



A Review On Impact Of Iot In Modern Food Industries

Mr. P. Sivakumar, Dr. S . Menaka

Assistant Professor, HoD

Department of Computer Applications,

Nehru Institute of Information Technology and Management

Coimbatore -641 105

Abstract:

The major application of Industrial IoT is in the food industry, agriculture and food safety. So, in the food industry let us first try to understand what actually happens. So, we have agricultural produce, those agricultural produce; they come from the field then those produces are basically taken through different processes and finally, the consumers basically consume the agricultural produce. So, let me elaborate this little bit further so, the process is well known as field to plate .So, in the agricultural field you would be growing the crops. So, let us say that sowing of seeds, the farmers are going to sow seeds, grow crops, apply fertilizers, apply pesticides, etc. and then after the agricultural plans they become matured, then basically these crops are harvested right. So, the next step is broadly is going to be harvesting. Following harvesting these food grains are going to be processed; food grain processing, after food grain processing we are going to have let us say the packaging, packaging of the food grains. After packaging of the food grains these packages are going to be transported; transportation and logistics. So, they are going to be transported typically to a wholesale market. Then it goes to the retailer, the retail market and finally, the consumers are going to buy and cook the agricultural produce and they are going to consume. So, basically this is going to be the plate right. This is typically the chain from the agricultural field to the plate. So, this is typically the chain of activities that are followed; this is the supply chain let us say. So, supply chain comes because ultimately for each of these things the supply will have to be ensured through this entire cycle right. So, all these supply through these entire processes and the different steps will have to be ensured. So, in this kind of scenario sensors will have to be used; you have sensors, IIoT devices will have to be used in the agricultural field for monitoring the growth of the crops, the sowing of the seeds, for applying fertilizers precisely adequately and so on and also to precisely and adequately apply the pesticides. So, sensors, actuators, plus different agricultural robots could be used over here. So, not only over here even for harvesting also these could be used for food grain processing, again these could be used, for packaging likewise transportation, logistics, wholesaler, retailer, plate actually let us leave this aside. So, we still are not in a point of having a plate which is sensor enabled and robotic plate and so on. So, that is a far dream to be achieved so, but in retailer basically sensors, actuators, robots etc. these are all going to help the systems, or the machines that are helping in the processes and the different states etc. to be made much more efficient autonomous and so on. So, let us now look further ahead and see what we have in terms of IoT implementation in the food industry.

Keyword used IoT, sensors, food industry, ICT, RFID

Introduction to IoT

The Internet of Things is a very big technology in which the virtual world of information technology integrates seamlessly with the real world of things. The real world becomes more accessible through computers and networked devices in business as well as everyday scenarios. With access to fine-grained information, management can start to move freely from macro to micro levels and will be able to measure, plan and act accordingly. However, the Internet of Things is more than a business tool for managing business processes more efficiently and more effectively – it will also enable a more convenient way of life. IoT Layers: Sensing layer, Communication Layer, Network Layer.

Food industry

In all over the world food industry and increased demand for the long-term storage and preservation of food have created the need to develop new methods that can be easily tracked and preserve food freshness and safety throughout the shelf life of the product (from production, storage, shipment, and consumption). IoT enabled Smart sensors and labels that can be attached to packaging represent next-generation technology that can be helpful to monitor the status of the product. These can be designed to measure markers of freshness and provide an “index of quality” of the product in real time, measure temperature changes, or identify the presence of harmful components in food. Apart from this, Additional capabilities can be added to provide more protective functions, for example, packaging with coating that can act as an oxygen barrier to prevent spoilage. These methods can replace costly techniques that are currently being used to monitor food products and increase sample throughput.

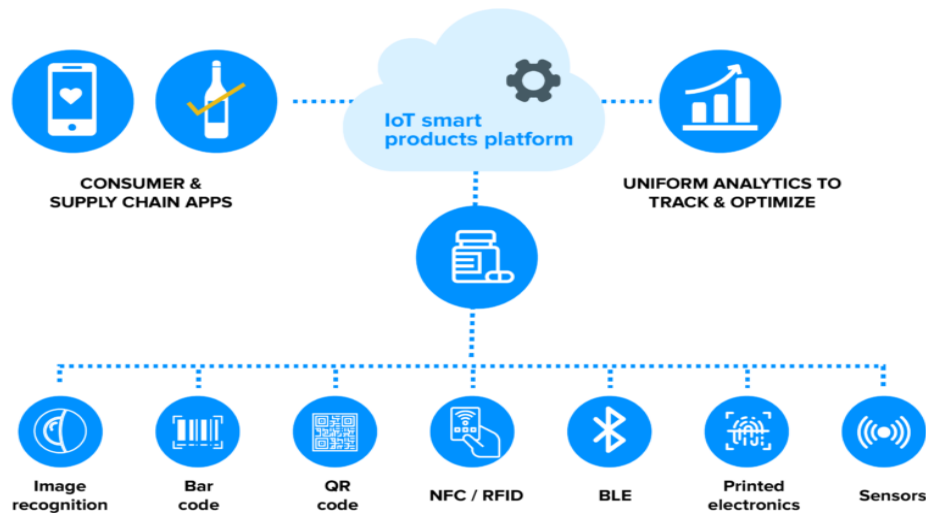
There are three category of food industry

1. first level food industry: It is a primary food industry involves in converting agriculture produce into consumable items. It consists of the cleaning, washing and processing of food items.
2. Second level food industry: It is a secondary industry converts the consumable food items into proper edible food items
3. Third level food industry: This is a Tertiary food industry is also known as frozen food industry. It consists of preserved food items like packed snacks and frozen food items etc.,

Literature review:

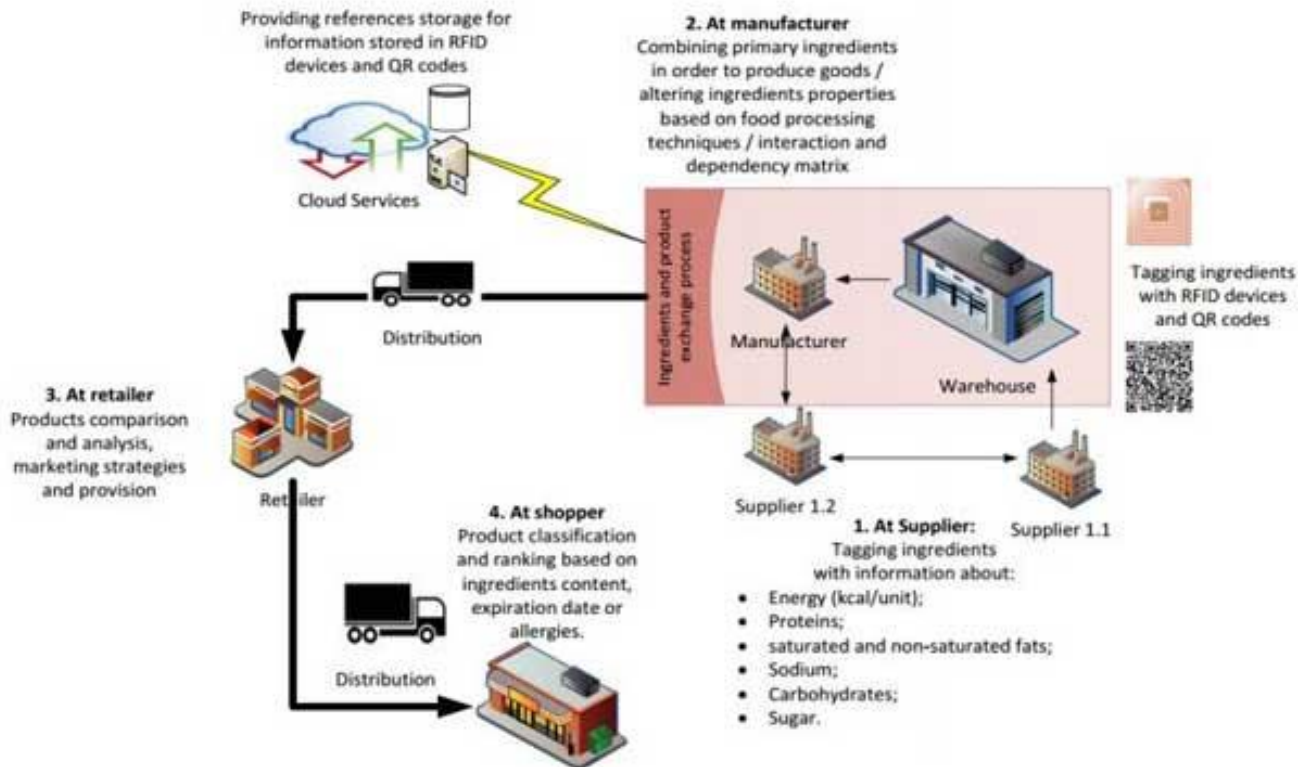
Sensors for doing number of things, sensors for monitoring humidity, temperature, composition of food products and so on. So, sensors can do number of these different things, but the sensors will throwing lot of data in real time which will have to be analyzed in real time as well in order to make the most out of those data that that have been retrieved. So, you need easier process control, increased food safety, etc. and it is also very important to have adequate end to end traceability. RFID is increasingly being deployed in applications across supply chains with readers that are distributed across factories, warehouses, and retail stores. Sensor technology is also being adopted in manufacturing and logistics in order to control processes and the quality of goods. Accessing real-time information through Information and Communication Technology (ICT) usage in the 'anytime, anywhere' manner, as suggested by the paradigm of the Internet of Things, calls for open, scalable, secure and standardized infrastructures which do not fully exist today.

Industrial IoT Applications - Packaging Optimization



The firm we can have sensors to monitor weather, to monitor the crop maturity, to monitor the presence of insects, to monitor the conditions of the field with respect to the soil conditions for example, how much soil moisture is there in the field, how much is the water level, how much is the fertilizer content of the field, the soil nutrient condition of the field. So, all of these things are possible with the help IoT implementation in the food industry[1]. So, these are some of the different applications like wise you have large number of different applications that are possible for IoT implementation.

Drone-assisted field monitoring is quite common, drone assisted field monitoring applications in agriculture are quite common and are being implemented, we ourselves in the lab are working on different agricultural drone applications for doing number of different things. food industry IoT implementations can be done for maintenance embedding sensors to these different machines such as farm machinery, tractors, etc. to monitor their condition, to monitor their performance, to detect whether any machine is going to go down in the future. Early detection of warning signs, smart maintenance etc. of these machines extending the lifetime of these equipments all of these things are possible with respect to maintenance in the food industry through IoT implementations.



IoT implementation in the food industry can improve the margins through predictive analytics, spotting early warning signs, making well informed decisions and maximizing profits. For the consumer, there are different initiatives, smart level is an initiative by the Grocery Manufacturers Association GMA, which uses QR code to provide product related information to the consumers. These consumers consequently can get information about the ingredient details of a particular food item, allergens exposure of that particular food item, nutrition, value and many different other Information. Consumers can scan the QR code to get details about the product; the product information includes nutrition, ingredients, allergens, third party certification, social compliance programs, usage instructions, advisories and also safe handling instruction. In the factory, IoT implementations can help the different machineries in the food processing industry, the different workers who are working in the food processing industry to remain connected autonomously[2]. This connectivity can help in gaining insights to improve the quality of the food product, the quality of the food processes and so on and consequently they can also help in the reduction of the time to market TTM.

IoT implementations can also improve compliance and safety of the food product, compliance to regulatory standard, compliance to best practices and also safe handling of the food products, these are all possible with the help of IoT implementation in the food industry. IoT implementation in the food industry can also help in empowering the workers through augmented reality safety glasses and other wearable, thereby increasing the overall productivity and efficiency of their processes, efficiency of the workers, and efficiency of the machinery that they are using[3].

Impacts of Iot in food Industry

Efficient product line – Iot monitors equipment performance and detects anomaly in production line. Real time analysis by predictive line Temperature tracking sensor Automated Hazard Analysis and Critical Control Points (HACCP) checklists are being used throughout the manufacturing, production, and transporting procedures thereby companies can get access to meaningful and consistent data that enable them to put into practice some food safety solutions[4].

Freshness/Quality Monitoring

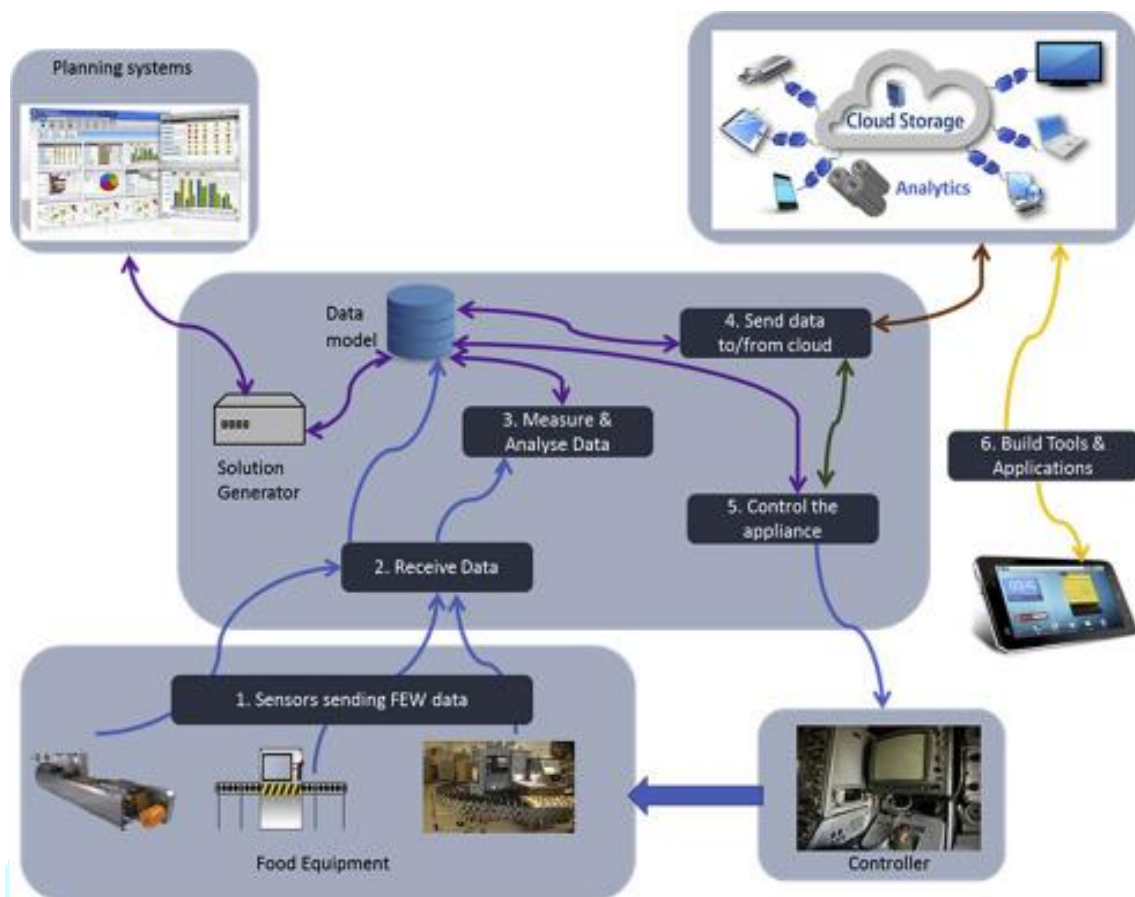
Several changes can take place in packaged food as a result of metabolism or microbial growth over time. For example, changes in gas evolution or microbial accumulation can be used to obtain information about the status of food, e.g., freshness or degradation. Sensors that can measure such changes could provide an overall estimation of food quality. Examples include “on-package” pH indicators that change color when food decays as a result of pH changes associated with the release of volatile amines generated during meat or fish spoilage[5].



the impact of IIoT in the food industry is like this; that we are going to have efficient production line, we are going to have adequate, suitable, efficient food safety measures, the food safety regulation implemented

Implementations : Case studies

City crop is an intelligent indoor garden that provides intelligent indoor garden to grow fruits, herbs, vegetables, greens and edible flowers, they have implementation of automated climate control, automated livestock monitoring, automated smart notifications which can be sent to the concerned stakeholders and also to the plant doctors' automated notifications would be sent. Diagenetix has this product, the bio ranger which can help in detecting the presence of microbial diseases in the food. Bio ranger is a small handheld device that connects with android app and instantly detect pathogens in the food[6]. Eskesso is a company that has the cooking sorcery the product which is basically for smart cooking. So, they have this Wi- Fi connected smart cooking device that can help in easy monitoring of the cooking status via the smart phone app. Smart cooking basically helps by placing the food packet and Eskesso device in a pot of water, electing the recipe and starting via smart phone app you can get your food cooked in a smarter way through minimal involvement.



Culinary science industries has the flavor matrix which basically infuses foods and beverages with unique flavors, they collect data on the food ingredients, collect user data and uses different implementations of machine learning and data analysis to enhance the flavor of dishes and provide user specific food and beverage pairing.

Intellcup has the smart cups solution which basically is a smart beverage vending machine which reduces the waiting time and increases the profit at the beverage shops. These are sort of like IoT enabled cups which have NFC integrated chips at the base of the cup and they connect the cups to the mobile banking platform and IntelliHead which is a modular dispensing unit. So, this NFC chips basically helps in connecting each user to a cup. So, the cups are usable and made with biodegradable material[7].

So, how the smart cup works . So, basically there are separate apps for the merchants and the customers, the customers create intellcup accounts using the app, they transfer the funds to the e-wallet and linking there after the cups are linked to the e-wallet by scanning a QR code via the app and docking the cup on the dispensing unit using the intellihead. So, customers there after enjoy the beverage that is finally, produced through this smart cup[8]. Likewise there are different other IoT solutions for the food industry by Spinn Inc for smart coffee brewing and farm shelf for smart indoor farming.

Better Food Safety

The implementation of the internet of things (IoT) in the food industry has been considerably diminishing the risk of food illness epidemic. Different kinds of sensors are being used to monitor essential production state, shipping time and most essentially the temperature. The utilization of real-time temperature tracking sensors allows organizations to closely supervise food safety data points, ensuring effective cold chain management[9]. With IoT, the supply chain will be able to function jointly to become acquiescent with global and local regulations.

Logistics

With the help of RFID (Radio Frequency Identification) transmitters and GPS systems, the distribution chain can be effectually monitored all along the whole storage and shipping course at the sales points or stores. This also enables companies to be acquainted with the preferences of customers, better reply to market requirements and decrease surpluses.

The advanced Radio Frequency Identification (RFID) tracking provides supreme visibility into the food supply chain, helps automate delivery and shipping processes and effectively monitors and controls temperature. It also enables shippers to track a location of the product with GPS. By collecting the meaningful data, shippers can estimate performance in a number of regions including understanding customer behaviour to diminishing deadhead miles in truck fleets[9].

Supply Chain Transparency

Generally, consumers or buyers expect transparency from the agencies that they purchase from. Employing traceability and transparency throughout the global supply chain will aid food agencies to succeed in business by acquiring customer loyalty and trust. Even though international and domestic regulations can amplify the intricacy of the global food supply chain, IoT technology can make it convenient for both companies and consumers to track products.

Further, transparency incorporates some added benefits for companies including improved inventory management, cost savings, and faster lead times[10]. Businesses can obtain such benefits by identifying and solving incompetence in the supply chain, exceeding and meeting food safety regulations, and offering transparency to customers.

Production and Storage

Sensors can significantly help to perk up quality control, products tracking, workers' activities, and taking advantage of real-time analysis for production[11]. Sensors persistently inspect the colour and specks throughout flour production, which helps to immediately rectify any inaccuracy. Moreover, sensors gauge the moisture content along with protein or cash content and allow real-time optimization of the production procedure.

Wastage Reduction

As per the report of food and agriculture organization of United Nations, nearly one-third of human food production is wasted globally each year. This not only results in money loss but also tend to damage our surroundings by growing carbon gas in the atmosphere. IoT technology makes it possible to effortlessly monitor the state of all food products and send the real-time information to the assigned individual, which decreases food wastage. Since we know that most of the maintenance is preventive or reactive but not predictive therefore by employing remote equipment monitoring we can foresee issues ahead of their occurrence thereby saving your money and time as well[12].

Conclusion

With the availability and enlargement of the Internet of Things (IoT) solutions & Services, the food industry is experiencing some key transformations particularly in terms of trends in food safety. Food manufacturing agencies can leverage the IoT technology to keep up the highest quality standards with the assurance of having the same product, with the similar higher quality at any time and anywhere.

Implementing IoT technology solution with any food business functionally could prove to be a most beneficial decision from all the aspects. If you anyone interested to integrate IoT solutions with your food business, get in touch with IoT and Iot related devices to acquire most trending IoT App Development services and solutions as per your specific requirements.

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