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Role of Internet of Things in Transportation Industry During Covid19 Pandemic

Dorothy Bundi*, Dismas Kitaria**
*Computer Science Department, Meru University of Science and Technology, Meru
Email: dorriegat@gmail.com)
** Computer Science Department, Meru University of Science and Technology, Meru
Email: teddismas@gmail.com)

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Abstract:

Transportation industry basically deals with the movement of people, animals and goods from one location to another . Internet of Things (IoT) is the interconnection of uniquely identifiable embedded sensors within the existing internet infrastructure. Similarly, IoT refers to the ability of everyday objects to connect to the internet and to send and receive data. IoT presents a unique technology transition that is impacting economies and will have huge positive and negative implications. There are 15 billion connected devices as of today and researchers believe that there will be 50 billion networked devices in the near future. Through this embedded sensor technology, companies will enjoy unprecedented visibility into operations, enabling new sources of value. This visibility, in turn, will transform how the transportation industry will function. This paper aims to explore the role of IoT in the transportation industry during Covid 19 pandemic by creating contextual awareness and identification of opportunities available as a result of this technology. The paper will adapt an exploratory methodology to identify challenges that hinder implementation of IoT in transportation industry followed by description of mechanisms that can mitigate these challenges for successful implementation. The results of this paper will be used to advice the policy makers in transportation industry on how IoT can be used to improve the service delivery during Covid 19 pandemic.

Keywords — **Internet of Things, Covid-19 Pandemic, Technology**, **Sensor, Transport, Network**

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I. INTRODUCTION

Transportation is the lifeline of any nation's economy(Kumar et al., 2020). Globally, transportation systems (Rohács & Rohács, 2020) are reeling under several challenges brought on by the sharp growth in the number of vehicles, estimated to rise from 1.1 billion in 2011 to 2.5 billion by 2050 worldwide. Traffic congestion, especially in mega cities (Rohács & Rohács, 2020) leads to pollution, fuel wastage, and accidents, and undermining the efficiency of emergency management and logistics. The economic cost of congestion is enormous, the estimated value being around KShs. 37 billion per year for road transport (Ian Twinn et al., 2020). Unfortunately, most governments and civic authorities have this far mainly focused on short-term solutions, such as more freeways, wider roads, restrictions on car usage, and so on. These initiatives do offer temporary relief but are ineffective in addressing the fundamental concerns, be it traffic and freight congestion, environmental damage, or

road safety (Malliga et al., 2021). This means that the conventional localized initiatives will not end up solving the issues. The current and most urgent need is a transformational solution, one that infuses knowledge and intelligence across the entire transportation. IoT (Končar et al., 2020) makes such a solution possible as characterized by connected platforms, pervasive computing devices, advanced mobile networks, improved security, privacy protection technologies, sophisticated data algorithms, and simulation and visualization tools. This means that an IoT-driven ecosystem is the answer to all transportation woes.

The global transportation industry is faced with different challenges (Kumar et al., 2020; Nasajpour et al., 2020) as the need for passenger and cargo mobility rises steeply. The scenario becomes more complex when you add the pressures of an increasingly competitive business environment. Industry players therefore need to look for innovative ways to improve operational efficiencies, contain costs and retain market share, while meeting or rather exceeding customer.

IoT is the interconnection of uniquely identifiable secure embedded computing devices within the existing Internet infrastructure (D. Bundi & Nelson, 2019) . Typically, IoT is expected to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine communications and covers a variety of protocols, domains, and applications. The interconnection of these embedded devices (including smart objects), is expected to usher in automation in nearly all fields, while also enabling advanced applications like a Smart Grid. Application of the IoT extends to all aspects of transportation systems, i.e. The vehicle, the infrastructure, and the driver or user. Therefore, a dynamic interaction between these components of a transport system enables inter and intra vehicular communication, smart traffic control, smart parking, electronic toll collection systems, logistic and fleet management, vehicle control, and safety and road assistance (Ian Twinn et al., 2020; Kumar et al., 2020). However, for 'smart transport' to be fully realized, it is essential that it be adopted by the broad transportation ecosystem as a.

II. RESEARCH METHODS

This paper employs an exploratory research design on existing literature with a focus to generate a workable hypothesis to be tested in future empirical studies. The objective of the study is to explore the impacts of internet of things in the transportation industry by creating contextual awareness of IoT and to identify the opportunities available in transportation industry. In addition, the paper identifies the challenges that hinder implementation of IoT in transportation industry and gives a description of mechanisms that can be used to mitigate these challenges for successful implementation. The results of this paper will be used to advice the stakeholders and policy makers in transportation industry on adoption of IoT towards improving service delivery in transport sector.

III. DISCUSSIONS

A. IoT Application Areas and Status

IOT can be applied and used in different areas and sectors in the Transportation industry; this includes and not limited to:

Smart parking: Finding a parking space in a busy city center can be time consuming and leads to increased traffic congestion (Nasajpour et al., 2020). Installing a sensor that detects if there is a vehicle in each space can be used to provide drivers with a picture of which spaces are available at any given time. **ParkSight** is a network of self-powered, wireless parking sensors that collect and report real-time information on the occupancy of individual parking spaces. Drivers can find somewhere to park more quickly, while local authorities and car park operators gain from increased utilization, improved enforcement and higher revenues. For example, a parking garage can use a digital sign to display how many spaces are open and on which level. Drivers can also use a IoT mobile application to locate available parking spaces and also apply for driving licence from open government platforms (D. G. Bundi & Kirongo, 2017; Din et al., 2019), a feature that eventually can be integrated into in-car navigation systems. By simply tapping on a map, drivers can see how much it will cost to park, how long they can park there, and pay for parking once they make their decision. City and town officials can

also use parking sensors to enforce parking violations policies as well as plan for future parking needs.

Road sensors: include low-power, wireless sensors that can be embedded (Nasajpour et al., 2020) into the roadway to measure variables such as **temperature, humidity, and traffic volume**. The sensor data is sent over a wireless network to a server for processing and analysis. The system then provides real-time information on road conditions. This information allows road crews to prioritize road maintenance during harsh weather conditions, which are responsible for almost a quarter of vehicular accidents. The system can also alert drivers of potential hazards, through roadway signage or traffic signals.

Electronic Sensors for vehicle maintenance and safety: MetroBus, the public bus service in St. Louis, Missouri uses electronic sensors (Malliga et al., 2021) to collect data on variables such as speed, engine temperature, and oil pressure. Computers analyze the data and offer recommendations to service technicians, helping improve the reliability of the city's transit system and lower overall operating costs. The will lead to fewer vehicle breakdowns and longer vehicle life times.

Trains and planes digital signage: Transport systems including train networks and airports, have complex infrastructures with a large and diverse range of equipment. In many cases a basic level of connectivity could benefit both operators and passengers. For example, train stations and airport terminals use a wide array of digital signage, from information boards to advertising billboards. Connecting these devices to our internet of things network could give a regular update on status helping to detect problems quickly and cutting maintenance costs.

Special Needs and Elderly Transportation Assistant: The transportation assistant application serves to address the group of commuters with special needs and who require assistance as they commute using public transportation. When these commuters travel, e.g., using the public train service, the transport assistant will inform the nearest transport staff so they can provide special assistance such as audio and visual services, and physical assistance for the passengers. When commuters are outdoors, the transport assistant will alert oncoming public vehicles to slow down as the passengers require special assistance to board the vehicle. The transportation assistant application can be embedded into watches, bracelets and panic button devices with built-in intelligent capabilities such as context-aware computing services and predictive analytics. Depending on the wearer's (user's) profile, the application recommends the most suitable assistance required by the wearer, gathering inputs from the current surroundings to make the decision.

Accident Avoidance/ Detection: With the use of sensors placed within the vehicles, the accident avoidance application can warn the drivers of accidents or dangers that may lie ahead on the road. For example, the application is capable of interpreting a series of complex events such as poor visibility conditions resulting from heavy rain, slippery roads and strong wind to the possibility of vehicles suddenly stopping. Consequently, it can alert and advise the driver on how to drive in such conditions. Sensors using infrared (IR) can help to detect the distance between each vehicle or the conditions of the road (e.g., rain levels and fallen debris), feeding the application with the information to alert drivers to avoid and steer clear of a potential accident site (Khan & Lee, 2019).

Monitoring and controlling vehicles remotely: **Delphi Connect** is a small device that allows drivers to monitor and control their vehicle remotely via the Verizon LTE network(Markus Mueck, 2017). The device includes GPS, so vehicle owners can see both historical maps of when, where, and how far they have driven, as well as real-time information about their vehicle's location. Drivers can use their smart phone to control their car, such as remotely locking or unlocking the doors(Visconti et al., 2019). Parents can enable additional controls to monitor their teenage drivers, so that they receive an alert if their children leave a pre-established geographic region or go over a set speed limit.

B. Benefits of Internet of Things

IOT comes with many benefits that can be enjoyed by the transportation industry as a main pillar of economic development of any given country.

Greater Efficiency: Reduce fuel consumption through fuel-saving advice based on driving

distance, road conditions, and driving patterns; or eliminate costly delays with alerts when roads are congested, blocked, under construction, or have width and height restrictions.

Improved Safety: Maintain driver and vehicle safety (Khan & Lee, 2019) with remote vehicle diagnostics that make it easier for service centers to respond to driver drowsiness, vehicle theft, accidents, natural disasters, and requests for towing, repair, gasoline supply, and tire changes.

Higher Reliability: Avoid downtime and expensive unplanned repairs with a vehicle performance tracking system that sends notifications of imminent maintenance issues.

More Conveniences: Enable drivers to access information on weather conditions, scenic spots, gasoline stations, rest stops, hotel rates, restaurants and parking lots.

C. Issues and Challenges of IoTs

Notwithstanding IoT's tremendous potential benefits, organizations must overcome numerous issues and challenges that are inhibiting IoT's adoption, implementation and growth. To get grounded in and eventually master IoT and enjoy the full potential, organizations will need to work closely with mature vendors to overcome key hurdles, such as:

Lack of standards and interoperable technologies: The sheer number of vendors, technologies and protocols used by each class of smart devices inhibits interoperability. The lack of consensus on how to apply emerging standards and protocols to allow smart objects to connect and collaborate makes it difficult for organizations to integrate applications and devices that use different network technologies and operate on different networks.

Data and information management issues: Routing, capturing, analyzing and using the insights generated by huge volumes of IoT data in timely and relevant ways is a huge challenge with traditional infrastructures. The sheer magnitude of the data collected will require sophisticated algorithms that can sift, analyze and deliver value from data.

Privacy and security concerns: Deriving value from IoT depends on the ability of organizations to collect, manage and mine data. Securing such data from unauthorized use and attacks will be a key concern. Similarly, with many devices used for personal activities, many users might not be aware of the types of personally identifiable data being collected, raising serious privacy concerns. And because most devices involve minimal human interference, organizations need to be concerned about hacking and other criminal abuse.

Organizational inability to manage IoT complexities: While IoT offers tremendous value, tapping into it will demand a whole new level of systems and capabilities that can harness the ecosystem and unlock value for organizations.

D. Solutions and Mitigating Factors

There is need to understand IoT complexity and identify areas where it can offer significant benefits: As organizations brace for digital disruption in their industries, decision-makers from multiple business functions should identify and prioritize the resulting opportunities and risks. Similarly, organizations should focus on developing technology-agnostic solutions to help mitigate threats and capitalize on opportunities of IoTs. Further, leaders should identify key elements that will be required to develop effective solutions to deal with potential scenarios. Chief Information Officials (CIOs) should be encouraged to gain a deep understanding of IoT to take advantage of its benefits.

Develop robust data management capabilities: CIOs can play a crucial role in identifying the data types deemed most valuable for improving operational efficiencies. This starts with specifying the equipment and machines that provide such data and determining how that data should be captured, stored and analyzed to gain insights that can lead to operational improvements.

Develop strong analytics capabilities: Deriving value from IoT requires the ability to manage and analyze large volumes of data. Doing so requires more than basic data management capabilities and traditional infrastructures. Organizations will need to leverage the latest developments in cloud, big data and analytics to mine the large and fast-changing volumes of data for insights.

Recruit and train talent to manage IoT: While technology and capabilities are important, equally

important are the skills to manage IoT complexity and large amounts of data that IoT ecosystems will produce.

Seek help from specialists to complement in-house capabilities: Organizations will likely require help from external specialist organizations to ensure that data is captured and insights are acted upon in timely ways. Specialist partners can offer strong industry and domain knowledge, technical expertise, customer service capabilities and help desk expertise.

Take advantage of network-centric operations: As the IoT ecosystem comprises smart devices and connections between them, organizations should build and take advantage of network-centric operations. In this setup, information is shared with users who are provided with need-based access to emerging technologies like IoTs.

Integrate machine data with enterprise systems to optimize business processes: The real value of the IoT lies in integrating data produced by devices with business processes to optimize critical functional areas and improve operational performance. Organizations should also focus on how the data produced by the IoT ecosystem can be used to improve products, services and processes or develop new ones. For instance, organizations can improve inventory management by using the real-time data generated by Machine to Machine (M2M) communications to eliminate the manual collection of information on stock levels(Kashyap, 2018).

Use Code Halos to establish new thresholds of business performance: The IoT ecosystem, with its billions of connected smart devices, continuously produces and shares digital information. Businesses can use these Code Halos to create unprecedented levels of insights and business value (Malcolm Frank, Paul Roehrig, 2014).

IV. CONCLUSION

By mastering and enhancing the ability to create and manage IoTs transportation industry leaders are establishing new thresholds of performance and delivering highly personalized customer experiences, products and services, while achieving high efficiency levels. Organizations can only expect to witness faster transformation and disruption of their traditional business models given the rate at which digital technologies, devices, connectivity and networks are evolving. Clearly, the winners will be companies that will embrace the use of IoTs in carrying out their business operations as a competitive tool to compete with new entrants and traditional competitors to keep growing their businesses.

From the above foregoing, the following two hypotheses are derived: the implementation of IoTs in the transportation industry will reduce the cost of operation leading to better transportation services hence improving the economic developments of any given country, the implementation of IoTs will lead to improved ways of implementing and monitoring policies by transportation industry stakeholders.

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