

# Revolution in Manufacturing by ML

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**Abstract**— A smart stick has been designed and realized for providing alert based assistance to the visually impaired and blind people for walking at the outdoor streets or at indoor house. The proposed smart blind stick has some exclusive additional features apart from its collision avoidance assistance feature, such as its low cost, fast response, low power consumption, lightweight, water indication, etc. The smart blind stick uses an ultrasonic sensor to identify the obstacles in front of the blind people and alert him/her via buzzer sound as well as mechanical vibration in order to avoid the obstacle; the smart stick is not only capable of detecting solid obstacles, but also it can alert the user when it detects the presence of water on the way by using appropriate water sensing arrangement. Rigorous performance evaluation of the prototype have been done by repetitive experiments for optimizing its accuracy of performance under numerous situations; in average the maximum achievable range of detecting the obstacles are found to be around 2 meters.

**Keywords:** Machine Learning, Industry 4.0, Revolution by ML, ML in Manufacturing

## I. INTRODUCTION

The rapid development in technologies which involve Internet of Things is one of the reasons for growth of manufacturing industry 4.0. Combination of IOT and software provides intelligent systems that work with high efficiency and generate error-free results. These intelligent systems act proactively and reduce failure rates. These features are fully based on data collected in the past, which is also known as Big Data. Machine learning algorithms are a way to analyse huge data and extract meaningful insights form it.

Machine learning and AI are boosting technologies around the world and impacted on almost every sector. Recent advancements in ML and AI drastically changed the manufacturing industry. The manufacturing industry is now overcoming critical challenges such as high-quality products at a minimum cost. In the manufacturing sector, ML is applied to the entire supply chain to improve operational efficiency and to minimize costs.

The concept of smart factories is achieved by manufacturers by making the systems compatible with ML. Smart factories also called as digitized factories, can continuously monitor the production and help to work proactively in case of system failure. ML algorithms are powerful enough to monitor systems, to forecast breakdowns and to schedule timely maintenance. Although industry 4.0 is largely automated, it still requires human support. There is no doubt that machines can perform tasks with perfection, but when it comes to performing one precise job human specialist must interfere. Currently, machine learning techniques are the only way for machines to adapt to changing environments and build more complex strategies for achieving their goals, which cannot be achieved with explicitly programmed

solutions. This paper describes how machine learning works and how it is able to fulfil recent industry challenges.

## II. HOW ML WORKS

Machine Learning is a subset of artificial intelligence that allows software applications to predict outcomes more accurately by considering historical data as an input. Machine Learning broadly classifies itself into two parts. Supervised Machine Learning and Unsupervised Machine Learning. This classification is done based on how algorithms learn to be more accurate in their predictions.

### A. Supervised Machine Learning:

As named supervised machine learning requires data scientist supervision to train the model by providing labeled inputs and desired outputs. Supervised machine learning uses classification and regression to develop machine learning models.

#### 1) Classification:

Classification is used to predict discrete values. It uses a function that can divide a dataset into classes based on various parameters. The function is trained on training dataset and based on that output data is categorized into different classes.

#### 2) Regression:

Regression is used to predict continuous values such as salary age and cost. Regression finds correlation between dependent and independent variables and predicts the continuous variable.

### B. Unsupervised Machine Learning:

Unsupervised machine learning doesn't require human interference as it doesn't require labeled data. It identifies the patterns from the dataset on its own. Unsupervised Machine Learning uses clustering algorithms to develop models.

## III. CHALLENGES IN MANUFACTURING

As the manufacturing industry is running on a large scale, many manufacturers are facing some challenges while running their business. This section is all about what are the common challenges faced by manufacturers currently.

### A. Efficient manufacturing plants:

To increase productivity, reduce costs, and maximize profits. Manufacturer's goal is to increase efficiency at manufacturing plants. To provide low-cost products, many of them sacrificing their quality of product. However, compromising quality may result in a reduction in profitability, as customer trust will be lost due to low quality products, and they refuse to buy the products anymore.

### B. Predicting Demand:

Before launching any product in market, it is necessary to do market research that will give an idea about customer's thoughts, expectations, and requirements. It helps manufacturers to look at future demands and design their

strategies accordingly. However, some industrialists are unable to predict market demands and end up manufacturing the wrong product (that is, not fulfilling client expectations). As a result, sales go down and have effects on profits.

#### C. Project Management:

Managing multiple projects at a time is a big deal for manufacturers because the goal is every project must be ready within deadlines with quality. Sometimes due to heavy workload, manufacturers fail to launch the products on time or they might lose some quality which leads to risk of losing client as well as money. Moreover, keeping track of each project and pushing the team to give their best is again a challenge in itself. In all this rush, there is a high chance of neglecting or missing important things in a project which again leads to big issues for the organization.

#### D. Requirements Checking:

Before starting any project, manufacturers need to analyze what are the requirements of the project. The calculation for raw materials, required time and manpower is done and based on that cost is estimated for the project. Due to errors in analysis manufacturers face shortages or limited access to materials. Sometimes the raw materials need to be exported from other parts of the city or from other country which also require cost. If a shortage of material happens then manufacturers need to order those things again, which increases transport costs. However, this cost is not included in the estimated cost; the industry must pay for it on their own. Similarly, due to some human errors rework needed to be done which increased the required time than estimated. This situation moves the organization towards a loss.

#### E. Marketing challenges:

Targeting the correct audience for a product is a key part of marketing. If product advertising is done within the wrong group of people, then all the efforts and time will go in vain. To find the targeted group of people and convince them for the product also required a lot of efforts. Winning Customer's trust is necessary to look outside of competitors group because every competitor is trying their best to win the market. In such cases, the correct way to advertise the product is also important. Overall marketing is the 1st step towards profit.

### IV. SUITABILITY OF ML FOR MANUFACTURING CHALLENGES

Machine learning helps manufacturers manage manufacturing plants. ML algorithms allows managers to continuously monitor machine performance and give exact information about important factors such as number of machine cycles completed, product is in which stage, required temperature is providing or not as well as ML can monitor machine maintenance points such as which part of machine needs to be replaced, it can also predict when the maintenance of machine need to be done. ML can help to extend machine lifetime by continuously checking lubrication temperature and running time. It will generate a report for managers which can be used to take care of machines.

Machine learning fully works with algorithms and historical data; these are the important aspects to predict

future situations. In manufacturing, predicting demand is one of the biggest challenges. Supervised or unsupervised machine learning algorithms are used to analyze historical data and generate market demand patterns. Based on which predicting future demands becomes easy, that gives manufacturers an idea about what market is expecting and they can plan their production accordingly. Machine learning algorithms can also help manufacturers to know what their expected group of consumers are expecting from their product. When these important things are known in advance, then it becomes easy to build a product accordingly. And this will ultimately lead to profit.

In an organization the important task is to manage all the projects. It is a difficult task to look out for every project and keeping it on time, managing budget and assigning people to projects. To handle these factors smoothly, ML learning and AI have extraordinary algorithms. Intelligent project management assistance is a gift for project managers as it has the capability of scheduling, reminders, and follow-ups. These intelligent systems when integrated with popular communication tools such as Slack and Project Management tools such as JIRA, make processes easier. AI bots can send notification for follow-up on certain emails and the due dates for deliverables. Intelligent systems have proved to be a significant time saver for project managers as it can handle less intensive tasks and allow project managers to focus on their teams and their efficiency.

Requirement management is the most significant factor in the success and failure of the project. Poor requirement management leads to extra cost, extra time, rework, and poor quality. AI-driven systems help manufacturers to estimate requirements beforehand and prevent shortages of materials or wasting money on extra goods. ML models can do magic by analyzing data related to a project and estimating the exact number of raw materials needed. This allows managers to import materials within a time frame and to calculate the total cost for it. that can make the final overall cost estimation easier.

By adopting ML and AI-driven systems in manufacturing, it is possible to act proactively and to avoid major mistakes which can lead to poor quality products and the market image of the organization.

### V. BENEFITS OF ML IN MANUFACTURING

ML has been successfully utilized in various process optimization, monitoring and control applications in manufacturing, and predictive maintenance in different industries (Alpaydin, 2010; Gardner & Bicker, 2000; Kwak & Kim, 2012; Pham & Afify, 2005; Susto, Schirru, Pampuri, McLoone, & Beghi, 2015). ML techniques were found to provide promising potential for improved quality control optimization in manufacturing systems (Apte, Weiss, & Grout, 1993), especially in 'complex manufacturing environments where detection of the causes of problems is difficult' (Harding, Shahbaz, & Kusiak, 2006). However, often ML applications are found to be limited focusing on specific processes instead of the whole manufacturing program or manufacturing system (Doltsinis, Ferreira, & Lohse, 2012).

A. *ML advantages in specific department are discussed below:*

1) *Predictive maintenance:*

Machine learning benefits in predictive maintenance are seen as Reduction in failures, downtime, and repair time. As it can predict equipment failure, unplanned downtime, and inefficient emergency repairs, that's why it leads to lower maintenance cost.

2) *Quality control:*

Machine learning offers algorithms that compares products against common fault and filter out faulty products. ML-based computer vision algorithms has great contribution in product inspection and quality control. ML -based quality testing can increase the detection rate by 90%.

3) *Inventory management:*

Using machine learning algorithms inventory management affecting factors can be minimized. It is now becoming a trend in manufacturing industry. By using ml manufacturers can observe improved stock tracking accuracy, optimized inventory storage and transparency in supply chain communications.

4) *Product development:*

ML can improve product designs and can help in managing product development factors. It can reduce risks associated with development of new products and create new revenue stream for business.

## VI. CHALLENGES IN ML DRIVEN MANUFACTURING:

ML can perform extraordinary in the manufacturing sector with all its positive impacts on business and can take the business to the next level of success. However, to implement ML in a business is itself a tricky and difficult part. It is not like just picking an algorithm and applying it over the desired part of the business. But it also requires human attention; it also needs to be maintained by experts. Some big challenges in ML-driven manufacturing are:

A. *Shortage of Experts:*

Even ML models are self-learners and can perform the task by themselves; it requires human assistance to look whether it is behaving in right way or not, it is most important to check that the model is giving output in desired way with accuracy or not. For that, a team of AI professionals, data scientists, ML engineers and data analysts is required. Many businesses cannot afford to hire these experts. On the other hand, big firms who have the capability to hire these resources, are unable to find the desired quality and experienced individuals. It is a fact that there is a shortage of skilled people in this sector.

B. *Infrastructure:*

The manufacturing sector always has a wide variety of tools, machines, and production systems. To deploy machine learning models on those systems requires additional infrastructure to handle ML models. Sometimes the industry is working with outdated software which is incompatible with ML systems. It creates difficulties in connecting with sensors, databases, and frameworks. To make everything compatible with ML requires high cost for installation of new systems.

Some businesses find it unaffordable, while some lag in finding proper guidance on making everything ML-driven.

C. *Data Quality:*

High quality data is base for success of ML models. But in manufacturing having quality data is more challenging as this data is often biased and full of errors. Production systems mainly work in extreme environments with lots of noise, high temperatures, and vibration. These factors may affect data and decrease data quality. This data with lots of impurities needs to be preprocessed. Data preprocessing process will get extra time resulting in delay in production process. Also, bad quality data highly effect on outputs generated by ML model.

## VII. CONCLUSION

Machine learning has obviously done miracles to every industry now a days, especially in manufacturing industry; all three business stages (operations, production, post-production) has impacted greatly. All crucial tasks such as production systems, business planning, predicting client expectations, etc. are running with less effort and more accuracy. Overall, it can be said that ML is a key factor in industry 4.0. It is not only supporting manufacturers to upgrade the quality of products but also to earn more profit. ML algorithms are strong enough to run an entire production system automatically with minimal human interaction. Overall, it is agreed upon that ML allows to reduce cycle time and scrap and improve resource utilization. Furthermore, ML provides powerful tools for continuous quality improvement in a large and complex process.

However, migrating to a ML-driven business demands sophisticated tools and ML-compatible systems with a highly qualified team. Installing ML-based systems is of course challenging but managing them and turning a business towards the next level of success is even more strenuous. As ML and AI primarily work on data, having appropriate data is again a big task. Machine learning algorithms train themselves on historical records, so if the historical records are erroneous and impure, then the model will train in the wrong way and hence the out-result will get affected. Moreover, the data collected through various resources might not be consistent and have lots of impurities. This case required extra efforts and resources. Despite these obstacles, many industries are adapting to it and coming up with extraordinary innovations in the market. If there is a capacity to overcome challenges, then ML is definitely a booster for the industry.

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