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Smart Disease Surveillance Based on Internet of Things (IoT)

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Abstract: Surveillance is a regular collection, analysis, and interpretation of data on disease patterns of a geographic area which helps in indicating outbreaks of major health related symptoms. In developing countries like India, efficacy of a surveillance system is often hindered by the quality and availability of data. Internet of Things (IoT) concept enables the possibility of information discovery about a tagged object or a tagged person by browsing an internet addresses or database entry that corresponds to a particular active RFID with sensing capability. In the Internet of Things based "Smart Disease Surveillance" the smart device, which is none other than the main server located in every hospital which maintains patient records, will automatically process and send the required information to the backbone network. This backbone network will in turn process and give information to the health ministry so that the trends are understood quick, smart and easy. This will help the ministry to take necessary steps without much delay as all the information is given by the smart devices.

Keywords: Disease Surveillance, Internet of Things, Disease Surveillance in India, Health care India ideas.

I. INTRODUCTION

The Central Health Ministry needs disease case reporting in order to know and be aware and also to warn the people of the various diseases the citizens should be careful about. Currently, in India weekly disease surveillance data on epidemic prone disease are being collected from reporting units such as sub centres, primary health centres, community health centres, hospitals including government and private sector hospitals and medical colleges or a survey team collects data from various private and public health centres to do a detailed study. But generally it's only after the widespread outbreak people are aware this is due to slow and inefficient disease surveillance system prevalent today. Smart Disease Surveillance based on Internet of Things is a proposal to make an efficient disease surveillance and hence help in identifying the trends of the various diseases .The proposal is for a huge network of smart devices which can automatically process and analyse data entered into it. The devices then send the data to the central backbone network which can be of the Central Health Ministry which are supposed to be alerted of the spreading of the disease. Once the trends and analysis have reached the backbone network then it can easily conclude the fast spreading disease and take the necessary steps for its prevention across the nation and the world. This will also help people to be aware of the disease as soon as possible.

II. SMART DISEASE SURVEILLANCE

Smart disease surveillance is a novel and innovative proposal to speedup up the existing process of surveillance and also making it accurate and timely at a national level.

A. Disease Surveillance

Disease surveillance is an epidemiological practice by which the spread of disease is monitored in order to establish patterns of progression. The main role of disease surveillance is to predict, observe, and minimize the harm caused by outbreak, epidemic, and pandemic situations, as well as increase knowledge about which factors contribute to such circumstances. A key part of modern disease surveillance is the practice of disease case reporting.In modern times, reporting incidences of disease outbreaks has been transformed from manual record keeping to instant worldwide internet communication. The number of cases could be gathered from hospitals - which would be expected to see most of the occurrences - collated, and eventually made public. With the advent of modern communication technology, this has changed dramatically. Organizations like the World Health Organization (WHO) and the Centers for Disease Control now can report cases and deaths from significant diseases within days - sometimes within hours - of the occurrence. Further, there is considerable public pressure to make this information available quickly and accurately. Formal reporting of notifiable infectious diseases is a requirement placed upon health care providers by many regional and national governments, and upon national governments by the World Health Organization.

B. Internet of Things(IoT)

The Internet of Things (IoT) is a scenario in which objects, animals or people are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.Typically, IoT is expected to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine communications (M2M) and covers a variety of protocols, domains, and applications.[The interconnection of these embedded devices (including smart objects), is expected to usher in automation in nearly all fields, while also enabling advanced applications like a Smart Grid.Things, in the IoT, can refer to a wide variety of devices such as heart monitoring implants, biochip transponders on farm

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animals, electric clams in coastal waters,[1]automobiles with built-in sensors, or field operation devices that assist fire-fighters in search and rescue. These devices collect useful data with the help of various existing technologies and then autonomously flow the data between other devices. Current market examples include smart thermostat systems and washer/dryers that utilize Wi-Fi for remote monitoring. Integration with the Internet implies that devices will utilize an IP address as a unique identifier. However, due to the limited address space of IPv4 (which allows for 4.3 billion unique addresses), objects in the IoT will have to use IPv6 to accommodate the extremely large address space required. Objects in the IoT will not only be devices with sensory capabilities, but also provide actuation capabilities (e.g., bulbs or locks controlled over the Internet). To a large extent, the future of the Internet of Things will not be possible without the support of IPv6; and consequently the global adoption of IPv6 in the coming years will be critical for the successful development of the IoT in the future.

C. The Proposal

The components of Smart Disease Surveillance are:

- **Smart IoT devices(main servers at the hospital) and**
- **Smart backbone device**

The main component of the IoT is the RFID system. RFID can automatically identify the still or moving entities. The main aim of IoT is to monitor and control objects via Internet. The Health Ministry registered register will have one active RFID sensor fitted main server.

The server is a smart IoT device which will be able to analyze and process the data entered into it. The server in the hospitals can also be considered as a device making use of artificial intelligence and thereby act as a decision support system. The tasks of the smart server device will be the following:

- Collect the trending symptoms from the data entered.
- Analyze the data and make reports.
- Check if collective symptoms can be a sign of another disease.

Once the reports and conclusions are generated by the smart server device, the conclusions are to be passed to the backbone device through Internet.

The backbone device is also a smart IoT device with a larger purpose. The smart backbone device will have to analyze and produce results from data generated from different smart devices. This device will be generally of the Central Health Ministry. This device will produce reports from the data obtained from various smart devices as to

- The disease fast spreading
- The set of symptoms found commonly among the people of the nation. Sometimes, this may be an initial symptom of any other fatal disease. Hence generating reports indicating a particular set of symptoms are trending may put more analysts to work.
- The Health Status of the nation
- The possibilities of a disease based on particular symptoms collected from an area.

Thus the Central Health Ministry will get a ready and a more accurate survey and disease surveillance based on Internet of Things. This will greatly help the present system which is slow and inefficient. The smart servers can fix a time and keep passing the data to the smart backbone which will help the Ministry with the surveillance which might otherwise take months. By then the outbreak would be too big to handle and might have caused damage to a number of lives too.

The Central Health Ministry can therefore

- Know the trending disease very quickly and in no time
- Help in decision making as to the possible disease based on the symptoms
- Get a timely and accurate survey
- Give a timely warn to the citizens regarding the disease.
- Check the stock of the medicines for the disease
- Can avoid underreporting of the cases to the maximum

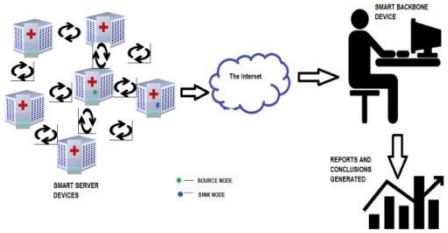

Fig 1. Smart Disease Surveillance Based on IoT

The conceptual view of the proposed Smart Disease Surveillance based on IoT is shown in figure 3.Here several Smart devices form the nodes in the network. The node which is currently sending the data is the **source node.** The **sink node** accepts the data from the source node and transfers into the Internet and from there to the smart backbone device. The sink node is just one node which can manage higher data rate or can be a separate gateway device which can pass the data in an accurate and timely manner to the Internet.

III. NEED IN INDIA

The Government of India realized the importance of Disease surveillance after the Cholera outbreak in Delhi and the Plague outbreak in Surat, which not only had significant mortality and morbidity but also significant economic consequences. One more case highlighting the need for smart disease surveillance is the recent underreporting of dengue cases in the nation.

Case 1: CHOLERA OUTBREAK, DELHI, 1988:
Delhi experienced an outbreak of cholera during July-August 1988 which affected residents from all walks of

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life. A total of 1824 laboratory confirmed cholera cases were detected in two months period at I.D. Hospital, Delhi alone. The number of cholera cases in July-August 1988 was 5-10 times that of the same period during the previous years in the Capital.

Case 2: PLAGUE OUTBREAK , SURAT,1994:
In 1994, a pneumonic plague epidemic broke out in India. It was particularly widespread in Surat, Gujarat, where it resulted in 52 deaths and in a large internal migration of about a quarter of the city's 1.5 million, who fled fearing quarantine. The mass exodus occurred over long distances by railways and short distances by buses and other carriers. Surat does not have an airport for commercial flights. The train and bus stations were full of people struggling to make space for themselves and their family members, sitting, standing, hanging out the doors and windows and even on the roofs. The news coverage, aggravated the panic, locally, nationally and internationally. India Today, a prominent weekly magazine, described migration from Surat as reaching "biblical proportions". A German magazine described the exodus very vividly. An international response followed in the aftermath of the Surat plague outbreak. The World Health Organization (WHO) announced plans to establish a Disease Intelligence Unit that will function independently when such outbreaks occur to help diagnose the problem quickly. In addition, WHO asked the International Civil Aviation Organization to tighten its health controls at all international airports and to strengthen quarantine measures that seem to have lapsed since the eradication of smallpox.

Case 3: DENGUE, 2006-2012 :
While official data show some 20,500 annual cases of dengue fever in India, a new study has found the number is nearly 300 times higher than reported, costing the country over 1.1 billion USD a year. According to the study by US and Indian researchers, an average of six million people a year in India had a symptomatic illness between 2006 and 2012 with this mosquito-borne disease.
The figure is nearly 300 times higher than officially reported. India is believed to have more cases of dengue than any other country in the world, with major outbreaks in recent years.

IV. RELEVANCE

The current projects in India implemented for smart disease surveillance has many disadvantages and are not timely and accurate

- No integration and budget for retraining for NSPDC
- Feedback inadequate
- District and sub-district level are pivotal to the IDSP. District level epidemiology needs further strengthening with effective use of improved tools of data collection and analysis; and training for analytical and predictive epidemiology.
- States/UTs should ensure presence of adequate data managers, epidemiologist, microbiologists, entomologists and veterinary specialist for regular and effective monitoring & evaluation of the project activities and generating operational research evidences.
- The district and regional public health laboratories need up-gradation to shift from sheer clinical testing to detecting and monitoring epidemic threats, and assistance in improving quality of outbreak investigation and reporting.
- The IDSP should have a technical advisory group to supervise and guide it future progression.
- Although about 90% of the districts report every week (including mandatory Nil reporting) through email or IDSP portal but the quality of data compiled at district levels still need rigorous monitoring and capacity building.
- Capturing of data from private sector clinicians is still patchy.
- The epidemiological data compiled were neither fully analyzed nor utilized at district level for guiding interventions despite presence of epidemiologist but rather were forwarded to higher levels.
- The processed data and reports should be used to guide public health interventions which is still lacking at state and district levels.

V. CONCLUSION

Considering the present situation in India where there is a need for an efficient and timely disease surveillance system, this Internet of Things based, Smart Disease Surveillance system will be a major breakthrough in the fields of Medicine and Computer Technology. The current situation where surveys are conducted on a weekly basis and are heavily dependent on the district and state health centres for disease case reporting will change to a situation of timely and accurate disease reporting and reduced burden for the district and the states .All they have to do is register with the Central Health Ministry for an IoT based smart device and update their records with details of symptoms.
The possible outcomes are

- Timely disease case reporting and thereby completely eliminating under reporting.
- Accurate analysis and trends about the diseases.
- Will help the Health Ministry to take timely preventive measures.
- Will Help the Health Ministry to check if the nation has enough support of medicines to tackle any outbreaks.
- Will be able to predict a disease by the collective trending symptoms in an area .
- Delayed reporting will be avoided completely.
- Will help the central Health Ministry to warn the citizens on time.

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REFERENCES

[1]. Future Internet:Internet of Things ,IEEE paper by Lu Tan and Neng Wang , Computer Science & Technology Dept., East China Normal Univ., Shanghai, China
[2]. A Cooperative Internet of Things (IoT) for Rural Healthcare Monitoring and Control,IEEE paper by Vandana Milind Rohokale, Neeli Rashmi Prasad, Ramjee Prasad,Center for TeleInFrastuktur, Aalborg University, Denmark.
[3]. Wikipedia-https://en.wikipedia.org/
[4]. Bulletin of World Health Organization-www.who.int/bulletin
[5]. Disease Surveillance in India-Indmedica- a ppt by Dr.Sampath Krishnan.
[6]. Integrated Disease Surveillance Project (IDSP) -idsp.nic.in/