An Exploratory Study On The Application Of Internet Of Things And Monitoring Systems In The Automobile Industry

Ibrahim Ali Mohammed
DevOps Consultant
Department of Computer Information Systems

Abstract— The focus of this paper was to analyze the role of IoT and monitoring systems in the automobile industry. The automobile industry is growing at a faster rate as the world population and demand for vehicles increases. The trend of IoT in automobiles is increasing every day due to the proliferation of automatic vehicles. This will cause many changes in the automobile industry as many customers look at improving their interactivity with their vehicles [1]. Modern industry is embracing the use of computer chips and sophisticated sensors to control how vehicles operate in various environments. The mass interconnectedness of many functionalities in vehicles is now a common phenomenon in car manufacturing. This will continue to advance as the demand for more efficient vehicles increases [2]. Automotive IoT incorporates many devices in their systems to optimize the functionality of their products. Most of these interconnected devices are complex and collect large volumes of data that will be processed in real-time. Common devices that form the automotive IoT include sensors, GPS trackers, and cameras. The main role of incorporating IoT in automobiles is to optimize the manufacturing process while also making transport manageable and more efficient. It also makes automobiles more intelligent when moving from one point to another. The advanced IoT features are effective in-vehicle interaction, predictive maintenance, road safety, enhanced quality control, and minimized human errors [2].

Keywords— Automobiles, Automation,sensors, GPS trackers, Internet of Things, IoT monitoring, car manufacturing, Automotive industry

I. INTRODUCTION

IoT can be described as interconnected devices that work together as one system to increase the efficiency of processes. The IoT makes a lot of contributions to the automobile industry by improving the efficiency of vehicles which ultimately improves the transportation industry. IoT has made the automotive industry advance in how people interact with their automobiles. China is already embracing automation with the manufacture of driverless buses that can pick up passengers and drop them off at their designated places. Automation has been seen in the manufacture of driverless vehicles like Tesla. With IoT being part of the components in manufacturing, many vehicles are now becoming more interconnected, smarter, and safer. Additionally, customers are saving money that would be required for frequent maintenance by solving the problem before it occurs. IoT is generally an effective component that improves the overall customer experience for the millions of customers buying cars every day [1,2].

The automobile industry is considered one of the biggest manufacturing sectors with over 70 million units produced globally. The global turnover as of 2017 was projected at 3 trillion dollars with a combined global GDP of 3.65%[2,3]. This is a bigger industry with yearly sales increasing exponentially every year. It was projected that it's over the last four years, the sales were between 75-80 million units. Innovation will tremendously increase sales as customers seek to buy cars that will suit their needs. If most companies adopt the IoT technology in most of their products, they will see a breakthrough in the number of sales [3]. Customers are always looking for futuristic products that they can connect and interact with to satisfy their needs.

IoT is opening up more space for exploring new innovative solutions to modern automobiles [4]. The current industry needs automated and variegated multipurpose applications to solve current challenges in the transport sector. Understanding the roles of IoT in the automobile industry is important for manufacturers and customers to boost the global automotive market [4,5]. This paper will therefore explore how IoT is revolutionizing the automotive industry and optimizing the industry into a better sector for the benefit of the customers.

II. RESEARCH PROBLEM

IoT can be described as interconnected devices that work together as one system to increase the efficiency of processes. The IoT makes a lot of contributions to the automobile industry by improving the efficiency of vehicles which ultimately improves the transportation industry. IoT has made the automotive industry advance in how people interact with their automobiles. China is already embracing automation with the manufacture of driverless buses that can pick up passengers and drop them off at their designated places. Automation has been seen in the manufacture of driverless vehicles like Tesla. With IoT being part of the components in manufacturing, many vehicles are now becoming more interconnected, smarter, and safer. Additionally, customers are saving money that would be required for frequent maintenance by solving the problem before it occurs. IoT is generally an effective component that improves the overall customer experience for the millions of customers buying cars every day [1,2].

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III. LITERATURE REVIEW

A. IoT Monitoring

Scholars have defined Internet of Things (IoT) monitoring as an assessment, discovery, monitoring, and managing process for interconnected devices. This is an important task for any business in discovering what impacts its operations, services, and production. This is why IoT is often referred to as an industrial Internet of Things [6]. There are many industrial uses of IoT which are proving to be significant for many operations. IoT can help modify business models while improving productivity, reducing production costs, and increasing overall efficiency. Most of the devices we use today are interconnected to others through the internet. For instance, one can send an email to another device through the internet. In most cases, these devices can generate data and interact with many devices through the IoT resources preinstalled into them. However, this interaction can be a risk if these devices are not secured using proper security systems. Hackers can cause damage by sending viruses to applications, servers, and systems. Data security is important in monitoring and managing what IoT devices receive, collect, and process. If used properly, IoT is a valuable tool for many industries especially the automobile industry [7].

B. IoT Automated Monitoring Solutions

The Internet Of Things is an important resource in automating systems in many manufacturing processes. These processes are done by deploying commands and actuators which allows the systems to make decisions based on the data it is fed. Most of the data are collected from sensors[7]. Some of the automated control solutions in manufacturing processes include:

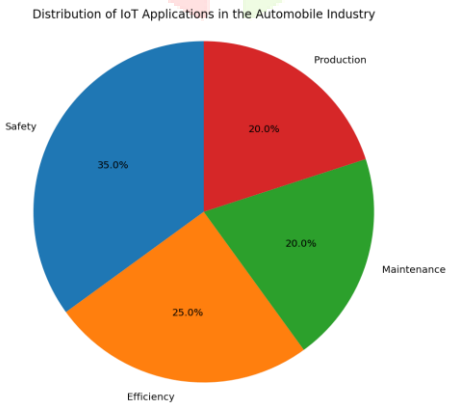

Fig i: A pie chart showing the distribution of IoT applications in automobile industry

i. Rule-based management

This solution is based on the ability of a system to collect and utilize data in running operations. The system must be installed with algorithms that can analyze and produce results. In rule-based management, there must be procedures formulated before the installation of a system. A good example of this process is the use of IoT monitoring by railway companies like Deutsche Bahn in Germany. This company utilizes IoT monitoring to measure cargo parameters, temperature, and vibration [8]. Once the data is received, they are compared with already stored parameters to identify any differences. Any permissible values will be configured using control applications.

ii. *Machine Learning Control*

Machine learning is an important technological advancement in automobiles as the most advanced IoT system.ML utilizes data collected by sensors and other tools to analyze any phenomena in any system using algorithms [8]. This is used to develop models which are then validated for accuracy and correctness. This is then deployed on the IoT system to run the processes of the subsequent operations. Machine learning replaces human analysis with commands from the accumulated data and information collected by sensors. Machine learning has a high potential to optimize many complex processes that would otherwise be burdensome to human abilities [9]. It helps in the optimization of resources like time, data, working hours, and materials[10].

C. IoT advances in the automotive industry

i. Fleet management & telematics.

The potential of IoT in the automobile industry can be seen in fleet management. With IoT incorporation in fleet management and telematics, companies in this industry can automate their operations and reduce the cost of doing business. Some of the roles played by IoT in fleet management include tracking the location of vehicles, monitoring their speed, driver behavior, fuel consumption, and load management. IoT provides analytical information to fleet managers that they can use in assessing cost-effective routes, the performance of vehicles, and monitoring the behaviors of drivers. IoT can also be leveraged in the predictive maintenance of vehicles using sensors to prevent any disruption of operations[12]. A good example of this functionality is in the DHL Smart Tracking solutions to provide information like traffic, location weather conditions, etc. This is necessary for field scheduling and understanding the most important factors in route optimization.

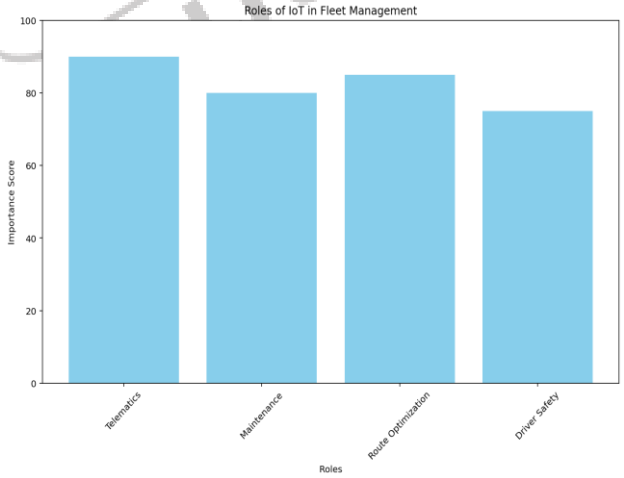

Fig ii: Roles of IoT in fleet management

ii. Connected cars

Vehicle interaction can be improved through interconnected devices like sensors. This functionality is important when communicating relevant information like speed, routes, location, fuel consumption, etc. Vehicle-to-vehicle (V2V) interaction is an important feature in minimizing and controlling accidents on our roads [13]. This is also helpful to

drivers in avoiding accidents when nearby and navigating through traffic.

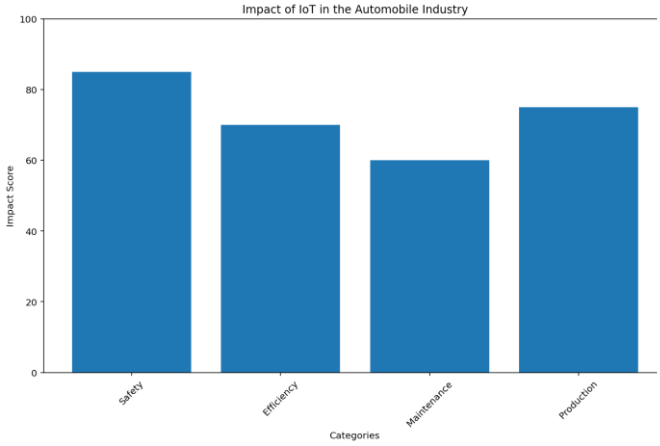

Fig iii: A bar graph showing the major impacts of IoT in automobile industry

C. Predictive maintenance

Vehicles can be installed with IoT sensors which can be useful in detecting any malfunctions in a vehicle. These sensors can collect data on various conditions of a vehicle including engine temperature, fuel consumption, run time, and fluid levels among other factors. Drivers can be warned in real-time about any malfunctions to prevent any breakdown of a vehicle. Monitoring these conditions is important in making informed decisions about a vehicle especially when servicing is needed. These predictive maintenance schedules are necessary for drivers to save time and prevent vehicle breakdowns. Some of the companies that are embracing IoT devices are Volvo and Tesla. Volvo introduced the Sensus Connect Infotainment System which is based on cloud-based services. These systems have navigation mechanisms using 3D maps which enable drivers to receive destination information in remote locations[13,14]. They can also allow many vehicles to interact with each other on a wide web while also simplifying car ownership.

IV. SIGNIFICANCE AND BENEFITS

IoT is offering many benefits to the automotive industry especially in analyzing systems and providing alerts. IoT has bridged the gap between devices and processes for many stems and this is critical to the manufacturing industry [15]. This innovative technology can track many functions of a vehicle from engine temperature, location, fuel consumption, and fluid levels. This information is relayed to drivers in real time which makes it efficient in monitoring the conditions of vehicles. Fleet companies can utilize IoT sensors to fix many problems in their service, especially the quality of the service. As noted earlier, IoT provides analytical information to fleet managers that they can use in assessing cost-effective routes, the performance of vehicles, and monitoring the behaviors of drivers. IoT can also be leveraged in the predictive maintenance of vehicles using sensors to prevent any disruption of operations. IoT can also improve resource utilization especially when regular servicing is done before a vehicle breaks down. Factories can use IoT to maximize the use of resources and identify problems. IoT offers a cost-effective way of monitoring and fixing manufacturing challenges in the automotive industry.

V. FUTURE

IoT will transform the automotive industry in the U.S. into a more futuristic sector of the economy. The demand for more automated and self-driving vehicles will drive manufacturers to embrace IOT in their products. The ability to increase the interaction between customers and their vehicles will increase demand and push for connected devices that can be controlled remotely. The U.S. will also see more innovative IoT vehicles, especially flying cars as manufacturers embrace the insights from self-driving cars. Vehicles will also be monitored through remote automated systems which can track many conditions of a vehicle. The increased IoT control and monitoring will see improved operations and vehicle maintenance. This will be beneficial to fleet companies in managing costs and improving servicing of their vehicles needed for long distances [18]. The transport companies can also monitor how the vehicles are loaded and the distance traveled to assess the best routes. Any malfunctions will be detected faster using sensors that collect information on a vehicle's wear and tear.

V. CONCLUSION

The main aim of this paper was to analyze the role of IoT in the automotive industry. Some of the aspects of IoT monitoring were explored to understand how they improve various operations. Fleet management has gained a lot from IoT devices installed in their vehicles. They can cut costs on repairs and operational needs as they travel for long distances. In addition to cutting costs, IoT has also increased customer satisfaction due to the automated functions of a car. IoT technology has also found its way into self-driving cars pushing the demand for increased production of futuristic vehicles. As noted earlier. IoT is opening up more space for exploring new innovative solutions to modern automobiles. The current industry needs automated and variegated multipurpose applications to solve current challenges in the transport sector. Understanding the roles of IoT in the automobile industry is important for manufacturers and customers to boost the global automotive market. The future looks bright for the automotive industry as IoT is embraced more to increase the efficiency of vehicles while also cutting the costs needed to run them daily. IoT will push automotive companies to produce more vehicles with automated functions to improve customer experience.

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