS

IoT based transportation system were evolved in the recent times, and most of the people were opting to have IoT embedded features to make the transportation and logistics process easier and convenient. Few related works in this category is discussed in this section. A. Menychtas et al. (2013) proposed IoT based transportation system for highly varying end-to-end mobility recommendations by collecting the information from individuals. This method provides the benefits to all modes of transportation (public transport, private transport, cab captains, passengers, cyclists, pedestrians etc.) [6]. On the other hand technological developments in the IoT is active, this technological developments where in form of developing high secure communication layer etc. A. G. Leal et al. (2014) developed integrated testing facilities for IoT networks and other sensor devices. This sought of facilities would help most of the academia, research, and industrial streams to enhance their knowledge through a means of practical experimentations in the upcoming technologies like IoT and sensor networks related to the intelligent transportation system [7]. L. F. Herrera-Quintero et al. (2016) proposes a solution for transportation planning using the IoT technology and big data analytics for the bus rapid transportation systems. For the effective transportation planning, ITS smart sensor prototype is developed by L. F. Herrera-Quintero et al. this device is collect the information from the people who take transportation system by means of the electronic gadgets used by them. This information allows the ITS smart sensor prototype to mark the origin and destination routes helping the administrators in making the transportation planning work simpler [8]. S. H. Sutar et al. (2016), came up with the IoT, GPS, and Android based solution to address the problem related to traffic management for public transport system. This combinational technology helps in addressing various problems associated with the increased number of vehicles on the roads [9]. A. Weis et al. (2017) proposed IoT based On-Board Diagnostics data system with android integration for monitoring the fuel range of the vehicle and nearest fuel station based on the fuel price and proximity. This system would create a fuel station map from which the user can have better decisions to choose the nearest one without wasting much time for searching it [10]. A “modular, scalable enhanced road side unit” [11] proposed by A. Al-Dweik et al. (2017) will function based on IoT technology using the cellular network monitoring the various parameters like “speed limit adjustment, metering routes to reduce vehicle congestion and emissions, and issuing weather advisory warnings” [11]. This sought of systems will help in achieving the intelligent transportation. D. Puiu et al. (2017) proposed an IoT based application for the people who are travelling by means public transport. This application would recommend the people about the route and the incidents that would happen or happened on that routes [12]. This way IoT is used in journey planning based on the previous data and its analytics.

From the above discussions, it is very clear that IoT has many applications and it would help in solving the problems associated with the transportation and logistics sector.

VII. CONCLUSION

A brief study is done in this paper about the IoT use in transportation and logistics industry. IoT use would help this sector with many opportunities and benefits. It is highly advisable to adopt the internet of things in to transportation to make it more effective and profitable.

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