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Course - B.tech CSE - IOT
Section - T2

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Biotechnology Application relating to IoT.

The Internet of Things (IoT) provides network platforms that connects, shares & interact data from machineries, instruments and appliances to portable devices with internet system. IoT has impact on various sector of Research and Development, healthcare, pharmaceutical and biotechnology industries which use several devices, instruments, network platforms, computational data generation, data storage, capacity to integrate, share the data through efficient central networking system for automation analysis and innovation. Current biotechnological advancements, its a interdisciplinary dependency on various fields such as on computational biology, data science, information technology, nanotechnology, physics and engineering etc. necessitate for the amalgamation, reproductability, efficiency as well as exploring this dimension for smart strategy and innovation in biological sector.

Contribution of IoT is mostly shown its application in the development of smart city, smart villages, digital health, precision agriculture, wearable devices, connected car, smart supply chain, industrial internet, intelligent R&D and smart houses. Basically, IoT is the combination of four different components integrated together that are : sensors/devices, UI, data

processing, connectivity.

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Smart sensor, wireless network, actuators and devices in R & D lab, instrumentation, production equipment. & networked through computer systems generates huge data in Biotech / Pharma / Healthcare sector. Digital health has recently gained lot of consideration.

A lot of IoT based solutions have been explored in various biomedical applications.

E-health is deeply dependent on IoT, which provide advantages in terms of cost effectiveness, better accuracy, reliability, efficiency, real time monitoring and minimal human effort in healthcare. IoT results in improving production efficiency, automation, sharing the data and subsequently scheming various functions and analysis efficiently.

Along with this increased population there is also raise in the disease such as chronic diseases, cancers, tuberculosis, heart attacks, etc.

IoT have recently shown promising advancements the healthcare sectors.

IoT in Agricultural Biotechnology.

The ever growing population leads to the rising demand of food and feed for the livelihood. To achieve this livelihood and sustainability, the agriculture sector has to be improvised with latest technology that is IoT.

The agricultural biotechnology embracing with IoT provides a suitable alternative to transform the agricultural practices. Now-a-days, the concept of smart and precision farming paved the ways for the technological inculcation for enhancing the productivity of crops in controlled and accurate manner.

Recently, various high end IoT enabled products & services have been come into limelight that provides the easy platforms for the farmers to do agricultural farming in efficient way. That system includes some examples like variable rate irrigation optimizer (VRI), soil moisture probes, Virtual optimizer PRO and other IoT based systems. These devices make farmers to understand the soil fertility and its composition and enhancing the efficiency of water utilization in controlled manner.

The concept of smart green houses that comprises IoT based sensors that can intelligently measures and control humidity, temperature, pressure, light levels saves time, cost, energy, labor intensive process of farmers with no manual intervention & increased productivity in desired manner.

The wide implementation is necessary for the effective consequences of the IoT based services.

IoT in Pharmaceutical Biotechnology

In the pharmaceutical industry, the discovery of novel drugs and biologics are the promising avenue for the commercialization in business. It's mandatory to embrace IoT in today's world of digitalization with pharma that offers surplus opportunities for the innovation, agility, consistent quality, branding and value at global scale. The significant transformation has been envisaged in the every aspect of biopharmaceutical development to clinical trials and efficient supply as per market demands.

The implementation of smart and automated equipment's and accessories provides an excellent platform for adding more precision in quality of drugs with minimal errors. The real time monitoring through smart sensing speeds up the fast regulatory reporting leads to the better adherence of regulatory compliance. The developing concept of "organ in a chip" offers high-throughput screening of drugs for the development of vital diagnostics with on-line monitoring. The cost of exorbiant clinical ~~traits~~ trials has been reduced by the application of IoT based sensors. The development of smart warehouses enhances the efficiency in visibility for the technicians and warehouse operators in larger extent.

The transmissions of real time data for the location of products, inventory details, and maintenance of temperature for thermo-sensitive biological has drastically reduced the cost of bio-pharma by 65%. Recently, the advancements in smart packaging labels such as 2D-bar coding, RFID tags confers online tracking of the products from manufacturing to distribution. The implementation of smart serialization through Auto-ID with Automatic Information Data Collection (AIDC) in packaging materials has led to the complete digital foot print for precise controlling of proper conditions in cold chains for the temperature sensitive drugs during the transport.

IoT devices empower easy and fast communication of accurate & precise information of patients to doctors. Therefore, it adds on the improvement in daily lives of individuals & facilities intensive care in home, office or social space. Therefore, based on research, it is proven that IoT has immense potential to transform the pharma sector provided that pharma players could adopt this technology as soon as possible.

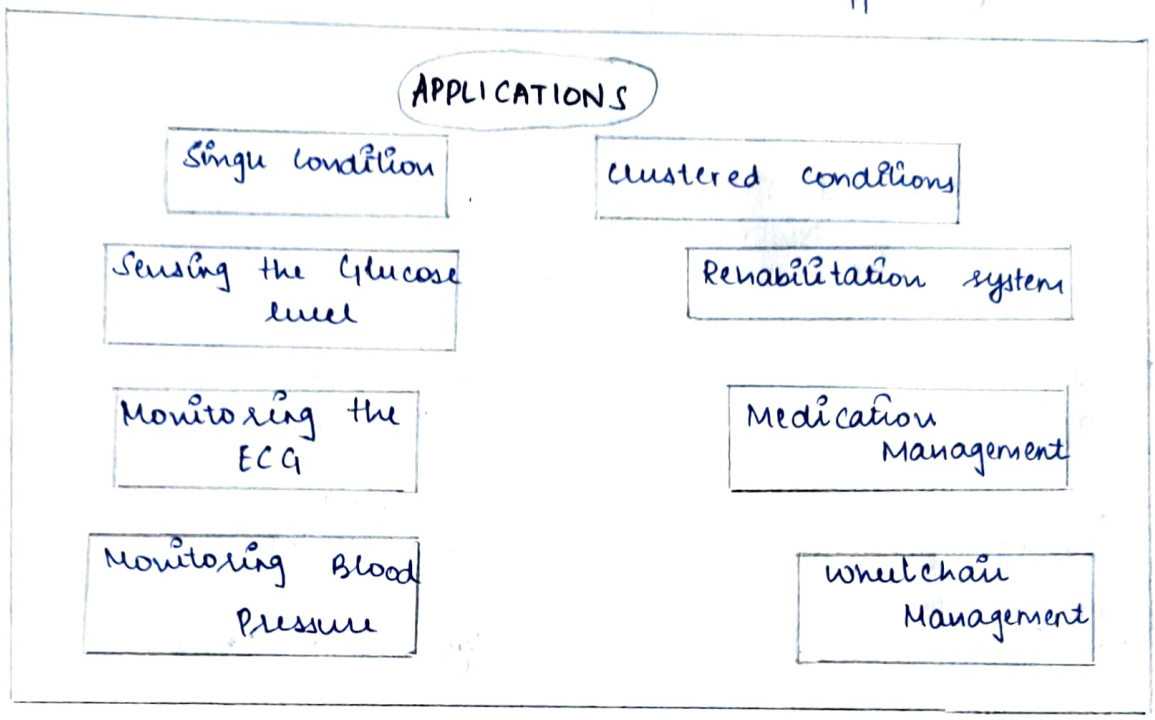
IoT in Research and Development for Biotechnology

The world has entered the era of "omics" by which we are acquiring & implementing the knowledge at molecular level. The high evolutionary pace of novel microbial strains, phages and other biological breakthroughs necessitates the biotechnological research more precise and agile. The acquisition of reproducibility and consistency of the results of the biotechnology research are one of the oldest and prime problems in this sector.

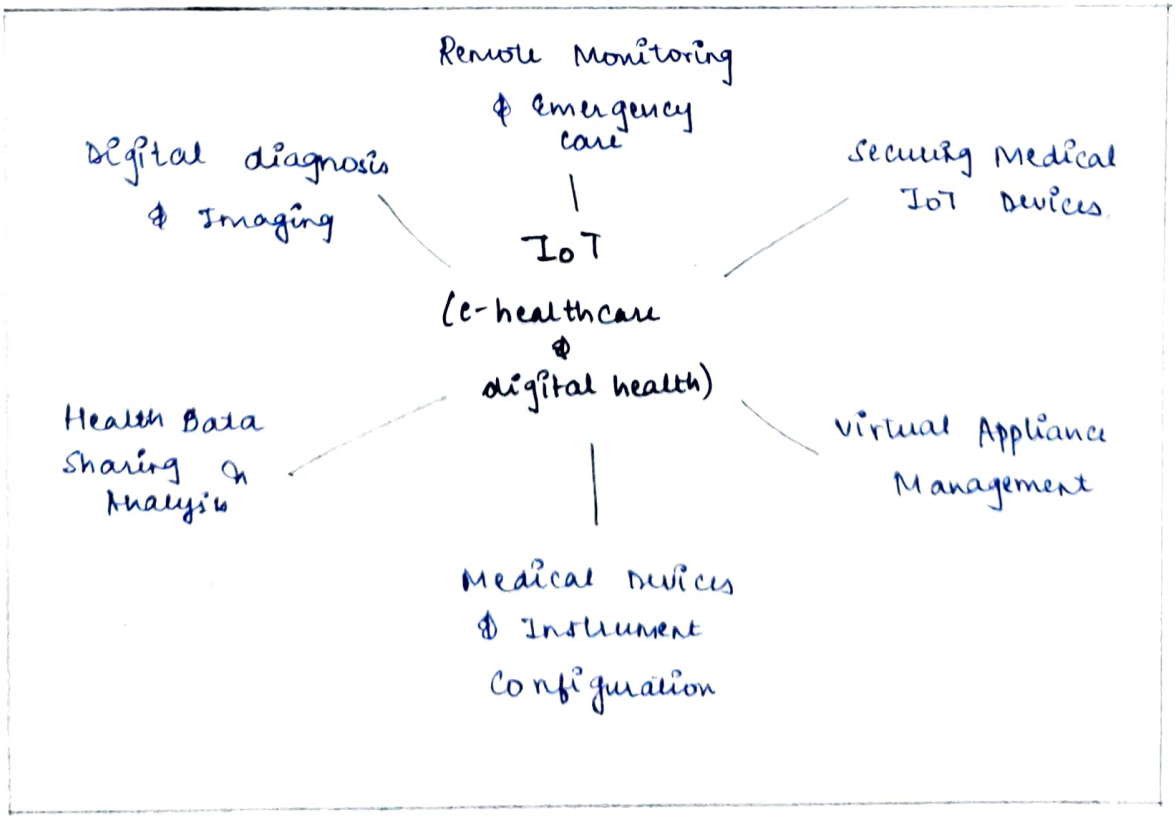
Moving biological materials from one place to another can be automated and IoT can be used to track this movement without human error impacting this movement. Ultimately, even technology can make mistakes, but what makes IoT differentiated is the ability to pinpoint those mistakes and account for them as research continues; the need to discard reduces drastically.

IoT has entered R & D of biotechnology to facilitate such innovations and inventions so that robust solutions can be brought about in the life.

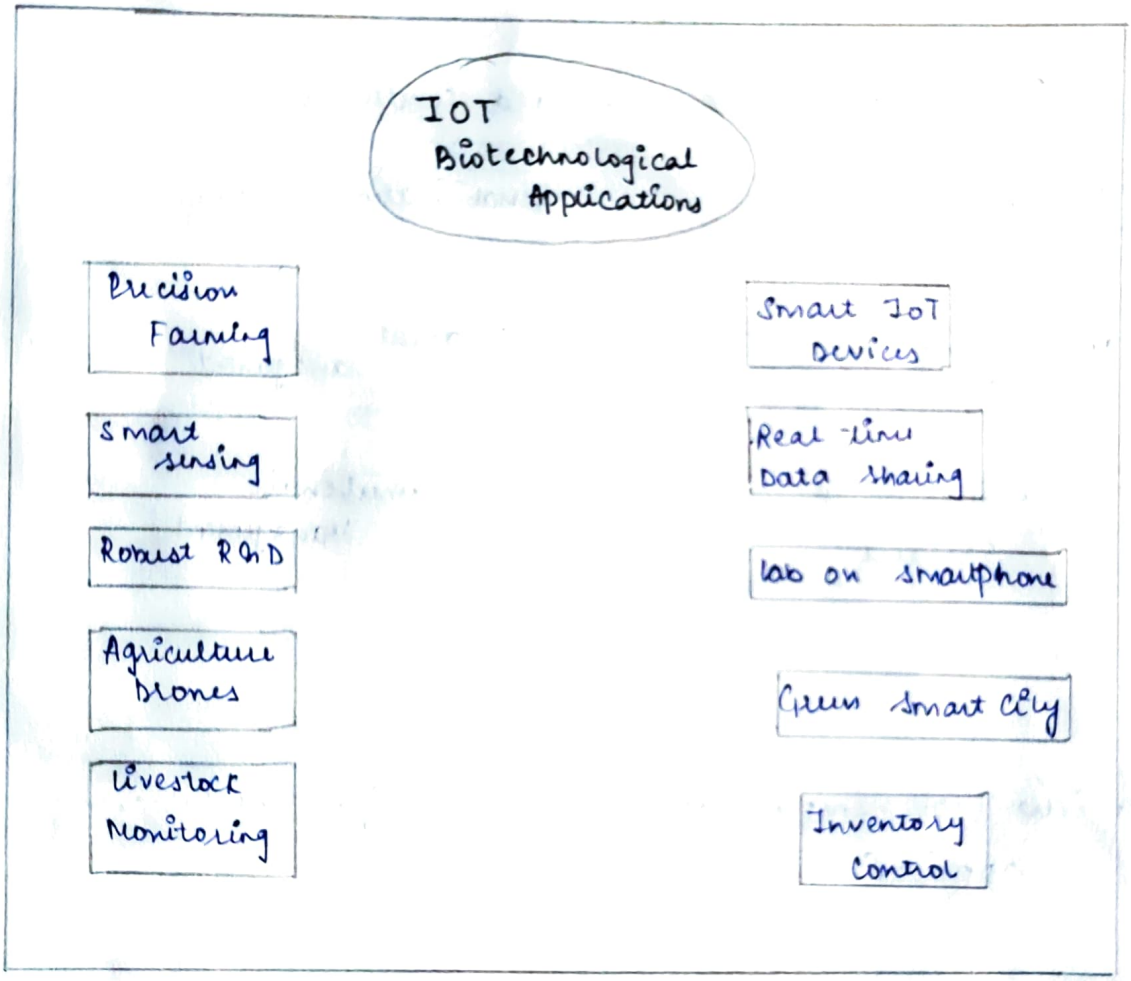
* Applications of IoT for Healthcare application in two ways.



* Overview of Implication of IoT for healthcare applications.



* Overview of various prospects of Internet of Things (IoT) for Biotechnology application



Current Challenges.

The emergence of IoT paradigm, a global dynamic interactive network has capability of connecting everything through virtual linkage of integrated devices. They are proving their mettle in every aspect of life and biotechnology is no exception so far now-a-days. The technology is moving ahead with more innovation, invention and productivity in biotechnological research that can be clearly proven by different examples. However, IoT is embraced with sparkling glaze till facing certain challenges that need to be overcome for the successfull implementation at global scale. The complex configurations of IoT devices due to utilization of diversified complex protocols laid significant impact for their acceptance in biotech industry. Apart from that, the proper authentication standards are not formulated yet therefore, the end users are not familiar with their maintenance and management of life cycle of these high-end devices. The security interfaces are very much restricted that can interact and share the security data also a barrier for their wider implementation. There are also challenges associated with their auditing and logging standards for the end users. Though, the technology has opened the window for intensifying research and development at higher pace but these challenges have to be resolved.

Future perspective

The skepticism and unpredictability of biological process, discovery of novel organisms, rising industrial demand for bio-based products and ensuring the reproductability in biotechnological research are key players for the adoption & integration of IoT in bio technology.

IoT provides a window for the efficient, reproducible, fast and precise research ~~for~~ into the biotechnology, world. The IoT leads to paradigmatic developments in performing mundane tasks like automated cleaning of glasswares and petridishes, filling multitier plates, dispensing cell culture media & micro-pipetting reagents in laboratory. The inter connection of various laboratories in the current working domain of IoT in biotechnology research. Though the technology is embraced with certain interoperability and technical challenges but the bio technological research is certainly on horizon by incilation of IoT in upcoming future.

IoT has a remarkable prospects in applied biomedical and clinical research. IoT, smart devices, smart phone based technology, sensor & combination of such platforms could bring potential scope for solving general biotechnology and biomedical issues. IoT help in diagnosis of the disease in earlier stage and provides the better solution using network connection and deep learning algorithm.

Development of ~~advancement~~ advanced effective smart IoT platforms is desirable that could revolutionize automation of R&D, digital diagnosis, e-health sector, precision farming in agriculture areas. Using AI to enable IoT and diagnostics, smart devices to deliver precision and personalized healthcare care at comprehensive extent. has tremendous potential in digital and big data era. Portability, connectivity and security for the next generation point of care diagnostics platforms based on capillary driven microfluids and IoT provides intelligent, connected, sensitive, inexpensive, faster, secured and advanced way of diagnostics, Technological advancements and current developm of point - of - care IoT devices have demonstrated improvement of health sector but further improvement are required to scale these devices and platforms by focusing on systematic health care workflows, policies, and clinical protocols, guidelines for its global utility to improve patient health.

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