Internet of Things (IoT)on Bio-Technology

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***Abstract*—The wide construct of "biotech" or "biotechnology" encompasses a large vary of procedures for modifying living organisms consistent with human functions, going back to domestication of animals, cultivation of the plants, and "improvements" to those through breeding programs that use artificial choice and conjugation. Fashionable usage additionally includes gene-splicing yet as cell and tissue culture technologies.Researchers are looking for bio-technology management for over a century. Luckily, IoT has the solution to help the employment methodology at every stage of the bio-technology management.**

Keywords—Internet of Things; sensors; Open IoT; Bio-Technology Management; Bio Sensors

I. INTRODUCTION

Biotechnology is the use of biological processes, organisms, or systems to manufacture product meant to boost the standard of human life.The science of biotechnology may be diminished into sub disciplines referred to as red, white, green, and blue. Red biotechnology involves medical processes like obtaining organisms to provide new medicine, or exploitation stem cells to regenerate broken human tissues and maybe re-grow entire organs. White (also referred to as gray) biotechnology involves industrial processes like the assembly of latest chemicals or the event of latest fuels for vehicles. Green biotechnology applies to agriculture and involves such processes because the development of pest-resistant grains or the accelerated evolution of disease-resistant animals. Blue biotechnology, seldom mentioned, encompasses processes in marine and aquatic environments, like dominant the proliferation of harmful water-borne organisms.
Investors are going crazy for everything and something related to the web of Things, or machine-to-machine communication. After all, the sphere has the potential to feature important potency gains throughout the world economy in applications starting from family appliances to agriculture to industrial producing. Whereas it's seldom mentioned, the web of Things additionally has the potential to revolutionize biotechnology laboratories and analysis and development efforts -- maybe making well additional worth for biotech than in the other headline-grabbing applications.
The leaders in machine-controlled biotech laboratory services won't be family names these days, however they are athletics to make next-generation bio fabrication facilities which will be troublesome, if not possible (or, at the terribly least, terribly expensive) to contend with. In alternative words, the first movers may well be the sole players within the marketplace for quite it slow, that may force future biotech firms to adopt business models strikingly completely different from those determined these days. Rest of the paper is organized as follows, Section II describes Related Works, Section III describes Biotech and the Problems, Section IV describes future of biotech, Section V describes smart solution, Section VI describes proposed model and Section VII describes the conclusion.

II. RELATED WORKS

This paper offers a breath summary of application of many biotechnologies in good town and also the ways that of its inclusion in web of things. Biosensors for environmental management native biological water treatment systems and pic bioreactors for building a mentioned as an area of web of things. Temporary summary of future biotechnology which will notice application in inexperienced good town conception conjointly given.[1]
The development of molecular technology (MNT) carries various risks like the assembly of doubtless unhealthy nanoparticles, the potential creation of small, harmful, self-replicating robots, and plenty of others. The preventative Principle is usually invoked once managing things that may be hazardous; but, the label "Precautionary Principle" is hooked up to a minimum of 2 totally different ideas, that should be analyzed singly. This paper discusses 2 sorts of the preventative Principle, that we'll decision the "strict form" and also the "active form", and relates them to the aim of the middle for accountable technology, and to CRN's policy recommendations.[2]
Manufacturers are providing remote fridge observance and automatic information work for years. However the IoT permits the mixing of various instruments, from totally different vendors, into one integrated platform, says Andreas Hochberger, United Nations agency is to blame of rising technologies at Eppendorf conductor in city, Germany. In 2015, Eppendorf was one in every of a dozen German firms that contributed to the smartlab project — a model science lab

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of the long run supported the IoT. Another smartlab is planned for the Labvolution 2017 conference to be control in Hanover in could. At the guts of the smartlab, says project leader Sascha Beutel, United Nations agency is at the Institute of Technical Chemistry of Leibniz University in Hanover, may be a science laboratory data system to that all lab parts are going to be connected and controlled, from ‘intelligent’, self-cleaning science lab benches to good safety specs which will project chemical safety data and augmented-reality displays. “To our information, this can be the primary try ever created to create an entire laboratory digitally supported and interactive,” says Beutel. Existing industrial implementations of the IoT area unit less comprehensive. Tetrascience, that was supported in 2014 and is supported, in part, by Digital Science (a practice in London operated by Holtzbrinck commercial enterprise cluster, that conjointly encompasses a share in Nature’s publisher), has sixty tutorial and trade shoppers, says chief govt and co-founder Alok Tayi. At university, nineteen labs use the service, that connects instruments to an internet dashboard, says Quentin Gilly, senior organizer of the university workplace for Sustainability’s inexperienced Labs program. The labs have connected over a hundred devices to the net, principally incubators and freezers; Turner’s science lab has used the system to attach eleven of its instruments. Peter Girguis, United Nations agency studies the biology of deep oceans, has 5 freezers and refrigerators at Harvard connected to the tetrascience grid. These units area unit equipped irreplaceable samples collected throughout tours on analysis vessels stationed anyplace from the middle Atlantic Ocean to the Pacific Ocean. “It prices several greenbacks to induce these samples,” he says. Several of the lab’s most precious samples area unit hold on in −80 °C freezers, that area unit monitored employing a system that mechanically notifies Harvard’s Operations Center once a fridge is over temperature. However, the lab’s –20 °C freezers and refrigerators don't seem to be compatible with the system, then nobody is alerted if they fail. Once the chance arose to check the tetrascience system, the science lab jumped at the possibility, says Jennifer Delaney, United Nations agency manages Girguis’s science lab. “It didn’t take an excessive amount of convincing.” Tetrascience uses a Wi-Fi module, concerning the scale of a deck of enjoying cards, which will be connected either to an external detector or through AN instrument’s information port. Sensors will monitor temperature, humidity, and greenhouse emission and oxygen levels, additionally as vibration, candlepower and mass air flow. This kind of apparatus will supplement internal sensors to make sure that crucial hardware like incubators and hypoxic chambers area unit performing arts of course. Direct association through AN instrument’s information port, permits devices like balances, ph meters, and even superior liquid natural action systems to be monitored or, in some cases, controlled. Not solely will scientists monitor those instruments. However, they'll conjointly stream information to electronic science lab notebooks, track the device’s usage and work, and management experimental workflows, Tayi says. “The goal may be a holistic computer code platform which might tie along individuals, information and devices.” Tetrascience users access those information through an online browser. The page lists all connected devices and their standing, and science lab managers will set temperature thresholds and alarm choices. The system conjointly displays every sensor’s history, thus users will see, for example, if a fridge has been slowly warming over many days — a proof, says Gilly, that it should need a service. Many tetrascience users have expressed frustration over born Wi-Fi connections, that generally have to be compelled to be reset manually. The info aren’t lost — the hardware will still log them for weeks, merchandising them into the system once property returns — however in step with Tayi, the corporate has updated its hardware to be “far a lot of reliable in terms of connectivity” and has else the choice of causation information over local area network cables and mobile networks.[3]

III. BIOTECHS AND THE PROBLEMS

The biotech facilities of the future will rely increasingly on automation. Why? Consider what a typical day in a traditional biotech research lab looks like. Researchers sit at the bench, furiously hand write detailed parameters of their experiment (temperature, ph, oxygen content, and the like), tediously move small volumes in and out of test tubes hundreds of times, and track labels for dozens or hundreds (or more) of samples.

One big problem: humans make mistakes. They write down the wrong parameter (or forget altogether), add the wrong liquid to the wrong test tube, and mislabel samples. Even when an experiment is performed perfectly, two labs can produce very different results. Reproducibility is biotech's oldest problem.

In 2011, healthcare leader Bayer took a random sample of drug development studies published in peer reviewed journals, while Amgen did the same in 2012. Each company performed the same experiments outlined in the studies in their state-of-the-art facilities to see if they could produce the same published result. Bayer found that no more than 25% of the results could be reproduced, while Amgen could only replicate results 11% of the time.

That's pathetic -- and costly. It is cited as a leading reason for high drug failure rates in healthcare applications of biotech and has decimated early industrial biotech companies such as Amyris that attempted to scale chemical production from 2-liter bioreactors to their 200,000-liter commercial scale counterparts. It highlights the finicky nature of biology (in our current limited understanding) and that humans simply aren't the best way to conduct biotech research.

Robots and software, on the other hand, always log the correct parameters, never add the wrong volume or liquid to a test tube, and don't mislabel samples. (Unless, of course, a human programs them incorrectly.) Only once biotech research is truly reproducible can we quickly commercialize new inventions and pinpoint errors in the R&D process. How is the Internet of Things coming to the rescue?

IV. FUTURE OF BIO-TECHS

Organism company Ginkgo Bio works recently launched Bioworks1, an 18,000-square foot facility with 20 robots armed and ready to conduct biotech research. Everything in the facility is given a bar-coded label and logged in a virtual database. In addition to making it easier to follow each sample and step in an experiment, bar codes help robots to track inventory and automatically place orders for out-of-stock components to ensure research can continue without a hitch. The company leverages its R&D expertise to build new organisms capable of manufacturing the cultured ingredients its customers desire, thereby monetizing the R&D process through contracts, and collects royalties if the ingredients are successfully commercialized. Customers save money by avoiding the need to conduct in-house research and gain a competitive advantage through a more effective or lower cost ingredient. Ginkgo Bio works gets paid to compound its understanding of biology and widen the gap between internal and external capabilities, perhaps one day making it absurd for products companies to build their own organisms. After all, technology companies today don't produce their own silicon chips. We can thank Intel for that.

Similar versions of that business model are employed by other organism companies. Intrexon ended 2014 boasting 17 exclusive channel collaborations, or eccs, that leverage the company's technology platform and automated R&D labs. While its future is heavily dependent on healthcare applications, CEO R.J. Kirk expects to generate $100 million in revenue from engineered cow embryos and other bovine reproductive tools and services in 2015.

You can probably see where this is going. Automation is now a necessity for successful outcomes in biology-derived products, although there are no guarantees. Amyris learned some difficult lessons about reproducibility when it first attempted to scale manufacturing in 2012. While the company appears to be on the right path to deliver on its original potential, enabled in part by its talking robots (which I recently visited) that build 120,000 unique yeast strains each month, execution will make or break the investment opportunity

Those early troubles weren't fun for shareholders, but eventually led to the departure of several key employees who would go on to start their own companies taking aim at biotech's reproducibility problem. Zymergen has quickly ascended the ranks as a leading organism company, while software start-up Riffyn aims to make biotech R&D truly reproducible through data collection, talking machines, and data analysis.

In addition to organism companies, several computer-aided manufacturing, or biocam, companies have built automated R&D platforms accessible through the cloud. Researchers residing anywhere with an Internet connection -- be it an academic lab, a major pharmaceutical company, or a local coffee shop -- can submit experiments virtually to Emerald Cloud Lab or Transcriptic, have armies of robots execute the experiment, and send an email when the results are ready for download. It's cheaper, the results are reproducible, and researchers can spend more time doing actual science. While making biotech R&D more reproducible and predictable is great for corporations and academic institutions,

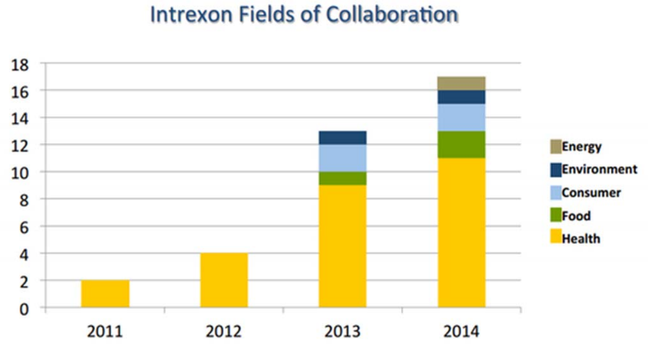

Fig 1-

Fig 1- Intrexon Fields of Collaboration

automated platforms also put world-class infrastructure into the hands of the masses. We're nearing the point where anyone with a little biology knowledge, a laptop, and an Internet connection can create a custom organism or biology-derived product from a coffee shop. In fact, it's already possible today.

V. SMART SOLLUTION

Existing Fertilizer Research and Testing Systems:

A certain number of plants are cultured in a controlled environment. Fertilizers are added in varied quantities. Also, the concentration of various constituents of the fertilizers are varied in a specific number of permutations. The plants are allowed to grow for a said amount of time, then their heights are recorded mostly manually. A statistical report is created and further experiments are conducted by changing the permutations for a certain number of times. The final result would so the highest plant used the best quality fertilizer in that trial. This data is sent to fertilizer industries for good quality fertilizer production. This system is tedious, and takes a long amount of time. The more the number of same experiments conducted the closer we go towards synthesizing the best/ideal fertilizer. But these iteration makes the process time consuming. Also, the accuracy of the experiment depends on the equipment of the particular laboratory. Lab conditions play an important role in such experiments.

Proposed Cloud/IOT Based Research and Testing System:

In the proposed model, there are going to be several IOT enabled laboratories with specialized equipment set for particular types of research. There would be several such instruments in each lab. In this particular case, there are going to be several fertilizer testing machines, fertilizer synthesizers and seed preservation system. Every machine is automated with the help of micro-controllers that are connected to a network of this particular lab. Several other such labs are connected to vast network, which is also linked to the fertilizer industry. The scientist doesn’t even need to enter the lab. He/she can sit on a computer in his lab or his home and conduct experiments using the instruments remotely. As part of the work flow, the testing machines would take seeds from the preservation and storage system and place them in cultures. The fertilizer synthesizer would then create fertilizers and administer specific doses in each culture in specific order of permutations. The plants would be allowed to grow for an amount of time and height of the plants would be measured using sensors and automatically recorded in an online database. All this experiment is conducted with minimal human intervention, except the need for some maintenance and on demand support personnel. The scientist can access the experiment data, change experimental conditions, and directly change fertilizer constituents of synthesizer, all of this from his home PC or his smart phone. The scientist can easily run one or two-line automation scripts that generate large number of such permutations. Speaking of large number, he/she can now automate the process across several laboratories having vast number of such instruments, in order to improve the accuracy of the results. The research process is itself quite seamless. The scientist doesn't need to worry about the particular labs or instruments available there, the automation system takes care of that and employ machines from several such IOT powered labs as per requirement. All the data from the labs can be statistically analyzed and this data can be sent to the scientist (and the industry itself real-time if needed). Scientists from all around the globe can have access to the data as well as machinery and share their project with each other. So, the scientist can take care of science and get rid of all the dirty work. Not only that, the data from the labs can be sent to appropriate machine learning programs for quick projection of results. Since this approach make use of multiple instruments from multiple labs seamlessly and results can be predicted much earlier, these experiments can be conducted in very short time. This will allow us to keep up with the increasing need for better fertilizers which is the need of the time. Effective resource sharing will allow multiple researches to be conducted in minimum amount of time and more efficiently with direct real time link to the industry for maximum productivity.

VI. PROPOSED MODEL

a) Hardware

Processors & Boards- Processors provide the intelligence behind IoT systems and are often integrated into system-on-a-chip designs.

Transceivers- Hardware that enables dual directional communication for data collection and control message delivery. Examples include cellular, Ethernet, and Wi-Fi.

Sensors & Actuators- Sensors transform energy into electrical data; they are the eyes and ears of IoT. Actuators transform electrical data into energy; they are the muscle of IoT.

Power Supplies- IoT power supplies include traditional, thin-film and printed batteries, energy harvesting modules, flexible photovoltaic panels and thermoelectric sources.

Gateways & Routers- Technologies that enable legacy devices and other systems to connect to the IoT. They integrate technologies and protocols for networking.

Devices & Equipment- Products used by end users that contain IoT technologies. Examples include enabled equipment, wearables, hand-held scanners, and tracking devices.

Wearables- IoT sensors and devices that are worn or embedded into clothing or accessories.

b) Software

Applications- Horizontal applications are standardized (e.g., asset tracking). Vertical applications are tailored to specific needs (e.g., delivery fleet management).

APIs- APIs are the market enabler for IoT. They allow users to manage devices, enable data transfer between software, and provide access capabilities.

Middleware- Middleware integrates the diverse components of an IoT application by structuring communication, workflows, and business rules.

Data Analytics- IoT analytics includes real-time or edge computing and batch analysis. Analytics can be behavioural, descriptive, predictive, or prescriptive.

Data Visualization- Visualization solutions use dashboards, alerts, events, maps, and other tools to present easily comprehensible data to end users.

Cloud & Fog Platforms- Data management solutions capture, index and store data in traditional database, cloud platforms, and fog systems for future use.

Security- Security software provides encryption, access control, and identity protection to IoT solutions from data collection through end-user applications.

To implement a basic model of the system, we need Raspberry Pi boards, some actuators, some Wi-Fi modules, a fertilizer-synthesizing machine containing a reserve of ammonia, urea, anhydrous ammonium nitrate, etc. The machine also has a fertilizer administering arm. The arm has to move over an array of test tubes, containing loam soil. Another arm attached to a seed storage, has to put seeds in each test-tube. There are sensors on each test-tube that measures the height of plants. Finally we need a client and a server with Wi-Fi link to the Raspberry Pi boards. The computer connects to a central server. The server looks for available machines and assigns the task to one of them. The server sends a command to the raspberry pi on the machine, which uses the actuators to get the work done. The raspberry pi also sends feedback to the server on each step. The program used for this multiplexing of machines on the network is context sensitive, so it can run multiple tests using several connected machines so output of one is fed to another as required. So the user needs to use a argument like "-current ". Now in order to run the test the we just need to write some commands in the terminal program like:

```
$  ./testfertilizer -prepare -10
Run synthesis with 10 combinations, Enter bounds for:
NH4(NO3) >>> 18.5  18.95
Mg(NO3)2 >>> 9.6 10.2
Urea          >>> 45.8 46.5
Getting apparatus info...
Running synthesis…
[===============100%================]
$  ./analysesamples -current -15 -24
Deploying seeds...
Running analysis..
The setup would be monitored 15 times in intervals of 24 hrs.
The generated result will sent to the scientist through email, when done.
$ _
```

The first command will search for an available machine in the network and start synthesis based on the given parameters. The second command will run analysis on the recently used setup for given number of times and at given intervals. This command will also email the scientist the results when the tests have been completed with full statistical analysis.

c) Services

System Integration- System integrators link IoT component subsystems, customize solutions, and ensure that IoT systems communicate with existing operational systems.
IoT Data Management- IoT data management consultancies help to make sense of big data, decide which data to maintain and for how long, and troubleshoot IT issues.
Hardware Development - IoT hardware consultancies provide services such as solution specification, product design, connectivity setup, and partner identification.
Software Development- IoT software consultancies support the development of data analytics, visualization solutions, and platforms, as well as integration into embedded systems.
Business Strategy- Examples of business consulting services include go-to-market design and execution, business model development, channel development, and corporate M&A.
Procurement- Procurement consultancies support solution selection, ROI analysis, vendor shortlisting, and other areas related to selection and execution of solutions.
Training- Training programs range from executive workshops to technical programs intended to upgrade workforces with IoT expertise.

VII. Conclusion

Every day, it appears a replacement mobile or digital health device hits the market. The unimaginable pace of innovation during this field is exciting. However, as waves of those technologies become obtainable to the public, we have a tendency to should additionally prepare ourselves to answer a straightforward question: Do these tools work? However, do they drive higher worth not just for patients, except for the care system as a whole?For payers, this needs assuaging issues regarding the value of wearables and different mobile or digital support tools. WE have a tendency to should invest in clinical studies and capture unjust knowledge that highlight the potential of those tools to assist patients get the proper treatment at the proper time, so reducing semi permanent care prices.

For suppliers, we have a tendency to should make certain that these devices are being developed with physicians' wants in mind. Within the future, this might mean coming up with technologies and systems that may seamlessly integrate with existing knowledge, together with electronic health records, to come up with clear, purposeful insights that doctors will use within the clinic. After all, the goal of wearables and different following devices is to maximize and enhance doctor-patient interactions—not replace them.

Above all, the most important issue that may drive the uptake of IoT technologies in care are the worth these tools will offer to patients. Today's patients are additional enlightened than ever—they need and expect a personalized approach to worry. Within the short term, IoT tools will facilitate North American nation higher attain this customary by equipping patients and doctors with targeted insights to assist offer simpler, agile care. For the future, the insights gleaned from these technologies will facilitate fuel our shift toward a "smarter" approach to healthcare—one that mixes knowledge, digital health and preciseness drugs with innovative therapies to drive higher patient outcomes.

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