Best Possible Overview of Industry 4.0

I am fascinated by all of the trends that have been subject to discussion in the industrial automation and machinery world. Enabling technologies such as artificial intelligence, new possibilities in robotics, and more have had an enormous impact. I also strongly believe that new industrial processes and possibilities affect us all in many different ways. Therefore, I'd like to look into concepts, approaches, workflows, and future possibilities in industrial automation with you. I will cover topics such as machine learning, collaborative robots, the Internet of Things (IoT), predictive maintenance, and edge computing among others. In doing so, I will try to give you the best possible overview of what is referred to as "industry 4.0".

Let's start with predictive maintenance. Predictive maintenance aims at detecting possible failures early thus preventing them from happening. The goal of predictive maintenance is to maintain the machines proactively and to minimize plant downtimes. Maintaining machines proactively and minimizing plant downtimes is mainly done by proactively initiating maintenance measures early with the hope of preventing the actual occurrence of the fault. However, to predict an occurrence accurately, it is necessary to collect, store and analyze large amounts of data. How can a system handle this vast amount of data?

The Internet of Things In Predictive Maintenance
Handling vast amounts of data is a challenge. The recorded measured values and diagnostic data are transmitted from the machines via networks to service centres or directly to the manufacturers. As you can see, such a sophisticated network structure requires techniques and databases from the bigdata environment. To overcome such challenges, engineers frequently turn to the concept of the Internet of Things (IoT): it serves as a network technology basis. Three work steps are required to operate predictive maintenance efficiently, thus being:
- The collection, digitization and transmission of data,
- the storage, analysis, and evaluation of the collected data, and
- the calculation of probabilities of occurrence for specific events.

Predictive Maintenance & Big Data
When talking about vast amounts of data, it can also mean that the data format can vary greatly. For example, we would get information from the machines of the plant, but also information from the peripherals (for example sensors) and environmental characteristics such as temperature or humidity. Furthermore, we would have to collect the data regularly to be able to read trends and developments from the changes.

Due to these many different types of data and formats, as well as the massive amounts of data, databases must provide huge capacities. For the analysis of the data, it is necessary to access the searched values quickly and process them with high performance. Applications and database systems from the Big Data environment fulfill all these requirements. The larger the database is, and the more intelligent and sophisticated the analysis algorithms are, the more reliable are the findings to be obtained.

Advantages of Predictive Maintenance
Knowing the current condition of the machine or plant helps to avoid unplanned machine breakdowns and to optimize the deployment of service staff in the field. Maintenance and service intervals, as well as spare parts management, can be planned much better. Furthermore, by analyzing the collected data, it is possible to improve the performance of the machines and achieve higher productivity.
If the concept of predictive maintenance sounds familiar to you, it's most likely because you've already come across it in your daily life. For example, engine speeds, noise, or temperatures are recorded, and unusual vibrations or imbalances are detected at an early stage. In this way, vehicle parts can be replaced at the next workshop visit before they fail to perform their service. If the vehicles are networked and deliver the data online to service workshops or the vehicle manufacturer, the vehicle owner can be informed of expected problems and be informed to visit the workshop for urgent maintenance or parts replacement.

- Nishchal