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Data collection in health monitoring

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ABSTRACT

Data collection is most important in any industries. The data collection which refers to the collecting a data or information from respective sources. In each and every industry maintain a database with the attributes that are required and necessary. Even for health monitoring, some information about the patients is required for the further decision making or for the treatment. This collected data can be useful for the easy analysis and for the extracting data about the individuals. Here we are briefly explaining the techniques used for data collection in health monitoring systems. There are so many techniques which had been used for data collection and also it involves many types of research on the data collection, its security, efficiency, and so on. Data collection is very important to know the information about the individuals.

Keywords: *Data collection, Primary data, Secondary data, WSN, Health CPS, Biosensor, Triage network, Data node.*

1. INTRODUCTION

Gathering of information about a respective object from a related source is known as data collection. Which is useful to estimate an economy or the status of that. Its goal is to capture the evidence and to make analysis easier. Data collection is one of the biggest tasks in all the fields including business, education institutions, health institutions and other industries. There are two types of data collection methods (fig 1) 1.secondary data collection 2.primary data collection,

1. Secondary data collection method: refers to the published data already that may be books, newspapers, journals, magazines etc.

2. Primary data collection method: refers to the data which is not published, its further divided into two categories (a) qualitative data collection (b) quantitative data collection

(a) Qualitative data collection: which is associated with the sounds, feelings, emotions, signals, colors etc.

(b) Quantitative data collection: which is associated with the measurable or mathematical calculations in various format.

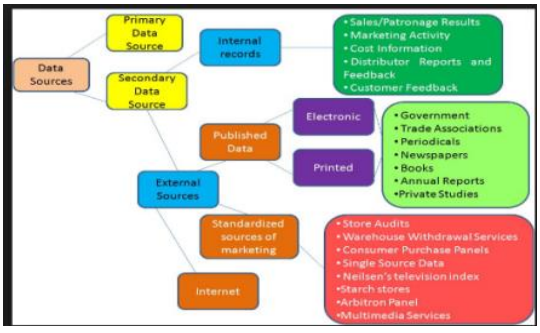

Fig 1 Hierarchy of data collection methodology

Data may be structured or unstructured, both data to be collected for the analysis process. The structured data is nothing but data in a single order or a format, whereas unstructured is a data which is simply dumped, the unstructured data is difficult for data mining to get or to retrieve a required information. This can be solved by data mining techniques.

Good health makes one happy, health is a more valuable thing in our life which gives peace and happiness where that cannot be bought by money.A unhealthy person cannot enjoy the pleasure of being healthy.Thus the proverb ' health is wealth'. To be safe and to maintain a good health there must be a proper health monitoring and management.

Health is a state of complete physical, mental and social wellbeing, it is a most important for every creature on the planet earth which increases the economy status. In the development of health care all over, health industries started to implement smart devices and communication applications for monitoring and management.

IOT plays an important role in health monitoring and management, which have been initialized in most of the industries. This is implemented so that they are accessible, efficiency is more, portable, and easy to use. Some may be higher in cost but some are affordable.

Fig2 IOT in different industries

The IOT is the physical device network, vehicles , home appliances(fig 2) and remaining items are embedded with software, sensors, electronics, which enables these objects to connect and communicate one other (data will be exchanged). The IOT allow objects to be controlled remotely or sensed across existing network infrastructure, which provides improved efficiency and accuracy in an output. It also integrates things.

For any industries data storage is the main problem, cloud computing became the solution, cloud computing is an information technology which stores data and shares the resources. Cloud computing is also known as a storage device.

Cloud computing has some characteristics such that cost reduction, maintenance, resources sharing, performance, increased productivity.

Some health industries use integration of cloud computing and IOT for health monitoring and management.

2. BACKGROUND WORK

a) Data Collection Technique in Wireless Sensor Networks

In today's technology wide variety of applications make use of wireless sensor network. They are battery powered in the health monitoring applications. Wireless sensor life time has been increased by several power saving technique for data collection.

It consists of sensor nodes they are small in size and with low processing capability and battery power. The crucial technique in WSN's is data aggregation. It is the process of collecting and aggregating the input sensor data.

WBSN's are generally used for monitoring the elderly people in homes and to nurse them. It's the collection of periodically physiological measurement is through bio sensor. WBSN and WSPAN (wireless personal over networks) provide an application in medical to measure specified physiology data and also the location-based information.

WBSN is a subset of WSN which allows continuous monitoring health. It collects and analyze virtual signs data by using different biomedical sensor (example: Body temperature sensors, Heart beat sensors, Blood Pressure sensors, ECG). The periodic transmission of vital signs is one of the most important for the patient monitoring.If the vital sign error threshold than the alerting signals are passed.

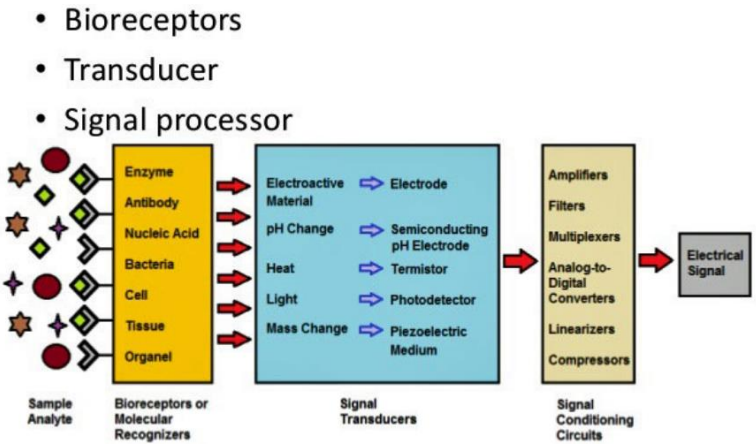

Fig 3 Procedure of biosensor

Assume that the biosensor is implemented in the patient body, the data that is sensed will be sent to the coordinator near the body or located on. The collected data aggregation, fusion, forwarding and its decision to the sensed node is will be taken care by the coordinator. The destination will have the received data(fig 3).

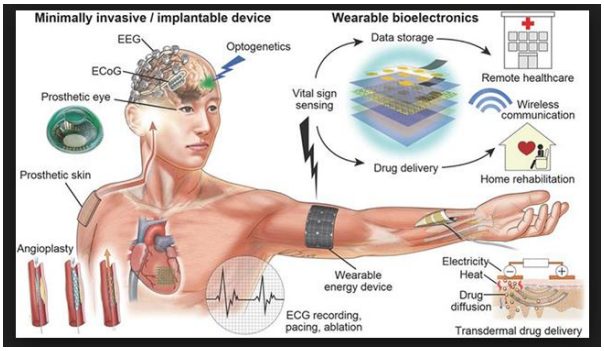

Fig 4 WSN in Human Body

Challenges of biosensor and it's overcome

- Due to the transmission provided, energy will be consumed.
- Heterogeneous raw data captured by the biosensors are in huge amount.
- Data function, difficult to fuse the information from biosensor nodes, which makes difficult to know the patient situation, to make a right decision.

Biosensor nodes detect emergencies and send measurements to the coordinators, when there will be a change in criticality level of the vital sign, by this we can reduce every assumption. Data function technique will be overriding by fuzzy set theory.

b) The architecture of WBSN and behavior of the biosensor

WBSN consist of the biosensor, one vital sign is sensor each of them. Periodic measurement names (samples gave) is collected by each Sensor in WBSN and send it to coordinates. It sends the captured measurement during a period and critical measurements with the help of a LED algorithm.

Algorithm 1: Algorithm of Modified Local Emergency Detection.

Require: R_t (Instantaneous Sampling Rate).

While *Energy* > 0 do

for each period do

takes the first measurement r_0

sends the first measurement r_0

gets the score S of r_0

takes measurements r_i at R_t Rate
gets score S_i of measurement r_i

if S_i !=S then

sends measurement r_i

$S = S_i$ end if

end for

end while

Suppose $s = \{v_0 , . . . , v_n \}$ be the series of sensed data at a R_t rate at a period p belonging to a given feature and $_{scores} = \{score(v_0), . . . , score(v_n)\}$ is corresponding scores series that will be computed using an EWS. Then the biosensor will send a data that is sensed v_i only if its score score (v_i) differs from the score of the previous sent data in the same period (cf., Algorithm 1).

The transmission will be optimized by eliminating the transmission of consecutive sensed data having the same score while maintaining data integrity by sending data each time a new score is detected. For example, suppose s= $\{v_0 , v_1 , v_2 , v_3 , v_4 , v_5 , v_6 , v_7 \}$ is a series of eight consecutive measurements for a given feature, $_{scores} = \{1, 1, 0, 2, 2, 2, 2, 0\}$ is the series of the corresponding consecutive scores.

The patient's situation can be defined by patients risk level:

1) Level one "Patient with low risk," $0 \leq r^0 < 0.5$: some of the situations, patients have to be monitored with a low level of criticality. Those are elderly people in caring houses, who are good enough in shape but need to be monitored occasionally. In other words, the biosensor nodes will preserve energy by sampling slowly.
2) Level two "Patient with high risk," $0.5 \leq r^0 \leq 1$: other situations, patients will be monitored with a high level of criticality. These patients are acutely ill or they had gone with some surgical intervention.

c) Biosensor Based Mobile Health Monitoring

Biosensor collects the patient physiological data. Sensor network aggregate the data and the collected data summary will be transmitted to a personal computer or a cell phone of patients. Data will be forwarded to the medical server through the above devices for analysis. Later feedbacks from the medical server to the patient personal computer. According to the feedback the necessary actor will be taken place (fig 5).

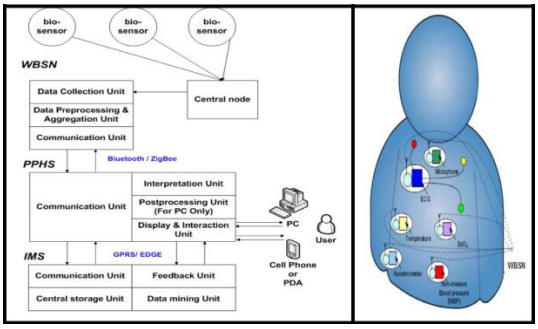

Fig 5 working of WBSN

3. DATA COLLECTION IN HEALTH CPS (CYBER PHYSICAL SYSTEM)

Healthcare CPS use cloud and big data technologies. This system gives a unified data collection layer for the integration of public medical resources and personal health devices. For the storage and analysis of multisource heterogeneous healthcare data a data-driven and cloud-enabled platform used.

Challenges that is Over Come by this system

- Multisource Heterogeneous Data Management with Unified Standards: The varieties in data that may be the homogeneous or it may be heterogeneity data which makes the health care data difficult to analyze. For scalability to be ensured the system should be able to handle various equipment devices of health care. The unified standards of data formats can overcome this difficulty, and also increase in efficiency of the query, processing, retrieval, analysis and data storage.
- Diversified Data Analysis Modules With Unified Programming Interface. Diversified healthcare data include semi-structured, structured, and other unstructured data. According to this, suitable methods should be deployed for efficient offline or online analysis, such as interactive query, batch processing, iterative processing, and stream processing. Unified programming interface will be a fundamental component of the development and access efficiency and to reduce system complexity.
- Application Service Platform With Unified North-bound Interface. To perform various roles the system has to provide various application services. The application service platform of this system is essential for resource data sharing, optimization, and technical support so that it provides reliable and available health-care services,

The architecture of Health CPS

The three layers of Health-CPS architecture (fig 6),

(1)Data collection layer (2) Data management layer (3) application service layer

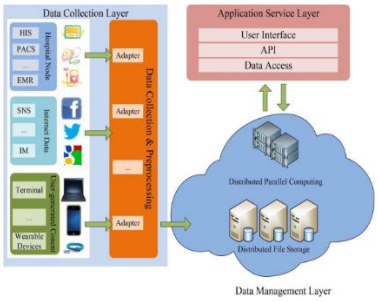

Fig 6 Architecture of Health CPS

1) Data collection layer: provides a unified system access interface for multisource heterogeneous data from Internet, hospitals, or user-generated content and it consists of adapter and data nodes. A raw data can be pre-processed in various formats and structures to ensure the security and availability of the data transmission to the data management layer.
2) Data management layer: That includes distributed parallel computing (DPC) and a distributed file storage (DFS) module. This layer is assisted by technologies of big-data-related, performance will be enhanced by DFS of the healthcare system which provides I/O for heterogeneous healthcare data and efficient data storage. According to the timeliness of priority and data analysis task, DPC will provide a corresponding analyzing and processing methods.
3) Application service layer: which provides results for users by the analysis of basic visual data. For the developers, It also provides an open unified API aiming at personalized healthcare services, user-centric application to provide rich and professional.

Data collection layer: It collects data from various health care with the help of data nodes and that data will be transmitted to cloud by the configurable adapters which provide the functionality to encrypt the data and pre-process.

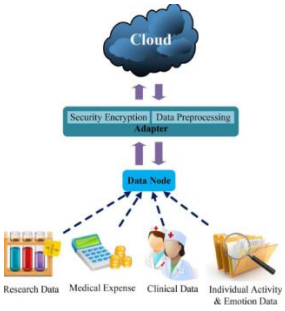

Fig 7 Data collection layer in Health CPS

The user-oriented Health-CPS collects the healthcare related daily behavior data and also the traditional medical data.

According to the data sources, data nodes are divided into

1) Research data: Which helps in identifying the drug side effect of the protein data or clinical gene or individual,
2) Medical expense data: This data helps to estimate the medical cost and analyze. These type of data are adopted in unified data formats and geographically dispersed. Data are generally stored in different databases of medical institutions.
3) Clinical data. Medical service providers usually provide this type of data for clinical diagnosis such as medical image and EMR.
4) Individual activity and emotion data: Personal health-relevant data. Based on the physiological data collected by wearable devices, the health status of a user can be easily monitored and traced. By the information published on the social networks, which collects the emotion data of individuals, that can be used in the mental health measuring and affective computing. As per the patient's emotion, a doctor may be able to adjust the treatment plan. An emotion-aware healthcare service promotes the innovation of modern medical with humanistic treatment.

The adapter is a middleware to provide a data node with access to the system, it's a raw data pre-processor and encrypted. Apart from removing redundancy, cleaning data, and doing compression, data format transformation by the pre-processing module. As per the data, the adapter adopts a system-defined data standard for the format conversion. The pre-processed data will be encrypted to ensure security. Decryption of the data package by the un-authorisers even if they have access to the system. The functional unit of an adapter is configurable to improve the scalability of a system, When the following conditions are met, the corresponding modules of the adapter can be updated online.

1) Data node variation: The functional units fails to work when the updated device data format and a former one are not consistent. In this situation, the request will be sent by the adapter for reconfiguring.
2) Data standards update: The data standard library will be extended if the data has been accessed by the system without a system defined data.

4. DATA COLLECTION METHOD IN TRIAGE NETWORK

Which collects patient's data with computerized triage tags. In triage tags listening power is used. Lifesaving priority of patients can be divided through Triage, a medical system which is sensed through breathing rates and a number of pulses from vital signs. Triage network helps doctors to handle the sudden change of patients through vital signs of patients which are collected at the sink (regularly at a management server).

Its aim is to collect vital data continuously till the patients are taken to health care center or medical institution. If the battery of nodes run out, impossible to collect the data of the patient. Battery consumption consists of three radio nodes transmitting, receiving and listening.

Triage network collects vital sign of patient automatically in triage site. Each patient is carried to a place called Triage post after an accident. Their doctors attach an electronic triage tag to the patient and the conditions of the patient will be given as input to that tag. Every patient will be classified by one of the color red, yellow, green and black, with the high priority order. This electric triage tag senses the virtual signs regularly and transmits the collected data to the host server. If it fails to transmit data to host server directly, the other tag within this communicating range forwards the data.

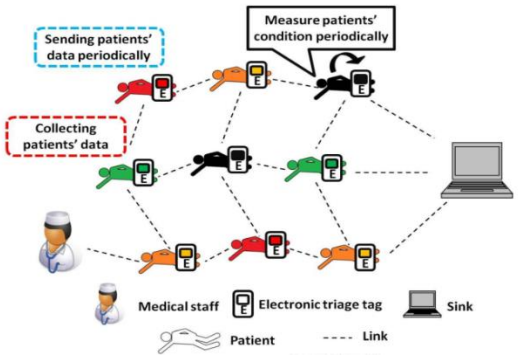

Fig 8 Triage network

Thus, by triage network virtual signs can be collected regularly and the doctor can handle the patient sudden changes. Patients are nodes, and PC, sink which collects data of the patient, the doctors with an electronic device are called doctor uncle.

- It has a mobility characteristic: the sensor in triage network has mobility. For example, Patient is given colors like a red, yellow, green and black group. The green group represents patients who can walk and they move in the network. Doctor node will move in the network based on the sink information. Doctor node and patients of given group can move in the network so it has a mobility characteristics.
- Participation or secession characteristics: since color are given in high priority order, each sensor can participate. It will have a different amount of time.

5. SENSOR DATA IN SMART PHONE BY BCD (BEHAVIOUR CHANGE APPROACH)

Data can be collected through home environments every day using CASAS. These homes are equipped with combination motion/ Light sensor or temperature, sensor etc. on cabinets and doors. These sensors monitor the daily activities of the residents through text messages when there is a change in its state. Once the data is collected, the labeling is done to each sensor with there respective activities using the CASAS- AR activity recognitions algorithm. In the smart home, it also records health events with the data and type, based on the housing member medical records. The comparisons of one-week baseline of smart home activity to through the BCD. If SHI is the participant, who is taking a treatment, because of this treatment, the sleep may decreases, once the patient treatment starts than the SHI outside movements will be more. The sensors which are related to the entry home activity will be updating or collecting the movements.

6. IMPROVEMENTS IN DATA COLLECTION AND HEALTH MONITORING

Since the countries are developing, even they are taking care of population's health, which is the main source for the countries are leading back in health information system where there is a gap in data collection, analysis and.In mid-1990's, developed countries had a rate of nutrition rate in children can be monitored accurately. To improve this system UNICEF initiated the multiple indicator cluster surveys (MICS) in 1995. This system is designed to provide quantitative data on a different topic, which includes child health and nutrition, maternal health, education, child protection, HIV, and AIDS. Nowadays, in this technical world data collection in health monitoring have been improved and its progress has been increasing day to day with a new inventions.

7. CONCLUSION

The whole system of health monitoring by using biosensor network places forward some future works such as finding the most effective mechanism for ensuring security in bio-sensors considering the severe restrictions of memory and energy, representing the collected data in the most informative manner with minimal storage and user interaction, modelling of data so that the system will not represent all the data but only relevant information thus saving memory.

Nowadays, space and time (from discrete sampling to continuous tracking and monitoring) are no longer a difficulty stone for modern healthcare by using more powerful analysis technologies. Medical diagnosis is evolving to patient-centric prevention, prediction, and treatment. The big data technologies have been developed gradually and will be used everywhere. The big data analysis technologies can be used as a guide in lifestyle and also for the support in the decision-making, and as a source of innovation in the evolving healthcare ecosystem.

A cloud-enabled and data-driven platform for multisource heterogeneous healthcare data storage and analysis. Supported by Health-CPS, various personalized applications and services are developed to address the challenges in the traditional healthcare, including centralized resources, and patient passive participation. In the future, we will focus on developing various applications based on the Health-CPS to provide a better environment to humans.
BCD can detect changes in smart home-detected by one's behavior and behavior data that occur as a result of health events. An algorithm can periodically look for changes in behavioral routine and alert the individual and their caregiver about these variations as they may indicate changes in health. Because BCD can analyze any type of sensor data, our continued research will adapt these methods to analyze smart phone and wearable sensor data.

In this work, we have briefly explained about some of the data collection techniques or the collection of data in the health monitoring systems.

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