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Internet of Things for Sophisticated e-Governance: A Special Focus on Agricultural Sector

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Abstract: Internet of things(IoT) is one of the trending technologies which can be best utilized in various e-Governance activities. The governance by government is done through e-Governance, m-Governance and now taking a new shape of incorporating IoT in e-Governance. The IoT is gearing up with the facility of communication among the objects (Things) which is generating vital data. This data can be utilized in e-Governance activities for societal benefits. The investigation with a case study on agriculture of Rayalaseema rural areas of Andhra Pradesh, Inda projected a positive result in turns of economy and comfort. This paper focuses on the IoT services to e-Governance, particularly in the field of agriculture for better productivity and policy making in operational, strategic and tactical levels. It facilitates rapid communication of data among various departments and establishes alliance among divisions of organizations which in turn enhances the country's economy and leads to prosperity.

Keywords: *Internet of things, e-Governance, Agriculture, Sensors, Data, Forming, Citizens*

I. INTRODUCTION

Electronic governance is the application of information and communication technology (ICT) for promotion of governance, delivering services and to disseminate information among stack holders, faster communications and integration of various services among its stakeholders. Its goal is to make the citizens participate in governmental activities electronically and to be part of nations capital by achieving their objectives with comfort from anywhere, any time. In day to day transactions e-Governance has become part of every citizen's governmental transactions and realizing its importance the government of India, introduced different levels of e-Governance projects at central, state and mixed level. It is studied and analyzed that the impact of e-Governance for practical implementation is fast, smooth and efficient which is helping in presenting the procedures with precession. The applications adopt telecommunication network,

information technology implementing government policies over internet to serve in a better way . The services of e-Governance are classified into three branches namely Government to Citizen (G2C), Government to Business (G2B) and Government to Government (G2G). As the government is for the people, by the people and to the people, serving citizens is the motto leading to the nation's development[6].

G2C: The government communicates to the citizens and facilitates the needs and services to the citizens using information and network technologies. India is the fifth biggest county in area and stands second with dense population, it ushers the needs of citizens to be focused by government for which a radical solution is G2C activity. As below 30% of Indian population are below the poverty line, the financials will not work out and hence minimizing the economics can be done through G2C e-Governance activity. Added to poverty, the illiteracy and rural lively hoods, is flaring up and it is adding pepper to traditional governance which lacks transparency. The corrupt officials and lack of reliability are boosting up, and the ultimate alternate to this act is G2C e-Governance applications[6][7].

Some of the successful G2C activities are Passport e-seva kendras, IRCTC online booking, Online filing of taxes, Computerisation of Land Records

(Department of Land Resources, Government of India), Bhoomi Project in Karnataka (Online Delivery of Land Records), Gyandoot initiative of Madhya Pradesh (Intranet-based Government to Citizen (G2C) service delivery initiative), Lokvani Project in Uttar Pradesh (public-private partnership project at Sitapur District in Uttar Pradesh to provide a single window, self sustainable e-Governance solution for handling grievances, land record maintenance etc.), Project FRIENDS in Kerala (Fast, Reliable, Instant, Efficient Network for the Disbursement of Services is a Single Window Facility to pay taxes and other financial dues to the State Government), e-Mitra Project in Rajasthan (The two major components of this programme are 'back office processing' and 'service counters'), eSeva project of Andhra Pradesh (provides 'Government to Citizen' and 'e-Business to Citizen' services), Revenue Administration through Computerized Energy (RACE) Billing Project, Bihar, Common Entrance Test (CET) for admission to professional colleges etc. [10]

G2B: The government communicates to the business organizations and facilitates the needs and services to them using information and network technologies. The primary objective is to decrease red tapes, save time and reduce operational bottlenecks. The G2B initiatives can be transactional, promotional and facilitative such as in licensing, permits, procurement and revenue collection, trade, tourism and investments.

Some of the successful G2B initiatives of India are "e-Procurement" Project in Andhra Pradesh to reduce the time and cost of doing business for both vendors and government. The "Gujarath e-Procurement project" to establish transparency in procurement process, shortening of procurement cycle, availing of competitive price among others. The Mission Mode Project under the NeGP aims to provide easy and secure online access to all registry related services provided by the Union Ministry of Corporate Affairs to corporates and other stakeholders [8].

G2G: Government to government (G2G) is sharing of data and/or information systems between government agencies, departments or organizations electronically. The goal of G2G is to support e-government initiatives by improving communication, data access and data sharing[11].

Some of the successful G2G initiatives are interactions carried out by various intelligence agencies like National Crime Records Bureau (NCRB), Common Integrated Police Application (CIPA), Crime and Criminal Tacking Network and System (CCTNS), applications of Forensic science labs, police communication network-POLNET etc. The transactions between various governmental departments exchange their goods and other document related transactions online through the government websites. e-Procurement among government departments is being conducted and the government to government transactions are not only taking place between state and central governments but also among governments of different nations.

Government-to-employees activities are accelerated in present day environment. "Khajane Project" in Karnataka which is comprehensive online treasury computerization project of the Government of Karnataka. The "SmartGov project" of Andhra Pradesh to streamline operations, enhance efficiency through workflow automation and knowledge management in the Andhra Pradesh Secretariat[5][6].

Transformation of technology: The technology used for e-Governance is rapidly getting changed day by day. It got incarnated from internet to mobile technologies, and within no time the mobile technologies incorporated geo positioning system and pervasive technologies. The e-Governance initially sprouted with internet technology and later using mobile technologies it became m-Governance. Making use of geo positioning system, that is location based technology, it got named as L-Governance. Now the e-Governance is making use of Internet of Things (IoT) for smoother and faster promotion of government activities. And there are new advancements like Physical Web, Internet of Everything, Industrial Internet, Cyber-Physical Systems, Web 3.0 and Web of Things.

IOT: The central concept on IoT is "Things speak", that is various electronic devices communicate with each other and make the intended work done. This allows user to gain the benefits of automation, integration, analysis in a system. They promote the faster execution of works with accuracy. IoT utilizes existing and emerging technology for sensing, networking, storage cloud and robotics. IoT best uses advances in software, hardware, and upcoming modern technology. Its prime features are Accessibility, Clearness, Seamlessness, Alertness, Reliability. Its new and advanced elements bring major changes in the delivery of products, goods, and services. This is giving tremendous influence and impact on the social, economic, and political aspects[2].

The most important features of IoT include artificial intelligence (AI), connectivity, sensors, active engagement, and small devices. AI of IoT essentially makes virtually anything "smart". The connectivity is related to networks. The IoT creates small networks between its system devices to communicate. The Sensors makes the devices to identify data and transmit it dynamically which is *active engagement*. Some of the sensors are temperature sensors, proximity sensors, image sensors, acoustic sensors, light sensors, pressure sensors, gas RFID sensors, humidity sensors etc. The various devices are used to facilitate comfort to user to make the works done. The scalability, precision of the devices can be adjusted as per user's requirement. Some of the commonly used devices are accelerometers, magnetometers, gyroscopes etc[12].

The critical IoT software includes Data collection, device integration and data analysis, application and process extension software. It covers the domains of embedded systems, networking and action through platforms, middleware, partner systems. These applications are responsible for data collection, device integration, real-time analytics, and application and process extension within the IoT network. They integration the critical business systems in the execution of allotted tasks.

IoT chiefly uses the standard protocols and advanced networking technologies. However, the major enabling technologies and protocols of IoT are NFC, RFID, low-energy wireless, low-energy Bluetooth, low-energy radio protocols and WiFi-Direct. These technologies support the specific networking functionality needed in an IoT system[1][3].

The striking benefits of IoT are improved customer engagement, technology optimization, reduced waste by effective resources management. This is catalyzing the G2B, G2C and G2G activities.

IoT has applications across all industries, markets, transport with special significance to traffic control is gearing up G2B and G2G activities. The applications of IOT in domestic usage and citizen financial transactions are triggering G2C activities. The IoT applications are being implemented by smaller groups whose target is to save energy to the larger groups who targets to set right their complicated operations are showing significant encouragement to promote G2G, G2B activities to next level. Industry, Engineering, Domestic and Infrastructure Applications of IoT include not only safety but also improving production, marketing, service delivery. IoT provides real transparency and creates greater visibility for improvement opportunities which is a boon for implementation of e-Governance applicatons. The deep level of control afforded by IoT allows rapid and more action on those opportunities, which include events like obvious customer needs, nonconforming product, malfunctions in equipment, problems in the distribution network, and more a creating wide oppurtunites for e-Governance applications to execute efficiently to satisfy the needs of stack holders.

IoT applied to government and safety allows improved law enforcement, defense, city planning, and economic management of G2G applications. In our daily lives, IoT provides a personalized experience from the home to the

office, or to the organizations we frequently do business with. This improves our overall satisfaction, enhances productivity, saves time and improves our health and safety. IoT pushes us towards our imagined future of medicine which exploits a highly integrated network of sophisticated medical devices which is part of G2C activity. Today, IoT can dramatically enhance medical research, devices, care, and emergency care which is taken to implementation in government hospitals, rural health centers which aids in promotion of G2C activity with great satisfaction. The integration of all medical equipments provides more accuracy, more attention to detail, faster reactions to health related events with improvements in patient care, while reducing the typical overhead of medical chaos[4][6].

The applications of IoT in environmental monitoring are extensive which helps the government to act on its protection, commercial farming, extreme weather monitoring, water safety, endangered species protection, etc. In these applications, sensors detect, measure and analyze the iota of environmental changes. Currently the air and water Pollution monitoring system primarily uses manual labor along with advanced instruments, and lab processing. The intervention of IoT reduces the need for human labor, allowing frequency and range of

sampling and monitoring with instantaneous analysis with sophisticated online, on-site testing and ultimately binding response efforts to detection systems. This allows us to prevent substantial infectivity, contamination and related disasters. Extreme Weather though powerful, advanced systems currently in use allow deep monitoring, they suffer from using broad instruments, such as radar and satellites, rather than more simplified solutions. The noval IoT phenomena promise more fine-grained data, better accuracy, and flexibility with quality output. This allows early detection and early responses to prevent loss of life and property. On the other hand today's sophisticated commercial farms have exploited advanced technology and biotechnology for quite some time, however, IoT introduces more access to deeper automation and analysis with communication to the precise superiors which helps the agricultural scientists, experts and government officials to guide the agro-illiterate farmers in right direction aiding in increased yield and revenue[2][4].

IoT supporting e-Governance applications has much potential; however, the benefits and barriers need to be considered. Especially with regards to the management and maintenance of large physical infrastructure, have not been investigated systematically and remain largely unreliable. There is a need to address the potentially unanticipated impacts of technology on governance structures and processes[10].

Case study on agriculture: The IOT Implementation in agriculture in connection to e-Governance activity is observed on the basis of state of the art literature and an explorative case study on agricultural yield and e-Governance alertness, and the observed potential benefits of IoT is presented [9].

According to the 2017 documentary report released by Department of Agriculture, Cooperation & Farmers Welfare Ministry of Agriculture & Farmers Welfare Government of India, the Agriculture plays a vital role in India's economy. 54.6% of the population is engaged in agriculture and allied activities and it contributes 17% to the country's Gross Value Added. Given the importance of agriculture sector, Government of India took several steps for its sustainable development [5][9].

In this regard the author focused his attention of IoT implementation in agricultural production linking with e-Governance. The experiments conducted in the area of Rayalaseema of Andhra Pradesh, India is a comparative analysis on the yields of the crops Rice, Wheat, Cotton and Ground nut in an area of 10 cents each, half with IoT controlled cultivation and the other without IoT, proved that former is better than latter. The data collection is focused on five parameters 1. Moisture in soil / Proper watering 2. Pest controlling activites 3. Minerals and salts of the soil(Strength of soil) 4. Timely reporting the dis orders to concerned authorities(Alarming) and 5. The final yield of the crop.

The percentage of soil moisture and atmosphere is identified by generic water flow and temperature humidity and soil moisture sensors. The Pest controlling is done with the help of color detecting and odor, vibration and pressure sensors. The Minerals and salts of the soil are identified using odor, magnetic, pressure sensors. The timely reporting is done with the programming done in Embedded Development Kits (EDK) which can be delivered thorough servers or Global System for Mobile Communication (GSM) to the respective authorities. The weight detecting sensors in addition to other related sensors are used in collection of the data.

The data collected from different crops is quantified on the scale of 10 points and it is presented in the Table 1 and its graphical representation in the following Graph 1.

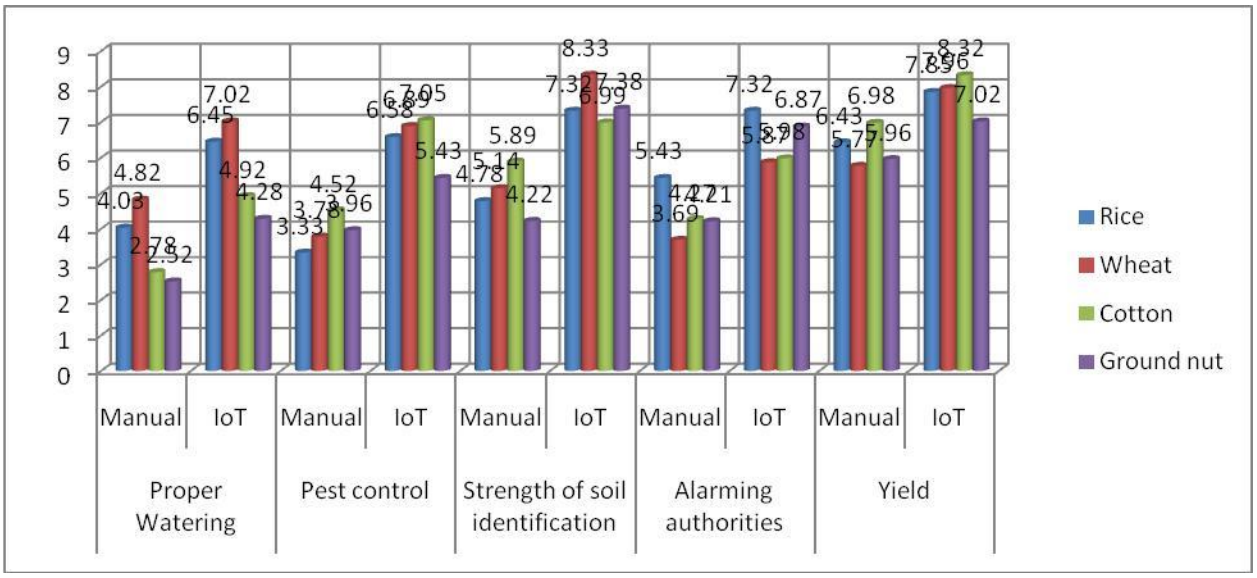
It is noticed that the data collected differs from location to locations as the parameters of the crop depends on the geographical location, climatic conditions majorly on rainfall and day light, the severity of pest attach in that zone etc. The other technical limitations in data collection is failure of sensors, communication problems with internet failure, electrical disturbances in rural remote areas and some of the common meager human errors.

The observations from the Table 1 led to conclusion that the technological IoT implementations in the agricultural sector of India, for sure will bring tremendous revolution and generate higher revenue. The The technological, sensor manure cultivation of crops will lead to new era of crop cultivation. The limitations to be answered are literacy among formers and their ability of using the devices, investment and other technical hassels. It can be assessed that a big national level revenue model can be created from these observations, which will boost up the Indian economy and leads to a new generation technological green revolution leading the country to prosperity.

Table 1: Comparative study on outcome of different parameters of various crops using manual and IoT system

Crop	Proper Watering		Pest control		Strength of soil identification		Alarming authorities		Yield	
	Manual	**IoT**	**Manual**	**IoT**	**Manual**	**IoT**	**Manual**	**IoT**	**Manual**	**IoT**
Rice	4.03	6.45	3.33	6.58	4.78	7.32	5.43	7.32	6.43	7.85
Wheat	4.82	7.02	3.78	6.89	5.14	8.33	3.69	5.87	5.77	7.96
Cotton	2.78	4.92	4.52	7.05	5.89	6.99	4.27	5.98	6.98	8.32
Ground nut	2.52	4.28	3.96	5.43	4.22	7.38	4.21	6.87	5.96	7.02

Graph 1: Comparative graph on various attributes of different crops



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