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Applications of Big Data in Automotive Industry: A Review

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Abstract: The Automobile industry has been a large shareholder in the global economy. Since its inception in the early 20th century, the automotive products have been greatly valued as they majorly influence the mobility of goods and people. There's a large amount of Digital footprint which is being produced at a large scale in each and every domain. This ever increasing interaction over the technology dependent global platform has called up for a better management of data with efficient tools. The world with rapidly increasing e-literacy and open access to the internet, people's contribution to data generation is gaining at an impeccable rate. The following paper has been written with an objective to provide an idea to improve the existing technology used in the automotive industry. In this context, the paper explains about the technical aspects that are related to Big data which helps to enhance the production, sales, resale, research and development and related processes cognitively and statistically.

Keywords: Big Data, Automobile, Cloud Computing, Analytics, Cost cutting, Hadoop, Distributed platform, HDFS, OEMs

I. INTRODUCTION

The automotive industry is one of the sectors which deeply contribute to the economy of the nation. With its large customer base, the dealerships can enhance their services by accumulating and analyzing the customer data using big data tools. This will help to increase the revenue turnover of the dealership and also respond appropriately to the changing market needs. By deriving fruitful insights from the analysis of the data obtained, OEMs and dealerships can improve their sales and services along with providing better customer experience.

As the world connects in the tips of the fingers through a mobile phone device, it has sort of become obligatory for the industries to scale up the infrastructure and provide the services and processes digitally. The tedious documentation and paperwork involved in closing a deal for purchasing a vehicle causes friction between the buyers and the business to convene the processes seamlessly. By transforming all the records and documents into digital information, dealers can manage to provide a seamless experience for their customers in the process of finalizing the contract digitally and even remotely.

II. RELATED WORK

There are various preliminary works regarding the utilization of big data technology in the field of automotive industry. Deloitte Inc. has published a research document which focuses on the supply chain efficiency after using analytics on the processes. It has shown major improvement in productivity after the alterations made post analytics. (Awais Akram Mughal, 2018) elaborates the methods for Big data storage, representation and processing required for the automotive industry. (Amini S, Gerostathopoulos I, Prehofer C, 2017) describes a situation where big data technology was applied in a dealership in Ohio and drastic positive outcomes were seen. A detailed explanation for the application of big data in the automobile industry is described. To understand the concept elaborately, few case studies are described with a comparative analysis.

III. IMPACT ON AUTOMOTIVE INDUSTRY

There are numerous independent processes involved in the automotive industry. This begins from setting up an industry for manufacturing and setting up a production line for an efficient build of the products. Supply chain of materials has to be intact in order to maintain continuous supply of components and appropriate orders have to be timely placed in order to achieve it. From the OEMs, the finished vehicles are handed over to the dealerships who sell the vehicles according to the customers' requirements. The dealerships also get periodic repair orders in terms of vehicle service. This needs the dealership to maintain supply chain parts and have sufficient stock in the inventory.

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Big data provides an infrastructure to store all the information regarding the customers, inventory, sales, services, spare items stock and similar things. The cloud storage makes the infrastructure cost effective and non-physical and provides a great cut of deal to the host. Inculcating the analytical methods and machine learning paradigms can help the dealer to provide custom services to their clients and provide enormous customer satisfaction.

Data can be obtained by profiling the users and providing all the dealership associated services in a single platform. This supports in gathering the information about the customer about the interests and aspirations specific to them. Since the custom data of a vast customer base has to be stored, Big Data stands out to be the appropriate technology in storing the data of high variety. Using machine learning algorithms, the users can be provided with the specific products, add-ons and allied retail services which adapt to their needs.

Major Data Sources

1. Stock Inventory - In and Out data of parts
2. OBD Dashboard
3. Telephone Data and Mobile GPS (G. Leen and D. Heffernan, 2016)
4. Onboard infotainment system

Stock Inventory in the dealership maintains the data of available parts for its usage. Using intelligent systems and configuring the database, auto order placing mechanisms can help in accommodating the continuous supply of parts. The big data can depict the peak sales period and hence provide suitable insights to place the required number of parts with the OEMs.

In the age of dominant infotainment, it can significantly contribute in understanding the behavior of the vehicle and its users. Different user profiles are targeted to accumulate the posts and activities to understand their scope of interest. This is done in real time with the help of big data and insightful data points are derived using Big data analytics. The geo-tagging of the data is made by attaching the coordinates of the post with the body of the content.

Global Positioning System(GPS) helps in gathering the mobility data of the target and helps in understanding the usage and utility aspects of the vehicle. Based on this, the service technician can provide appropriate services to the vehicle and make use of the data.

OBD Dashboard data can help in understanding engine performance, battery efficiency and provide insightful information about the ways in which the vehicle owner can inculcate actions to improve the performance. This data also helps in detecting the wear and tear of the mechanical parts and highlights the dealership to perform appropriate servicing to improve the vehicle.

IV. APPLICATION OF BIG DATA IN AUTOMOTIVE INDUSTRY: A CASE STUDY ON A DATA-DRIVEN PREDICTIVE MODEL WITH DYNAMIC DATA COLLECTION TO ENHANCE THE AUTOMOTIVE BUSINESS

The data science team of Deloitte LLP. created a researcher team to understand the opportunities in the automotive industry which has been stagnant in the technological point of view. The team understood that the entire automotive industry has been damped with lots of manual procedures right from placing the orders from multiple vendors and the processes were found to be dwindled with redundant actions. The primary objective of the research was to establish a time standing solution to satisfy the requirements of the industry and to monitor and eradicate redundant processes. It also aimed at providing a rapid response in minimizing processes with the help of advancing technology.

The source of data for this research was gathered from various sources which are having their own limitations. The regulatory policies of the state hampers the objective as it denies the collection of all the data required by the team. This was causing the delay in data acquisition as there were constraints between the states regarding data privacy.(Bisson, M. et al, 2016). Peak regions were recognized where the sales shot up during certain points of time which were seasonal and depended on varied factors.

The team also recognized the service of the vehicles were periodic and could generate constant and reliable revenue to the dealership. Using Big data, suitable recommendations can be made after analyzing the vehicle information to suggest the customers routine actions such as oil change, wheel replacement, etc.

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A vehicle's lifetime can be segregated into following parts,

1. Manufacture by OEM
2. Display in Showroom
3. Customer Purchase/ Retail Sale
4. Service

The first two items in the above mentioned list arepre-retail phases and the remaining are post-retail aspects. Pre-retail phase is usually a static phenomena because the production takes place and only concern is to ensure the reliable supply of the raw materials. The production speed must be varied according to the market demand and this can be understood by analyzing the big data.

Post-retail phase can be divided into two parts. The Retail sale is a variable operation where the customer interacts with the industry only once during the purchase. To understand the sentiment and requirements of a new customer, a sophisticated CRM module has to be developed and provocative suggestions must be made to the customer by using the data in the CRM. This helps in raising the business during the vehicle sale. Service part in the post-retail phase is a fixed operation. The vehicle owner, who is the customer to the dealership, shall periodically visit the dealership to get the vehicle service done. Using the vehicle data and the CRM data, appropriate suggestions can be furnished to the customer to make a wide choice.

Accumulation of all types of data on a large scale is gathered through Big data. This helps in both pre-retail and post-retail phases. The reliability of the data compliments fast paced processing and provides it to the analytical phase. The market insights can be derived with this analytics and make true positive assertions and reach a fruitful conclusion. This makes the analytics more true to the reality and gives a prominent advantage to the dealerships in making advantageous decisions.

A centralized customer relationship management creates a database to gather customer data. This allows the dealer to obtain the insights regarding the customers' choice and make itself possible to cater the requirements of the customers. The possibility to make the customer experience richer is the key advantage for any dealership to attract customers. The value it adds to the service is more than anything when compared to the other dealerships in the competitive market.

The insights inferred from the big data analytics were found to be useful moments before the occurrence of market downfall and help in reducing the production. Also, they were found to be reliable and it was possible to respond to the possible breakdown of a vehicle well before and react to it accordingly. The parameters denoted by the analytics and the behaviors of the target persons in driving the vehicle, analytical calculations can predict the possible wear and tear of the parts and its type at a certain point of time. For example, abnormal values of key performance indicators (KPIs) help the technician to detect the improper fitment and irregularities.

The retail sales of the vehicle is also associated with the financial assistance to the customer from the bankers, insurance for the vehicle whose premium depends on the insurance cover of the package and inclusion of additional accessories to the vehicle in the form of new features or designs. By understanding the users requirements by the big data, the dealership can increase the turnover by recommending suitable products to the customers.

By providing the user-centric services on the digital retailing platform, the dealership shall be able to obtain a competitive advantage over the competitors in the market as it provides favorable features to its customers. This helps in gathering a large customer base and also attracts new users to its portal, hence an opportunity to gather data from the source. This data is effective when the customer revisits the outlet or any of its branches as the sales team can use it to interact with the customer without any enquiries or questionnaires with them and save valuable time.

This research consists of a thorough walk through regarding the automotive industry's advancements after inculcating Big data technology in its business. The big data helped the dealerships in placing appropriate amounts of order for the sales. The cloud native infrastructure enables streaming data to be stored in the big data architecture.

V. CHALLENGES IN AUTOMOTIVE INDUSTRY IN USING THE BIG DATA TECHNOLOGY

1. Big Data Collection

The various types of data as mentioned above have lots of veracity and variety. This may cause difficulties in the process of information retrieval and data collection as there is heterogeneity among them. The process can be made instance specific to deal with the issue of data collection and by using appropriate methodology in the process.

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2. Cyber Infrastructure and Data Security

Data consists of pivotal information regarding individuals and should be as private as possible. It is the responsibility of the dealership who has contracted with the compliances to maintain the data integrity of the retrieved data. Data warehouses also have the preliminary responsibility to safeguard the data from the cyber criminals who leak the information often for malicious purposes. The cyber security of cloud data is also taken as a primary concern in the implementation of the big data architecture.

3. Big Data Analytics

Performing analytics on such a huge data source requires adequate system resources and has to accommodate high resolution factual information if required. The erosion of data must be firmly withheld so that it does not result in data loss and make the analysis a false positive. The requirement to have a distributed system to maintain a big data architecture has the necessities to consist of cloud infrastructure and reliable network connectivity.

RESULTS

The Automotive Industry today is a major contributor in the economy and contributes enormously to the nation's GDP. This industry has been in action since centuries but has failed to inculcate technological advancements along with the time. The backlog created by this stagnancy has caused tremendous friction between the components of the industry. In the age of the digital world, the process of purchase is still in the pen and paper and consumes lots of processes to reach out to any document after some years.

Dealerships also gained multifold profits in a quarter and had a great turnover in a short period of time. This supported the dealership to scale the existing infrastructure to make more investments in the domain of research and development. The integrated approach established by the seller makes the customer experience smoother and attracts the customers to their store in the event of a new purchase.

This review thesis explains the application of big data in the sector of the automotive industry. Starting with the overview of the present automotive industry, the paper carries the reader through the existing constraints and blockages in the automotive industry. Improvement of the economic turnover is a possible positive outcome which can greatly impact the sales and revenue of the stakeholder.

CONCLUSION

Big data being an emerging technology can provide a great transformation to the automotive industry. Automotive industry, which is greatly expanding since centuries, has been hindered with conventional methodologies. Using modern day technology, the transformation of this industry can be made successful by providing insightful analytical results to the service providers, dealerships and the OEMs. Big data shall definitely help the automotive industry to gear up with the softwares that scales up the businesses by many folds.

With the enhanced customer experience, it always provides an extra mile for the stakeholders to advance in the arena of intense competition. This shall compliment both the dealerships and their customers through the seamless transactions between them. This paper can also be used in fully digitalizing the processes which now, mainly remain on paper. This helps in accessing the user data immediately when required and provides better services within less time.

In the years to come, it is expected to scale all the business operations in the automotive industry to shift to a cloud native, online mode of purchase enabling the services to the customers remotely. The pacifying speed of technical advancements supplement the establishment of such a cloud native model. The users can now create a sale deal and choose customizations related to their vehicle and demand minute specifications to their make of vehicle. Also, existing users can make contactless periodic services of their vehicles by using IoT based vehicle key placing pods to and make a secure checkout. Contracts can be digitized and made entirely paperless including the signature of the buyer and dealer which creates a smooth customer experience. In a nutshell, tech driven automotive industry has a great potential to exploit the existing frictions and holes between the processes.

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