IOT STATE-OF-THE-ART FOR SMART INDIAN PHARMA

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ABSTRACT: Indian pharmaceutical industry has been anticipated best over the years across world. It's a larger supplier of medical facilities to entire world and a leading nation in pharma manufacturing. Internet of things provides the pharma industry with a selection of new personalized market opportunities, better controlled environment of pharma manufacturing, prevent maintenance of equipment and improve diversified supply chain management system. Owing to the deficiencies in transparency, the pharmaceutical manufacturing may be unable to warrant innocuous and safe medicinal production and circulation. Adoption of internet of things could represent a new competitive advantage for pharma companies exhibiting pharma IoT. This is a conceptual explorative research demonstrates future of Indian pharma, which is in a verge to become self-reliant nation. The use of internet of things, artificial intelligence, big data analytics and tracking of customers carrying internet connected digital devices (TCCICDD) and sensors implanted in wearables would help to locate the customer medical history with health monitoring. This would also alert both the clinical manufacturers and users resulting in designing personalized based better future of Indian pharma industry. Future Pharma would see the business link paraphernalia across development and dispersal by using better, more reliable larger volumes of data to revolutionize manufacturing.
Keywords: *IOT, pharma industry, health, make in india.*

1. INTRODUCTION

While discussing about pharma production sub- optimal environmental situations seems to be fatal. Any how this obstacle could be tackled easily with the help of internet of things (IoT). Also there exist a scope of personalization of health care products as based on the health of individual thus making medications possible well on time. Pharma industry face a chronic need to endure competitive in a market where product ranges are diversified, innovative start-ups stimulating the status-quo, logistical allies fetching more cohesive and patients more intricated in decisions around their upkeep. It’s just because of lack of transparency and adaptation of latest trends in technology such as IoT and sensors to ensure safe and secure medicine manufacturing and proper supply / distribution at time. The thought of IoT commences with entities denoted as distinct interactive digital devices

Pharma IoT generates transparency in drug manufacturing and storage environment accompanied by several sensors to monitor environmental parameters like photons, humidity, temperature and radiations. Also, this can be helpful to create a health database or to diagnose ailments at early stages with the use of wearable devices implanted within human bodies. Along with this it can also capture data of the users of wearable devices where sensors are implanted. This could help to collect and store health data of any individual which might be useful to detect any disease at initial stages.

Review of literature draws attention towards the needs of further research as there exists a research gap. This is an explorative research. Mentioning the major aims, this study used qualitative method on secondary sources to

proceed with development of prototype. The conclusive analysis helps to build a model based on the review of literature from existing work from multiple sources and researches. But this study would differ from the past as there exist assimilation of technology in the way businesses are done till date. The prototype demonstrated, imbibes both the aspects from IoT assimilation to implementation projecting correlations between industry 4.0 and pharma 4.0.

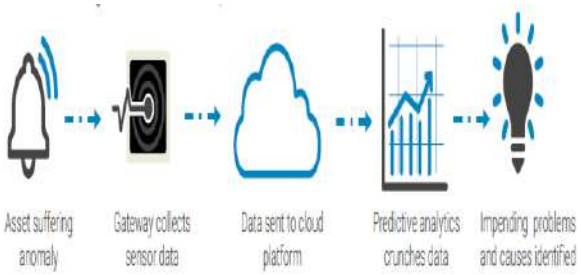


Fig.1 Pharma manufacturing

The purpose of this study is mainly depends n two things listed below:

1. To understand the scope of IoT implementation to smart pharma 4.0 in India.
2. To study smart pharma operations with IoT and sensors to uplift Indian pharmacy.

2. LITERATURE REVIEW

The Internet of Things for PharmaceuticalManufacturing

Internet of Things (IoT) is a buzzword in the area of information technology. The Internet of Things is an interconnected computer system with unique identifiers (UIDs) that are capable of transmitting information over a network. This review article highlights the potential applications of IoT in pharmaceutical manufacturing, warehousing, and supply chain management to enhance product quality, increase productivity, and reduction in errors during different stages of a pharmaceutical product. During the manufacturing of the pharmaceutical product, IoT may be useful in supervising and optimizing different unit operations for real-time monitoring and control to enhance production efficiency. In warehousing and supply chain management of pharmaceutical products, IoT is applicable in monitoring the real-time storage conditions of the drug product and improving visibility to enhance operational effectiveness.

Applications of Internet of Things in Pharmaceutical Industry

The pharmaceuticals and life sciences industries are generally require quite advanced technology to compete with the worldwide market share. Pharmaceutical and life science companies invest more time, effort and money into digitalization of their business. It is estimated that by 2020, there will be 50 billion connected devices, and in five years, 80% of companies are expected to utilize IoT in their digitized firms. IoT revolutionizes the pharmaceutical sector by providing and automating pharmaceutical manufacturing, discovery of drugs and remote monitoring of patients and more. Digitization holds tremendous potential to help pharma companies address various challenges. This chapter intends to provide an insight of Internet of Things in Pharmaceutical sectors.

Medical Internet of Things and Big Data in Healthcare

A number of technologies can reduce overall costs for the prevention or management of chronic illnesses. These include devices that constantly monitor health indicators, devices that auto-administer therapies, or devices that track real-time health data when a patient self-administers a therapy. Because they have increased access to high-speed Internet and smartphones, many patients have started to use mobile applications (apps) to manage various health needs. These devices and mobile apps are now increasingly used and integrated with telemedicine and telehealth via the medical Internet of Things (mIoT). This paper reviews mIoT and big data in healthcare fields.

Machine Learning in Drug Discovery: A Review

This review provides the feasible literature on drug discovery through ML tools and techniques that are enforced in every phase of drug development to accelerate the research process and deduce the risk and expenditure in clinical trials. Machine learning techniques improve the decision-making in pharmaceutical data across various applications like QSAR analysis, hit discoveries, de novo drug architectures to retrieve accurate outcomes. Target

validation, prognostic biomarkers, digital pathology are considered under problem statements in this review. ML challenges must be applicable for the main cause of inadequacy in interpretability outcomes that may restrict the applications in drug discovery. In clinical trials, absolute and methodological data must be generated to tackle many puzzles in validating ML techniques, improving decision-making, promoting awareness in ML approaches, and deducing risk failures in drug discovery.

IoT and the future of smarter research environments

The Internet of Things (IoT) becomes a popular research area in the present technology world. The combination of sensors and actuators makes a strong structure for cloud computing which may be utilized as networks of self-governing objects in real time system. IoT is growing day by day in smart cities, domestic life, and industries in different aspects. According to Gartner Inc., "IoT will include 26 billion units installed by 2020". IoT helps in making Smart environment such as home automation, smart wearable, security solutions, smart health care etc. The upcoming research areas of IoT are in making smart transport mechanisms for cities and making smart power grids. This manuscript presents an overview of recent trends of the IoT and its effects in the daily life of human being. The significance of artificial intelligence, autonomous control, cloud computing in IoT is also discussed. There is a necessity to synchronize technologies like wireless sensors, actuators, internet, distributed computing etc. for effectively activate the new technologies for IoT.

Business model innovation for Industrie 4.0: Why the "Industrial Internet" mandates a new perspective on innovation:

Industrie 4.0 (I40), i.e. the implementation of cyber-physical systems along the entire value chain and a far reaching digitalization of products and processes, is regarded as a significant agent of change in our current industrial system. While the previous discussion of I40 has been centered on technologies and standards, our focus is on business models (BM) for and enabled by I40. Having the right I40 BM will ultimately decide about companies' market positions and profitability. This calls for a systematic process for business model innovation (BMI). The previous academic literature has offered mostly conceptual reviews to date. Empirical analyses of management approaches and processes applied for BMI are scarce. Based on an exploratory research design, we present the results of a comparative interview study with large companies and industry associations. We analyze I40 business model characteristics, provide an in-depth perspective of companies' processes, structures and tools for BMI and derive upcoming practices as well as key compe-tencies for BMI in the course of I40. Our results indicate a diverse picture. While some companies have dedicated BMI structures in place and lead I40 BMI, others could benefit from complementing existing product and service development with a systematic approach to BMI, building the fundamental capability to exploit the opportunities of I40.

3. IMPLEMENTATION

Internet of things provides the pharma industry with a selection of new personalized market opportunities, better controlled environment of pharma manufacturing, prevent maintenance of equipment and improve diversified supply chain management system. Owing to the deficiencies in transparency, the pharmaceutical manufacturing may be unable to warrant innocuous and safe medicinal production and circulation. Adoption of internet of things could represent a new competitive advantage for pharma companies exhibiting pharma IoT.

Disadvantages:

- ❖ While discussing about pharma production sub- optimal environmental situations seems to be fatal.
- ❖ Along with this it can also capture data of the users of wearable devices where sensors are implanted

Device platform consisting of device hardware and device software using a microcontroller (or SoC / custom chip) and software for the device API's and web applications would prove helpful for smart pharma. Device platform consisting of device hardware and device software using a microcontroller (or SoC / custom chip) and software for the device API's and web applications would prove helpful for smart pharma. Connecting and networking (connective protocols and circuits) enabling internetworking of devices and physical objects called wearable things and enabling the internet connectivity to remote services. Server and web programming enabling web application and web service of pharma. Cloud platform enabling storage, computing prototype and product development platforms related to smart pharma. Online transaction processing online analytics processing, data analytics, predictive analytics and knowledge discovery enabling wider application of an IoT system.

Advantages:

- IoT enabled smarter plant offers solution to manufacturers, they could access the real time stream of data for better monitoring of the manufacturing process and advance perceptibility for the point of production to market reach.
- Manufacturers pull the data as and when necessary to track and trace process when an issue occurs which cautions and speedy recall of the products from the market quickly and efficiently.

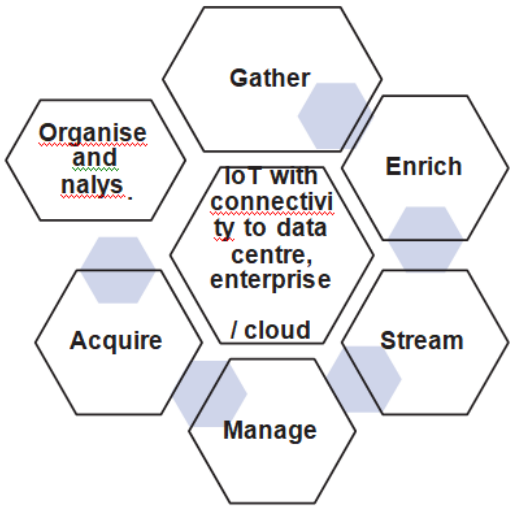


Fig.2: System architecture

Now-a-days all countries are giving priority to maintain good health of their population and to achieve this medical facilities must be adequate like health care monitoring and Pharma equipments. All pharmaceuticals manufacturing companies must know in prior of past or future diseases so based on increases of disease they can manufacture sufficient medicines and other medical equipments.

So in propose paper author is suggesting to employ IOT technology to make Pharma as Smart Pharma. Smart Pharma can deploy sensors at their manufacturing unit to monitor temperature like humidity so they can know which medicine can be manufacture and stored at their unit.

Simultaneously Pharma companies can give wearable sensors to patients which can monitoring patient condition and then send report to Pharma company so based on that data Pharma company can know how many patients are suffering from which diseases and based on that report they will manufacture medicines.

In propose paper author using Big Data analysis to collect and process data from large number of patients and using machine learning algorithms to predict weather patient condition is normal or abnormal and IOT technology is used to read patient body vitals and then using internet connection will send that data to PHARMA company.

Here we don't have any IOT sensors so we build it as simulation and using heart disease dataset to train machine learning model and then randomly selecting records from dataset and then applying machine learning model on that records to predict it as normal or abnormal and sending this report to PHARMA server.

In propose paper huge number of patient's data packet will be send to PHARMA server and require fast internet and if data packet size is huge then it will JAM internet traffic so as extension work we are compressing PACKET data to reduce its size so internet JAM can be avoided. We are showing comparison graph between packet size of plain and compress data.

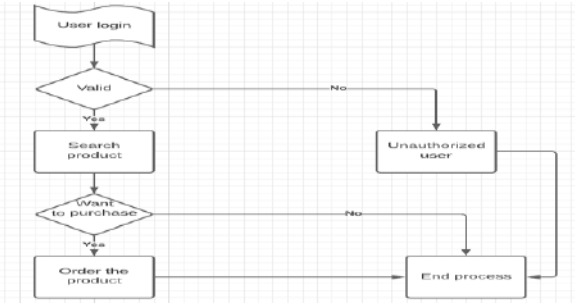


Fig 3: Data flow Diagram for User

Fig.4: Dataflow diagram for Manufacturer

4. METHODOLOGY

IOT TECHNOLOGY:

The term IoT, or Internet of Things, refers to the collective network of connected devices and the technology that facilitates communication between devices and the cloud, as well as between the devices themselves.

A typical IoT system works through the real-time collection and exchange of data. An IoT system has three components:

Smart devices: This is a device, like a television, security camera, or exercise equipment that has been given computing capabilities. It collects data from its environment, user inputs, or usage patterns and communicates data over the internet to and from its IoT application.

IoT application: An IoT application is a collection of services and software that integrates data received from various IoT devices. It uses machine learning or artificial intelligence (AI) technology to analyze this data and make informed decisions. These decisions are communicated back to the IoT device and the IoT device then responds intelligently to inputs.

A graphical user interface: The IoT device or fleet of devices can be managed through a graphical user interface. Common examples include a mobile application or website that can be used to register and control smart devices.

Let’s look at some examples of IoT systems in use today:

Connected cars

There are many ways vehicles, such as cars, can be connected to the internet. It can be through smart dashcams, infotainment systems, or even the vehicle's connected gateway. They collect data from the accelerator, brakes, speedometer, odometer, wheels, and fuel tanks to monitor both driver performance and vehicle health. Connected cars have a range of uses:

- Monitoring rental car fleets to increase fuel efficiency and reduce costs.
- Helping parents track the driving behavior of their children.
- Notifying friends and family automatically in case of a car crash.

- Predicting and preventing vehicle maintenance needs.

Connected homes

Smart home devices are mainly focused on improving the efficiency and safety of the house, as well as improving home networking. Devices like smart outlets monitor electricity usage and smart thermostats provide better temperature control. Hydroponic systems can use IoT sensors to manage the garden while IoT smoke detectors can detect tobacco smoke. Home security systems like door locks, security cameras, and water leak detectors can detect and prevent threats, and send alerts to homeowners. Connected devices for the home can be used for:

- Automatically turning off devices not being used.
- Rental property management and maintenance.
- Finding misplaced items like keys or wallets.
- Automating daily tasks like vacuuming, making coffee, etc.

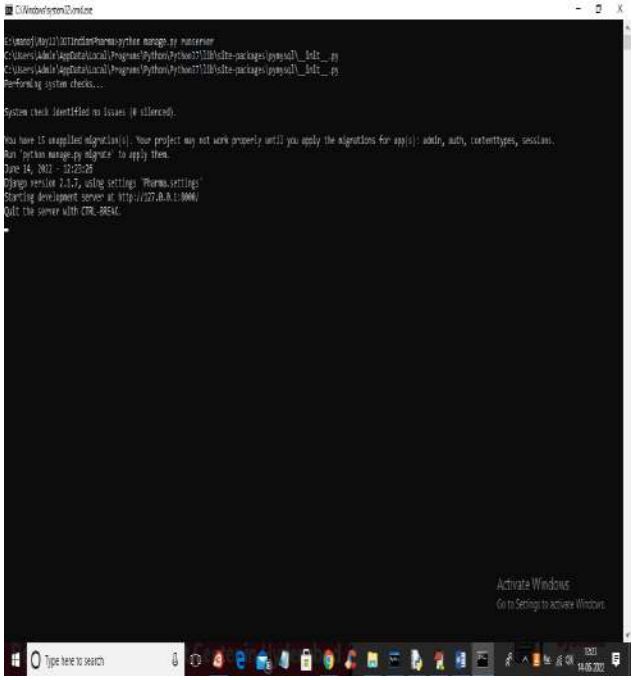
Smart cities

IoT applications have made urban planning and infrastructure maintenance more efficient. Governments are using IoT applications to tackle problems in infrastructure, health, and the environment. IoT applications can be used for:

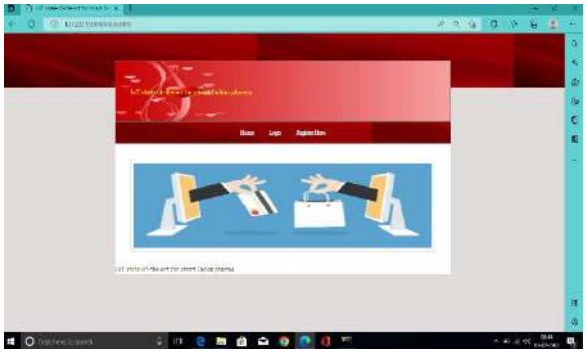
- Measuring air quality and radiation levels.
- Reducing energy bills with smart lighting systems.
- Detecting maintenance needs for critical infrastructures such as streets, bridges, and pipelines.
- Increasing profits through efficient parking management.

5. EXPERIMENTAL RESULTS

Now click on 'run.bat' file to start python DJANGO web server and get below screen

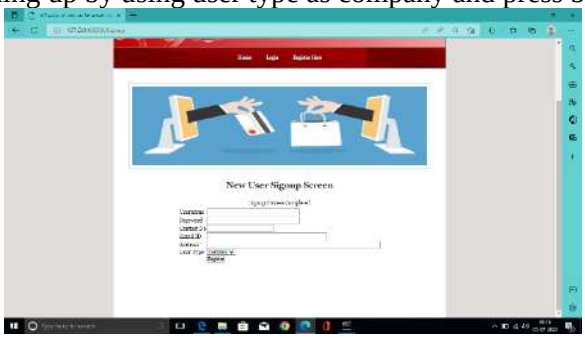


In above screen python DJANGO server started and now open browser and enter URL as http://127.0.0.1:8000/index.html and press enter key to get below output



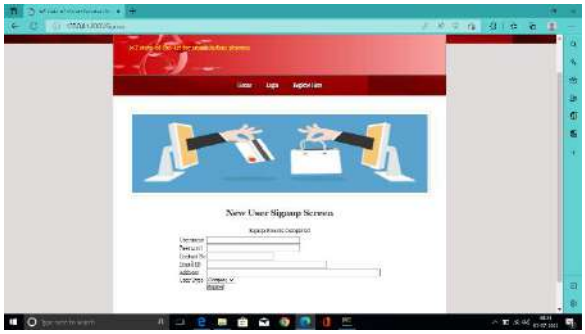
In above screen click on 'Register Here' link to signup user or company or organizations

In above screen company is signing up by using user type as company and press button to get below output



In above screen signup process completed and similarly user can signup

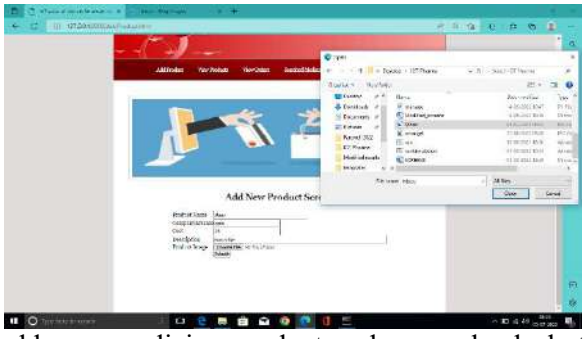
In above screen user is signup and press button to get below output



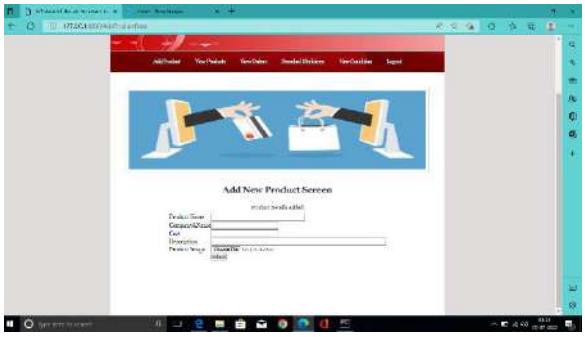
In above screen user signup completed and now login as company or organization

In above Screen Company user is login and after login will get below screen

In above screen company can click on 'Add Product' link to add new medicines



In above screen company can add new medicine product and can upload photo also and now press 'Submit' button to get below output



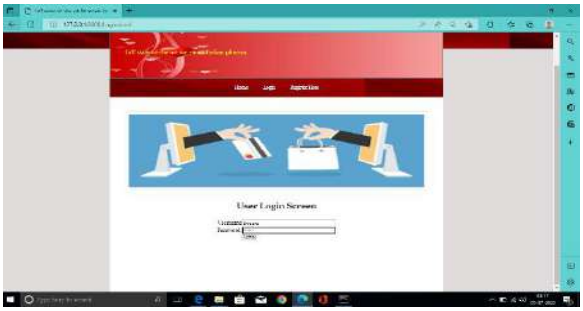
In above screen product details added and similarly you can add any number of medicines and now click on 'View Products' link to view their available products

In above screen company can view all available medicines details and now click on 'View Orders' to view orders from customers or users

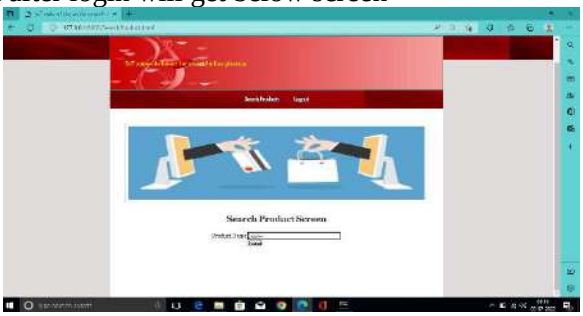
In above screen if any user make purchase then company can view their orders and now click on 'Searched Medicines' link to view medicines searched by users

In above screen company will view all medicines searched by all users and now click on 'View Condition' link to get patient condition from simulation application

In above screen companies can see IOT sensor data and can see patient condition as normal and abnormal and now logout and login as 'user' to search medicines



In above screen user is login and after login will get below screen



In above screen user can click on 'Search Products' link to get below screen

In above screen user will enter any medicines names and press button to get below search products output

In above screen user can view all details of searched medicines and can click on 'Click Here' to purchase and confirm order and this order will be viewed by company and full fill the order

In above screen 'Order Confirmed' and similarly you can add medicines and user can search and purchase orders

6. CONCLUSION

The Indian pharma marketplace, laterally with the marketplaces of China, Brazil and Russia, would forefront developments within these marketplaces. Market in Indian has diverse features branding it as an exclusive business podium. Initially, branded generics control, manufacturing up for 70 to 80 % of the retail marketplace. Next, local companies have relished a leading place determined by formulation development competences and initial investments. Then, price echelons are low, determined by strong competition. While India ranks tenth globally in terms of value, it is ranked third in volumes. IoT characterizes an absolutely digitally allied life and all our health data would be obtained from all the activities that we do having wearable devices which are as a rich source of information for science and medicine. Nano Sensors would possibly screen the way we eat, sleeping patterns, sugar count in blood, blood pressure, calories burnt, steps we walked, type of cavities we have or the bacterial contamination we have in our mouth / body. These would help to not only alert us at initial stages but would also help to diagnose the ailment at very early stages. These advents of digital disruption and inter connectivity would really benefit reinvent features of healthcare science sector. The concept of telemedicine and online distribution channels are well accepted in contemporary scenario. Smart devices also invite the needs for smart pharma. Modern interconnected technologies are providing great help to users to avail medicinal and healthcare support at their door step. Even the medicinal consultancies and counselling are possible due to advent of technology in a very reasonable cost. All these are gift of IoT and allied sensor technologies to mand kind. IoT packages and application solutions in pharma sector was probable to raise from US$420 million during 2015 to US$2,486 million by 2020, along a compound annual growth rate of 42.7% from 2016 to 2020 and by 2024 to 81.07 billion.

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