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HOW ARTIFICIAL INTELLIGENCE WORKS IN THE QUALITY CONTROL OF AMAZON

By Soumik Ghosh

The use of artificial intelligence has been growing across the industrial automation space for the several years now. But do you really understand what it does to affect outcomes?

Few areas of industrial technology today remain untouched by Artificial Intelligence (AI). From controllers to ERP to food safety and robots, AI is changing the technologies we use to run manufacturing and processing facilities in subtle and not-so-subtle ways. One application with a big potential to benefit from AI is quality control. The use of smart cameras and related AI-enabled software is helping manufacturers achieve improved quality inspection at speeds, latency, and costs beyond the capabilities of human inspectors. Of course, manufacturers have been using machine vision in quality applications for many years now. But the addition of deep learning-enabled quality control software represents a departure from earlier machine vision technologies.

Before exploring – let's talk a little about Amazon and Artificial Intelligence (AI)

Amazon is the largest e-commerce company, which was founded in July 1994, by Jeff Bezos. In 2015, Amazon surpassed Walmart as the most valuable retailer in the United States by market capitalization. In 2017, Amazon acquired Whole Food Market for US$13.4 billion, which substantially increased its footprint as a physical retailer. In 2018, Bezos announced that its two-day delivery service, Amazon Prime, had surpassed 100 million subscribers worldwide.

What is Artificial Intelligence (AI)?

Artificial intelligence refers to the simulation of human intelligence in machines. The goals of artificial intelligence include learning, reasoning, and perception. AI is being used across different industries including finance and healthcare. AI is an interdisciplinary science with multiple approaches, but advancements in machine learning and deep learning are creating a paradigm shift in virtually every sector of the tech industry.

What are the uses for AI?

AI is ubiquitous today, used to recommend what you should buy next online, to understand what you say to virtual assistants such as Amazon's Alexa and Apple's Siri, to recognise who and what is in a photo, to spot spam, or detect credit card fraud.

How is Amazon using AI?

Being an early adopter of artificial intelligence and automation, Amazon always had an edge in using AI to improve its business efficiencies. Not only has it been using AI to enhance its customer experience but has been heavily focused internally. Amazon uses AI to predict the number of customers willing to buy a new product, Amazon's AI is designed to provide customer recommendations to its customer. According to a report, Amazon's recommendation engine is driving 35% of its total sales One of the main areas where Amazon is applying continuous AI is to better understand their customer search queries and what is the reason, they are looking for a particular product. For an e-commerce company to make good recommendation for customer, it is more crucial to know that why customer is searching for product and what they are searching. Understanding the context can help the retailer to recommend relevant items to its customer.

“According to Amazon, predicting the intent of the query is a significant component of information retrieval which in turn, improves the relevance of the results through an understanding of latent user intents in addition to explicit query keywords. The researchers believe this might improve people’s shopping experience by matching only high-quality products to search queries.”

Understanding the System

To help understand how AI is changing machine vision, Anatoli Gorchet, co-founder, and chief technology officer at Neurala (a supplier of AI vision software), explains the process behind traditional industrial inspection processes using machine vision. The first step involves an expert deciding which features (such as edges, curves, corners, colour patches, etc.) in images captured by a camera are relevant to the inspection. Then, the expert creates a rule-based system that details, for example, how much “yellow” and “curvature” classify an object as a “ripe banana” in a packaging line. The resulting system, based on the expert’s input, automatically decides if the product is what it is expected to be.

Though this method has been very effective, there are some cases in which it renders machine vision ineffective. “For example, instances where the difference between good and bad products is highly qualitative, subtle, or variable can be hard to detect,” said Gorchet. This is where AI comes into the picture. Rather than having the machine vision system rely on the rules created by the expert, the AI-powered software can learn which aspects are important on its own and create rules that determine the combinations of features that define quality products.

“With neural network learning algorithms, users no longer need to handcraft a machine vision model for every production scenario,” said Gorchet. “They just need to collect the proper data—whether it’s for fruits, airplane parts, or ventilator valves—and train the model with it.”

The type of AI model Gorchet is referring to here is known as “deep learning.” These deep learning systems, such as Deep Neural Networks (DNNs), are trained in a supervised fashion to recognize specific classes of things. In a typical inspection task, a DNN might be trained to visually recognize, for example, a ventilator valve, based on pictures of good and bad ventilator valves. “Once these pictures are collected, a typical deep learning system has a training regimen that, when fed a good quantity and variety of data, trains a model that ends up being really good at coming up with precise, low error, confident classifications,” said Gorchet. Of course, if the line switches to a different part or product, the data collection, training, and deployment must be conducted again to develop a new model. To streamline this process, a new type of DNN is being explored for industrial quality inspections. These DNNs are known as “continual” or “lifelong” learning DNNs (L-DNNs). These L-DNNs, according to Gorchet, separate feature training and rule training to add new rule information on the fly.

“Like conventional DNNs, they need a slow learning of features based on a large balanced set of data—which includes equal amounts of images of good valves as well as every possible type of defective valve; but unlike conventional DNNs they do not include rule learning at this stage and therefore do not require images of all known valve defects,” he said. “In fact, the images do not even need to be of valves if they possess the similar features: curves, edges, surface properties. This data set can be quite generic and does not have to be industry specific. This means that the model creation can be done once by the L-DNN provider and does not need to concern the manufacturers at all.” *(Note: Neurala is a supplier of L-DNN technology.)*

This means that manufacturers only need a small set of images of good valves for the system to learn a set of rules of what a good valve is. L-DNNs, explained Gorchet, can learn on a single presentation of a small dataset using only good data and then advise the user when an atypical product is encountered. “A training regimen of an L-DNN can go over a set of tens of images, build a prototypical understanding of the object, and be ready to be deployed and reconfigured if and when production changes,” he said.

Amazon researchers created another data set, where each entry was labelled with three data items — a query; a product ID, which has been added by context-of-use categories; and the affinity score derived from the in-house dataset. This data set was then divided into two smaller sets — one annotated according to activity and one according to the audience, and from each of those smaller datasets they constructed two more — one with high-affinity score of 15 and one which was as low as 8. This resulting data set was then used to train six different machine learning models.

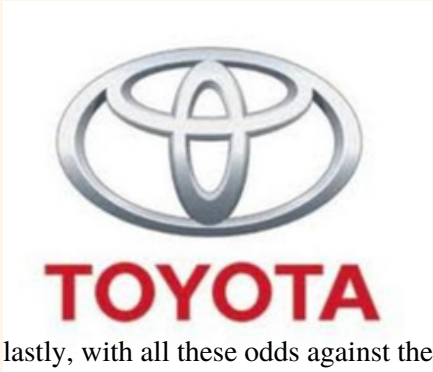
The resulted six models were trained to predict context-of-use based on customers' query strings. In tests, the best-performing model managed to anticipate product annotations with 97% accuracy for activity categories and 92% for audience categories. And, when asked by human reviewers to indicate the classifications they agreed on, they said, an average of 81% of the time the system's per-item predictions have been correct.

Conclusion

As Amazon continues to improve its algorithms, customers shopping on Amazon will see increasingly relevant shopping recommendations. According to Amazon, such research could open a whole new prospect for personalised digital shopping assistants. In this dynamic world where the tech giants are still struggling with their internal bureaucracy and technology silos, it is exceptional to see how Amazon keeps emerging with encouraging innovations to enhance the customer experience.

TOYOTA'S SUPPLY CHAIN EFFICIENCY

By Kunal Kothari



Toyota is one of the most extraordinary companies in the world and the attribute that makes it so incredible is the fact that Toyota is a company that had every possible obstacle to failure. First of all, Japan is such a small country which had very fewer natural resources and a small population. Therefore, both raw materials and labour were extremely costly. In addition to that, Japan is a land of natural disasters where earthquakes and tsunamis are frequent. Thirdly, when Toyota was just two years into the business, World War 2 took place. After the Hiroshima Nagasaki bombing, Japan's economy was in complete ruins. And lastly, with all these odds against them, they were in direct competition with the giants of the United States, like General Motors and Ford motors. And yet, despite these obstacles, Toyota has emerged as one of the most successful automobile companies in the world. In fact, in 2008, it evenbecame the largest car manufacturer in the world.

In 2016, Toyota's market capitalization was more than Ford, General Motors and Honda combined. Now, this begs the question, how did Toyota become such a successful company amidst such terrible market conditions? What exactly was their business strategy?

This is a story that dates back to 1950 in Japan. During the war, Toyota barely survived by pivoting between making trucks and cars for military needs. The management realised that, although they could not compete with the Americans with capital and machinery, there was one very crucial aspect that they could beat the Americans with and that aspect was nothing but efficiency. So EG Toyota, the top manager of the company, came up with the idea of something called the lean manufacturing system. EG Toyota understood that the standard method of operation of the US manufacturers was that they first forecasted the demand up to a certain extent, and then placed bulk orders so that they can save up on the cost of machine parts and raw materials. So, if there are three colours of cars that needed to be sold red, black and grey, the company will produce 200 red cars, 500 black cars and 300 grey cars and these cars will be ready to be delivered but will be stored in the inventory until the order comes up. And as soon as the customer places the order, they are immediately moved out and delivered to the customer. But in this process, the Toyota team identified that there is a major problem that in turn led to a series of four major inefficiencies. And the fixing of these inefficiencies is what turned Toyota into a billion-dollar company. In fact, it did not just change the way the automobile industry worked; it changed the way the entire world's supply chain worked.

The question is, what were these inefficiencies and how did the Toyota team fix them?

1. The Toyota team realised that when the demand forecasting happened in the United States, the production always used to produce cars in surplus and never in deficit. Therefore, more often than not, it leads to excessive resource allocation. This meant that unnecessary people were hired, more equipment was purchased and more materials and products were stocked up in the inventory. This in turn led to an increase in the overall cash costs without adding any value.

2. The presence of unnecessary people, equipment and materials automatically leads to overproduction.

3. Then the overproduction further leads to the third type of waste, which is the excessive inventory of the final products. In this case, if there are 1000 cars that are overproduced, that is a huge amount of land that is being utilised, leading to very high maintenance costs, labour costs and transportation costs.

4. Lastly, when all these ways come together, it leads to the fourth type of waste which is unnecessary capital investment. For example, if a 1000 crore loan has been taken out, and if it is utilised in overproduction, it's going to stack up a crazy amount of interest cost leading to very high costs with zero return on investment. And this further leads to more administrative costs, depreciation costs, etc.

But when the team of Toyota actually understood the root cause of this problem, it was all about just one thing. Forecasting of demand leads to excessive inventory, which in turn led to a chain effect resulting in the four types of waste. So Toyota decided to eliminate two of the most fundamental elements of the supply chain which are inventory and demand forecast. Toyota built a supply chain where there was no demand forecasting and zero inventory. This system revolutionised not just the automobile industry, but also became the world standard for supply chain management in every field.

Instead of having the cars manufactured and stored in the inventory, the cars used to be available for the customers in the pamphlets, and they used to be available in the showroom. And only after the customer placed the order, Toyota started manufacturing the car. Once the ideation and booking dates are finalised, the machinery and technology are acquired in three months. After that, the parts and components arrive within seven days of the production centre. After the booking starts coming from several dealers all across the country, the production actually starts and the path starts moving to the assembly. Now, when this moment happens, based on the demand, the exact same number of parts are set to arrive every single day. So, if 3671 components have been taken to the assembly, the next day, only 3671 components will arrive. And this happened not just for one component, but the hundreds of components that were being used for the assembly. This is followed by assembly activities and finally, the quality check is done. The vehicles that are assembled arrive at the dispatch zone and immediately they are shipped to the dealers based on their respective orders. And this entire process is set to happen in five days.

Therefore, the entire supply chain of the company starts functioning based on demand and not demand forecasts. This is how the just-in-time production of Toyota works wherein, even a single delay can cause the company millions of dollars in losses. And this insane precision gave Toyota three incredible superpowers for the rest of the competition. Firstly, in case of less demand or even if an earthquake shatters the plant, Toyota would incur only minimum damage because they had less stock of components and close to zero inventory. Furthermore, Toyota even asked its suppliers to follow the just-in-time principle for their systems, which again reduced the cost of the overall supply chain without creating a bottleneck for the suppliers. Secondly, all four types of waste were eliminated resulting in extreme cost-cuttingand this cost-cutting turned out to be so amazing that even when other companies applied it, which saw a 50% reduction in their inventory itself, and a lead time reduction of more than 80%, eventually resulting into massive cost-cutting and drastic increase in profit margins. And lastly, in the case of Toyota, from 1955 onwards, Toyota's production started shooting up, they made 22,786 vehicles in 1955, 46,417 in 1956, 70,856, in 1957 and by 1965, they achieved a growth of almost 2,000%, producing 477,643 units in 1965. This is how striking a perfect balance between extreme efficiency and extreme risk; Toyota and its engineers built an iconic supply chain that turned them into the largest and one of the most profitable automobile companies in the world.

MURATA – UNDERSTANDING THE DYNAMICS OF THE CAPACITOR SUPPLY CHAIN

By Sonali Vashisht

PHOTO BY MARTIN BOSMAN

Murata is the world's largest producer of capacitors, a tiny electronic device that helps smooth voltage. On a smartphone, voltage changes constantly and sharply as different types of applications are used. Generally speaking, the more powerful processor a smartphone has, the more capacitors are needed. A typical smartphone has nearly a thousand capacitors, according to Murata. Murata also makes communication modules, used for receiving and transmitting mobile signals, as well as power devices for converting electric currents. It is a major supplier to Apple, Samsung and Chinese smartphone makers. The company supplies smartphone devices such as filters for picking up some radio signals; amplifiers for strengthening signals for transmission; and duplexers for handling incoming and outgoing signals simultaneously. They are used in the Apple iPhone, Samsung Galaxy and Huawei Note smartphones, among others. The components are fitted into smartphones in China for shipment to final markets, with the U.S. being the most important. These components need to be designed differently, even though they perform the same functions, to match the operating system of each smartphone brand.

So the next obvious question is why we are looking into this topic?

As the U.S. and China economies are decoupling more quickly than ever after Washington rolled out its latest export controls on the Chinese chip sector. "The world is decoupling at a faster pace than I had feared," said the Murata manufacturing president Norio Nakajima. Murata, which makes key smartphones and other components, relies on Greater China, which includes Taiwan, for over half of its sales.

How are they planning to solve the issue?

They plan to, or rather implement a strategy where they would develop duplicate supply chains -- one for the U.S.-led economic bloc and one for the China-led bloc. Murata's main production facilities are in Japan, though the Kyoto-based company also has a major production site in Wuxi, China. Like other tech companies, it has begun stepping up efforts to diversify its supply chain. In November last year, the company said it will open a new plant near Chiang Mai, Thailand, in October 2023. The company said in June it will beef up production in Da Nang, Vietnam, by August 2023. One of the interesting points that we should focus on is the comment made by the Manufacturing president Nakajima that they would eventually have to think about producing in India in the future, though he said the country does not yet have the necessary infrastructure for such a move.

Where does Murata face the heat?

The major challenge for Murata is the procurement of basic materials. Its flagship multi-layer ceramic capacitor (MLCC) is a composite of barium titanate and a few rare metal materials, some of which are sourced from China.

China is a major producer of rare metal materials and used its dominant position for leverage in disputes with other countries. Some other countries, including in Africa and Southeast Asia, also produce these metals, Nakajima said, but they must have exact chemical compositions to produce the desired qualities. This means changing or adding suppliers is not easy, despite being necessary. Murata last month announced a plan to set up with suppliers a joint venture for the production of barium titanate, to strengthen its ability to secure the key MLCC(multi-layered ceramic capacitors) material. Murata itself has difficulty supplying products like batteries for electric power tools and Wi-Fi modules for automobiles, due to a shortage of power management integrated circuits and transceiver integrated circuits. Also, it is expected that the chip shortages would ease this year. Another risk for the company, according to analysts, is its higher-than-usual inventory levels. Nakajima countered that this was a defensive move against possible supply disruptions. "The appropriate level of inventory is higher today than before. I don't believe our inventory level is excessive," he said. Automakers in particular have been stockpiling parts and components to manage the disruptions brought on by factors such as the pandemic, China's zero-COVID policy, a global chip shortage and the Ukraine war.

So how are the competitors faring?

Murata is not the only Japanese high-tech company adjusting its supply chain amid geopolitical uncertainty.

Renesas Electronics, a top Japanese chipmaker, is concerned that it might get barred from supplying to China, a market that accounts for 22% of its sales, due to the U.S.-China trade war. Renesas depends on its U.S. operations for its main business of manufacturing analogsemiconductors, which convert analog signals such as sound, images, motion and temperature into digital signals. The U.S. is the global center of analog semiconductor production, led by Texas Instruments and Analog Devices. In 2021, Renesas bought U.K.-based Dialog Semiconductor for $6 billion in an attempt to diversify its technology base into Europe, making it possible to supply chips to China using European technology. Renesas CEO Hidetoshi Shibata stressed the importance of access to talent and technology in the U.S. and Europe. In a speech at an industry event hosted by SEMI, a global industry association, in December, he explained how the Tokyo-based company, created through the merger of Hitachi, Mitsubishi Electric and NEC's semiconductor operations in 2010, diversified its technology base through a series of U.S. acquisitions in the past five years, and also plugged its talent gap in Europe with the Dialog acquisition. "It is talent that matters most," Shibata said.

Tokyo Electron, one of the world's largest chip equipment makers, is another company racing to diversify its geographical footprint. Appearing at the SEMI event, Tokyo Electron CEO Toshiki Kawai laid out his company's strategy of strengthening its leadership through closer ties with top European companies, amidst an intensifying challenge from Chinese chip equipment makers. He highlighted the recently announced partnership with Belgian research institute Imec and Dutch company ASML, the leading lithography machine maker, to develop cutting-edge chipmaking equipment. "To develop the next-generation devices, we will promote collaboration with our customers around the world," Kawai said. Like the U.S., China and Japan, Europe is now trying to increase local chip production to minimize the risk of supply disruptions amid tensions between China and Taiwan. Europe used to be a major chip-producing region. It now accounts for only 10% of global production, as companies like ST Microelectronics and Infineon subcontract production to foundries such as TSMC. Europe wants to boost its global share to at least 20% by 2030. Chip equipment makers are in a position to benefit from moves by these countries to localize their semiconductor supply, which raises the question of where they should set up shop. Production at Tokyo Electron takes place almost entirely in Japan, even as more than 80% of its sales come from overseas. "Our rivals are shifting production overseas to be closer to their customers," a Tokyo Electron official said. That will make it easier for them to serve their customers, rather than from supply chains spread across the world. "We will have to think harder about where we should produce, in Japan or overseas," the official said.

To conclude, Murata is not just responding to the trade war. It is also looking at long-term demographic trends.

VIRTUAL REALITY APPLICATIONS IN MANUFACTURING PROCESS SIMULATION

By Pavan

Abstract

Virtual reality (VR) is a rapidly developing computer interface that strives to immerse the user completely within an experimental simulation, thereby greatly enhancing the overall impact and providing a much more intuitive link between the computer and the human participants. Virtual reality has been applied successfully to hundreds if not thousands of scenarios in diverse areas including rapid prototyping, manufacturing, scientific visualisation, engineering, and education. This paper gives an overview on the virtual reality applications in manufacturing processes.

Introduction

The current demand to reduce the time and cost involved in taking a product from conceptualisation to production has forced companies to turn to new and emerging technologies in the area of manufacturing. One such technology is virtual reality (VR). The origins of virtual reality can be traced as far back at least as “the ultimate display”. Virtual reality allows a user to step through the computer screen into a three-dimensional (3D) world. The user can look at, move around, and interact with these worlds as if they were real. The primary concept behind VR is that of illusion. It focuses on the manifestation of the fantasy world of the mind in computer graphics. It is also a new media for information and knowledge acquisition, and representing concepts of ideas in ways not previously possible. With the advance of computer technology, VR systems could contribute efficiently in various applications. Virtual manufacturing (VM) is one of the applications of applying VR technology in manufacturing applications. Researchers at the University of Maryland have introduced the concept of virtual manufacturing in 1995, while the contribution and achievements of VM have been reviewed by Shukla et al. Virtual manufacturing is defined as a computer system which is capable of generating information about the structure, status, and behaviour of a manufacturing system as can be observed in a real manufacturing environment. The vision of virtual manufacturing is to provide a capability to “manufacture in the computer”. That means VM will provide a modelling and simulation environment so powerful that the fabrication/assembly of any product, including the associated manufacturing processes, can be simulated in the computer.

Ivan Sutherland has introduced in a seminal paper the key concepts of immersion in a simulated world, and of complete sensory input and output, which are the basis of current virtual reality research. His challenge was to set the screen is a window through which one sees a virtual world to make it looks real, acts real, sounds real, and feels real. Although it is difficult to categorize all VR systems, most configurations fall into three main categories and each category can be ranked by the sense of immersion, or degree of presence it provides. Vast amount of VR software packages available on the market, which can be used to develop virtual environments for different applications (e.g. Superscape VRT and SENSE8). Moreover, software packages have been developed for virtual applications in manufacturing (e.g.DELMIA). DELMIA package provides authoring applications that can be used to develop and create virtual manufacturing environment to address process planning, cost estimation, factory layout, ergonomics, robotics, machining, inspection, factory simulation, and production management.

Manufacturing industries are the most important contributors to prosperity in the industrialised countries. However, it is becoming increasingly difficult to meet customers’ demands and to compete. The advances in virtual reality technology in the last decade have provided the impetus for applying VR to different engineering applications such as product design, modelling, shop floor controls, process simulation, manufacturing planning, training, testing and verification.

VR holds great potential in manufacturing applications to solve problems before being employed in practical manufacturing thereby preventing costly mistakes. Virtual reality not only provides an environment for visualisation in the three-dimensional environment but also to interact with the objects to improve decision making from both qualitative and quantitative perspectives. The following section discusses the use of virtual reality in manufacturing applications, which include, design, prototyping, machining, assembly, inspection, planning, training and simulation. Virtual reality applications in manufacturing have been classified into three groups; operations management, manufacturing processes, and design. A brief description of every group and its relevant subgroups will be provided in the coming sections.

Virtual reality may play very significant rule in design a new product. VR technology has been applied into two different applications in design; design and prototyping . VR provides a virtual environment for the designers in the conceptual design stage of designing a new product; the designer could produce 3D “sketch” of a product in the virtual environment. At this stage, functional experimentation of mechanical features such as hinges, assembly, etc. could be performed to evaluate the conceptual design and modifications could be made as required. Once the designers are satisfied with their design, then the design could be detailed to make the necessary modifications. In the product development process, prototyping is an essential step. Prototypes represent important features of a product, which are to be investigated, evaluated, and improved. Virtual prototyping could be used before building the physical prototype to prove design alternatives, to do engineering analysis, manufacturing planning, support management decisions, and to get feedback on a new product from prospective customers. The virtual environment for prototyping should include.

(a) **Functionality:** the virtual prototype should be clearly defined and realistically simulated to address product functionality and dynamic behaviour.
(b) **Human interaction:** the human functions involved must be realistically simulated, or the human must be included in the simulation.
(c) **Environment:** an offline computer simulation of the functions can be carried out, or a combination of computer offline and real time simulation can be carried out.

Operations management has been classified into three categories; planning, simulation and training. Due to the necessity of a smarter factory planning; Virtual reality is a useful method to improve the understanding of the plans and to support interdisciplinary discussions. This environment has been developed to provide a visual, three-dimensional space in which to explore the effect of various product mixes, inspection schedules, and worker experience on productivity.

Virtual reality-based training is the world's most advanced method of teaching manufacturing skills and processes to employees. Using cutting-edge VR technology, training takes place in a realistic, simulated version of the actual facility, complete with the actions, sights, and sounds of the plant floor. Some of the simulation products provide some form of visualisation for depicting model output (e.g. Witness 2003, Simul8, and Flexsim). shows a virtual environment created by Witness VR for a factory. Applications of VR technology on the operations management categories.

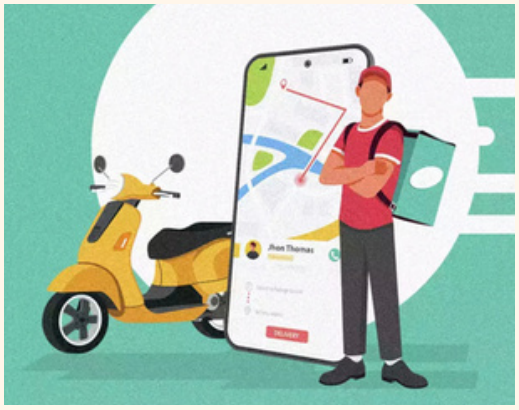
Manufacturing processes has been classified into three different areas; **machining, assembly, and inspection.**
Virtual machining mainly deals with cutting processes such as turning, milling, drilling, and grinding, etc. The VM technology is used to study the factors affecting the quality, machining time of the material removal process as well as the relative motion between the tool and the workpiece. An engineer uses a Virtual reality "semi-immersive environment" to simulate the use of a hexapod machine tool. University of Bath in Bath has developed an interactive virtual shop floor containing a three-axisnumerical control milling machine and a five-axis robot for painting. The user can mount a workpiece on the milling machine, choose a tool and perform direct machining operations, such as axial movements or predefined sequences.

Virtual assembly is a key component of virtual manufacturing and is defined as: "the use of computer tools to make or "assist with" assembly-related engineering decisions through analysis, predictive models, visualisation, and presentation of data without realization of the product or support processes. In assembly work, VM is mainly used to investigate the assembly processes, the mechanical and physical characteristics of the equipment and tooling, the interrelation among different parts and factors affecting the quality based on modelling and simulation. Virtual reality can be used for assembly/disassembly operations. For example, can a human worker assemble a part or a component? And then can the part be disassembled for service and maintenance at latter stages? Other questions need to be addressed, too: is it "difficult" or "easy" to assemble/disassemble a part? How long does it take? How stressful is it in terms of ergonomics? Is there enough room for tools? Virtual inspection makes use of the VM technology to model and simulate the inspection process, and the physical and mechanical properties of the inspection equipment. This aims at studying the inspection methodologies, collision detection, inspection plan, factors affecting the accuracy of the inspection process, etc.

Conclusion:
VR can be a powerful tool for testing and evaluating new products and ideas, decreasing the time to market and reducing product cost. Today, only large companies use virtual technologies and benefit from its competitive advantages. VR's widespread use and acceptance will require devices and software with higher quality and lower cost. Existing VR technology has been applied to solve clients' real-world problems, and has increased profitability, decreased time to market, and increased worker

Q-COMMERCE IN INDIAN GROCERY STORE

By Paulomi Nandi



Now-a-days, with technological evolution, people are more inclined to Internet world. Even for small things to daily necessities, we are dependent on online stores. Along with any online fashion stores to grocery stores are also have competitors now. For an example currently, BigBasket and Blinkit are booming in this trending days.

BigBasket Overview:

BigBasket, an online supermarket, currently owned by TATA group. It was launched in 2011 in India. Being one of thriving online supermarket, BigBasket believes in providing the highest level of customer service and is continuously innovating to meet customer expectations. Bigbasket builds on B2B business with automation technology for kiranas. As of using technology usage, BigBasket uses HTML5, Google Analytics for better performances. Along with that, the company uses customer feedback monitoring system to understand the customer expectation better. It also helps to track the inventory of the company and prepare a smooth process in respect to the supply chain management of the company. In 2017, Bigbasket has partnered with Snapbizz, a cloud-based retail technology provider that works with 2,000 retailers, in a new endeavour to expand their business-to-business (B2B) commerce (across all Tier I cities). The goal of the effort is to automate inventory management and supply chain procedures so that Bigbasket can automatically replenish the stockpiles of shops. In 2022, BigBasket acquires Agrima Infotech; plans to use its AI, ML expertise on tech innovation. Agrima Infotech's Psyight can identify all Indian fruits and vegetables from an image without using barcodes. And with upgraded delivery process, in 2021 BigBasketpromised to increase the delivery speed and deliver the items in 20 mins.

Blinkit Overview:

In one hand BigBasket, Amazon Now, Flipkart Groceries etc. have made people more depended on the online supermarkets, another brand failed to keep its position intact, named Grovers. In 2021, Zomato acquired Grovers and changed it to Blinkit. Where other online supermarkets running with tradition supply chain system, here Blinkit came with the Q-commerce technology.

Q-Commerce:

It refers to Quick Commerce, which means ‘on demand delivery’ in e-commerce terminologies. Q-commerce highlights on quick delivery process, typically in 10 mins. Q- Commerce was developed to increase consumer pleasure as much as possible by giving businesses who use it a competitive advantage in terms of delivery time.

How does it work?

Q-commerce provides delivery within 30mins or less. So, it takes to have multiple stores in a certain area. For Blinkit, the company acquired multiple dark stores in every 2km distance. So, the delivery gets easier in 10mins.

Since dec 2021, after Zomato acquired and applied this technology in delivery process, the customer feedback has been incredibly improved and the no of customer engagement also increased.

❖ **Industry analysis with Q-commerce:**

In any e-commerce business, the B2B strategies have be efficient enough to get customer satisfactory feedback to keep the business running. Here in online supermarket business competitions, it works as oligopoly because only BigBasket and Blinkit are running closely. On economical perspective, Amazon being one of the finest retail brands could not stand out as online supermarket, same happened with Flipkart. Therefore, we can say that the technology could only change the idea behind any business. So, it matters the most how a business applying operational strategies and meeting the customer expectations.