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An analytical review for cloud computing in healthcare system based biosensors

Mahmood. K. Awsaj

Laboratory of Signals, systems, artificial Intelligence and networks (SM@RTS), Sfax University, TUNISIA

Email: Mahmoodawsaj85@gmail.com

Yousif I. Al Mashhadany

Electrical Engineering Department, College of Engineering, University of Anbar, Anbar, Iraq.

Email: yousif.mohammed@uoanbar.edu.iq

Lamia Chaari Fourati

Sfax University, TUNISIA

Email: lamiachaari1@gmail.com

Abstract---For patients with geriatric medical specialty disorders equivalent to dementia, patients with ingrained devices such as pacemakers. The quantity of exercise and therefore the amount of daylight are important guides for dosing and treatment, thus observation daily health info is important to patient safety and health. A portable, wearable device and server configuration to watch information are required to supply these services to patients. The true period of time condition monitoring systems should embody GPS, accelerometer, and lightweight sensor, and might acquire health information in real-time by measure position for patients, the amount of exercise, the amount of sunlight, heart rate, blood pressure, the amount of atomic number within the blood, and different devices are often supplemental in step with the wants of the patient's condition. The server system includes sensor information, analysis rule and an internet server that's employed by the practitioner and the guardian to watch the sensor data noninheritable from the good sensors. In the present study, data has been collected from reliable sources equivalent to Science Direct, IEEE Xplore, Scopus, internet of Science, Google Scholar, and Pub Med, we've got summarized and analyze the appliance of those techniques that supported vapor computing, necessary conclusions were created in the extent of the possibilities of developing the proper remote observation system, which is able to be adopted by us within the approaching studies and which will be enforced much on the pathological cases.

Keywords---Healthcare, Cloud Computing, Biosensors, Time Condition Monitoring, Real Time, Patients Case Recognition.

1. Introduction

In recent years, the speedy development of the data network technology has connected enormous devices beside advanced sensors and initiated a smooth exchange of data among them [1]. Hence this gives rise to the stringy requirement of cloud computing for analysis and storage of data on a large scale. Healthcare industry stands for unique major domains of application that acquire a huge interest *via* the pharmaceutical industry, the investigation and development departments, and the public sector [2]. The mesh computing has tremendously upgraded staff and patient safety, and increase in the working capability in the medical industry. In the early days, diagnosis of few diseases was possible only by physical and analytical methods [3]. However, today with the advancement in technology, the health center essential care has shifted to personalized individual centered assistance. For instance, the blood pressure testing, diabetes monitoring, oxygen level observation, pulse maintenance is being done in a concurrent way [4]. The progress of data services and telecommunication has made it possible the remote monitoring of the patient's health serviceable and feasible. The quick evolution in the services of telecommunication, smart sensors (wearable), mesh computing provides real-time observations, diagnosis and feasible outreach to doctor steps and services available at doorstep makes life easy [5]. Analytics over the data stream front becomes the user data source for the systems of healthcare to find out new details forecast early discernment, and makes resolution in the captious circumstances for the quality improvement of life [6]. Also, contemplate how reassuring technologies like wearable's, big data, ambient assisted living and cloud computing are being administered in the medical industry and detect numerous-health and internet of things (IoT) policies and regulations global to discover how they help the continuous evolution of cloud and IoT computing in the Medicare industry. Besides, a thorough review of IoT security and privacy issues, involving security setups, attack types and potential threats from a Medicare viewpoint is performed [7].

The mesh computing is the assembly of services like servers, applications, platforms and infrastructure that keep storage and virtualization of data. The IoT is combined with software, sensors, inbuilt electronics and connection of the network resulting in a rise in the raw data volume and transforming time. Hence, cloud computing is required for storing large data [8]. The preventive healthcare system is the best example of cloud computing in healthcare based on physiological signals that impart early detection of disease [9]. The collaborative research between the group from Institute of technology, University of Ontario and IBM has developed telemedicine based out of mesh computing, providing support of doctors for methodology for rural and remote commune [10]. From a security viewpoint, the data protection in mesh system is the necessary part. The booming field software security of computer science is to protect electronic data against hacking. The main objective of computer security is to secure and keep data confidential. Nevertheless, data security is to store data in cloud systems. Thus, the laws of an individual to access data should be limited to authorized

individuals [11]. In the healthcare industry, data security integration to mesh system that withholds patients medicinal data acquired from biosensors, various medicinal instruments and grafts is majorly pivotal [12].

The big data term is a notion utilized in various study fields like physical sciences (meteorology, physics, chemistry, etc.) accounting and finance (marketing and banking), defense and military sectors and medicinal sciences (genomics and biomedicine) [13]. Biomedical data collection is exponentially growing, this abundant data gives notable opportunities to understand and also find the interplay among variety of biomedicine domains like metabolomics, phenomics, genomics, proteomics, biometrics, imaging and clinical data. For biomedical science, there's necessity for evolving new technological viewpoint, complex algorithms and software for storage, management and collection of data [14,15]. The cloud computing influence on the healthcare sector and its opportunities and challenges are not studied well. Hence, there is a need for improvement in this sector [16].

We started looking for our findings using Google Scholar and Inspec / Compendex, but the set of results was too broad and redundant. Results for Google Scholar and Inspec / Compendex also exist in ACM, Springer and IEEE. Based on the sources, we are focusing on the IEEE and ACM. We used different types of databases to retrieve the data, and the search results were based on a search string that discussed the health care system described in the methodology for select references in this research that is shown in Table 1.

Table 1. Methodology for select references in this research

Name of Sources	No of Articles	Selected Articles
IEEE	90	24
ACM	58	19
Inspec	89	13
Google Scholar	76	19
Others	123	21
Total	436	96

2. Background

Biomedical sensor is a type of sensor which combines electronic and biological system that gather variables of signal from biological compound and transform the signals into electronic product. Classification of these sensors can be done into physical and chemical. Sensors from chemical biomedical involves bioanalytical, photometric, gas and electrochemical sensors [17]. The sensors are used to calculate the quantity of chemical compounds or chemical variations. Sensors from physical biomedical are used to calculate physical amounts like temperature of body, the flow of blood, pressure of blood, displacement of muscle, moisture of skin and growth of bone [2].

For storage, analysis and collection of big data acquired by biomedical sensors, the decision system should be issue of data [18]. The architecture of system consists of 5 various levels. The Level 1 is consisting of transmission of data to

aggregators via biosensors. The Level 2 is composed of big data (storage, discretization and data collection) [19]. The Level 3 is consisting of medicinal details where the data is analyzed and classified. The Level 4 is dependent on synthesis of data (i.e. knowledge of disease). The Level 5 contains a system of decision support dependant on healthcare actions[7]. In this circumstance, system of decision support is dependent on the algorithms use on recursive action that utilize the structure of stack data collection of data. In analysis of medical data, support system for decision rotate around process of data extraction that allows correlation, clustering, classification, prediction and analysis of data [2,7,20].

The transdisciplinary fields comprising of clinicians, biomedical engineers, data and computer scientist are working along with to modify the biosensors multimedia applicability in medical sectors[8]. A few systems involve BAN (Body Area Network) that is a communicating devices network like sensors and actuators. Either these appliances are wearable or affixed in the patient's body whose outputs (i.e. signals) are transmitted and processed to a server or chosen medical professionals whom can evaluate the display of multimedia of the yield in the form of signal representation or graphical result of biochemical process of patients (blood pressure, heart rate, pulse rate, glucose level, etc.) also environments (gases, humidity, temperature, etc.) [21].

The development in the AI and ML perspective field has offered a new area in the healthcare and medicine field. These methodologies have successfully been used in problems solving in biomedical sciences by utilizing predictive and modeling methods [22]. Doctors together with computer adept have been functioning along with to develop another method for monitoring and diagnosis of diseases like cardiovascular, genetic, pathogenic, cancer diseases, etc. [23]. The data extraction use in healthcare significantly contributes to acknowledgement of biomedical data, prediction and diagnosis of diseases. The computational cost decrease and increase in data amount has permitted various algorithms of ML to play important role in system of biosensing for pathological and clinical diagnosis [24].

Classification of ML algorithms can be done into reinforcement, unsupervised and supervised. SML (Supervised ML) algorithm is commonest perspective utilized in healthcare, where data are tagged and model network learns features (for classification of the image) or data reorganization patterns (for prognosis) [25]. Regular methods utilized for SML involve SVM (Support Vector Machine), NNs (Neural Networks) arbitrary Forest, decision flow chart, etc. [26]. Unruled ML uses untagged dataset plus model learning to forecast outcomes dependant on the patterns learned from input data learned patterns. Basic Unruled algorithms of ML involve gathering and rule extracting[27]. The slightest used approach of ML is augmentation where process of learning is dependant on the software's use to involuntarily understand the finest performance inside a specific circumstance[16]. The advancements in Biosensors merging with the AI have lead to smart biosensors evolution [28] established biosensor of XPRIZE DeepQ Tricorder, which may diagnose various 12 disorders like sleep apnea, COPD (chronic obstructive pulmonary disease), leukocytosis, stroke, otitis media, infection of urinary tract, hepatitis A, atrial fibrillation, pneumonia, anemia, diabetes and tuberculosis and apprehend five concurrent vital signs like

blood pressure, ECG, oxygen saturation, temperature of body and respiratory rate. [29] implemented DL for lung cancer diagnosis. Implemented model of CNN for predicting contamination of bacteria utilizing data gained from optical biosensor built on photonic crystal [30]. Biosensors linking with approaches of Machine learning will strengthen prognosis, detection and making medical decision.

Quan et al. [20] established system based on artificial intelligence for prognosis of low level of blood glucose (hypoglycemia). The designing of the system is done using LSM (Long-short-term-memory) and the outcome shows network elevated performance in hypoglycemia prognosis after 30 minutes. Administered learning of machine to enhance detection of hypoglycemia from non-invasive sensor acquired data [31]. The set of data involves the response of galvanic skin, temperature, air, skin and heart rate. The SVM was used by the system to classify and train data into hyperglycemic and hypoglycemic [32].

3. Physiological Health Monitoring

The contemplation of physiological variables and patients routine activities is the important aim of healthcare services concerned with the administration of cooperating environments for living. The medical sensors which are wearable plays an important role in those systems, because they collect health-associated particulars that may be utilized to intricate concurrent diagnostics of the conditions of human health [33]. As illustrated earlier, a system of AAL can be dependant on the medicinal sensors so that, while attached to house gateways, healthcare data are sent to the system of health monitoring concurrently. WSNs (Wireless sensor networks) were utilized to attach sensors to medical applications and smart gateways, thus permitting physicians or caregivers to observe patients solitarily [34]. So as to discover the status of health of individuals and his response to exterior factors, it's important to observe the different physiological variables which are recognized as relevant. For several years the below given five essential signs are examined: blood oxygen saturation, respiratory rate, blood pressure, heart rate and temperature [35]. These may be gained via non-intrusive and non-invasive sensors, that may be involved in systems of long-term fitness tracking [36]. Aforesaid sensors are generally recognized to as smartwear sensors. These can record and monitor concurrent information regarding motor activities and physiological state of an individual, neither creating discomfort nor interspersing daily activities as shown in Fig. 1.

These smartwear biomedical sensors compute physiological signs which may be utilized to get rate of respiration (RR), saturation of oxygen (SpO_2), heart rate, body temperature, blood pressure, ballistocardiograms (BCG's), seismocardiograms (SCG's), photoplethysmograms (PPG's), electromyograms (EMG's) and electrocardiograms (ECG's) and various other factors. The sensors are normally attached in WBAN (wireless body area network) or BSN (body sensor network), and may be directly placed on the skin top, upon garments or even inserted in the individual's tissues (see Fig. 1). The preceding subsection contemplates the main necessary signs which donate for a better observation of human wellbeing, and the methods and sensors for analyzing and analyzing such variables [37].

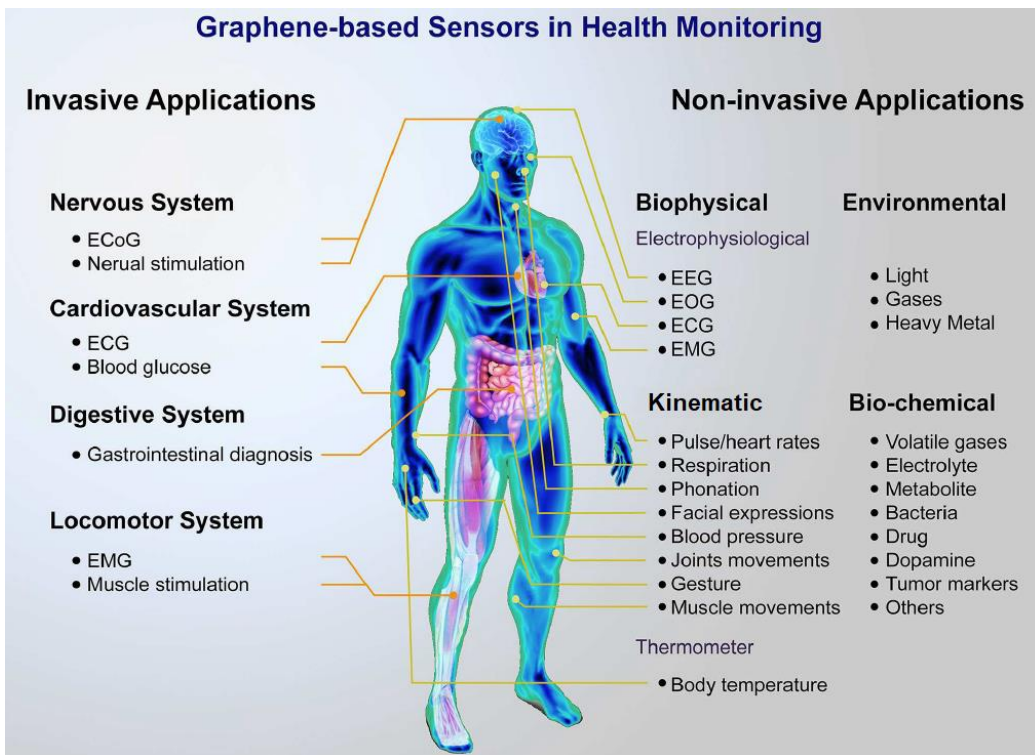


Fig. 1. Application and sensor platform with health monitoring system [24]

Regular monitoring of the patient's response to exterior factors, by monitoring physiological variables is the healthcare service's important aim. To discover the health status of individual five crucial signs are examined; blood oxygen saturation, respiratory rate, blood pressure, heart rate and temperature by using biomedical sensors by not hampering the routine activities.

4. Types of system application in healthcare

There are various techniques to monitor and record the activity of heart utilizing non-invasive methods. The extensively used method and tool of diagnosis for medical environments is the ECG (electrocardiogram), that calculates the heart's electrical movement. An ECG can be envisaged by the waveform generation characterized by five valleys and peaks named as P, Q, R, S, T and U, consecutively, and every one contemplates the physiological state of the sufferer's heart and principal blood vessels of it. The complex QRS shows ventricular depolarization having short period if the heart is functioning systematically. The R peak or wave, is the complex foremost positive peak, which is used to understand the sufferer's HR and HRV (heart rate variability), considering the time span betwixt its occurrence (known as RR interludes) [25,26]. This technique utilizes electrodes of Ag-AgCl (damp electrodes) which should be fastened in body's certain areas. Although, the conducting gel is surrounding electrode, that works as a medium for conduction betwixt the electrode and skin, that may create an irritating effect on the skin when employed for longer times. Other probable

drawback connected with long-term application is electrode surface deterioration, leading to degeneration of quality signal [27]. Henceforth, monitoring of ECG dependant upon damp electrodes is not reliable while keeping in mind the long term observation of the heart's activity and also these may not be utilized without hampering the individual's routine. Various alternatives to replace these conventional electrodes are proposed in the literary texts. Electrodes from dry textile may be implanted in customized clothes, like bras and undershirts, for recording of ECG. The technique has proved to be applicable for unstopped ECG observation as alleged by Tsukada et al. [28]. The characters of flexible and hydrophilic matter of the hitoe® textile electrode permitted it to quickly accommodate to the surface of human's skin. Because of the transmitting polymers (PEDOT:PSS) being anchored firmly among nanofibers (The Technology That Supports Hitoe™.), the pad of hitoe® textile allows timely washings not affecting the electrical transmittance.

An and Stylios [29] described fabric electrodes which involve a movement sensor with an electrode which is textile-based. This hybrid fabric electrode is capable to synchronously document motion and ECG signals. Both the signals, when simultaneously acquired, are advantageous for the heart disease diagnosis. Variations in cardiac rate occur following or during a behavior like alterations in running, walking or posture. The connection of routine physical activities obtained from movement data along with ECG is very convenient for cardiologists because it helps them understand the reason for certain cardiac disease, e.g., unusual ECG is resulting by over-exercising. Depending upon the countless benefits of e-textile electrodes, various other investigators reported such technique's use and textiles for systems of wearable ECG monitoring [30-33]. Systems of smart textile dependant on textile optic sensors are also viable methods to track cardiac and respiratory activity. Presti et al. [34] proposed system devises fiber Bragg grating (FBG) based smart textile to discover small movements of chest persuaded by the beating of the heart. By putting a smart textile at 3 separate positions of the chest, the author explored the impact of calculation points in the form of performance of FBG and amplitude of the signal, this is something that is not considered in previous studies of FBG-base. As other substitute, the PPG (photoplethysmography) method is proved to be a great substitute again ECG [35,36], specifically for measurement of SpO₂, HR, HRV. It is recognized as an unobtrusive and non-invasive method. It utilizes a photodetector and a source of light kept in touch with the surface of the skin to calculate the volumetric differences of circulation of blood in arteries and veins [9].

Light reflection or optical absorption is connected with the blood's amount which is existing in optical track. Variations in volume of blood are coexistent with the heart's beats. A sensor of PPG is generally located at the sites of peripheral body, to count the volumetric differences in the beds of microvascular [37]. Components of the anthropoid peripheral vascular arrangement which may be utilized to locate the coverage area of sensor's involve the toe, earlobe and finger. Malhi et al. [38] outlined a smartwear device dependant on a sensor of PPG located on the finger, between finger glove and wrist strap. This arrangement gives customers the freedom movement possibility, without hampering their routine. A device which is wrist worn, as outlined by the reporters in [39], involves a channel for heart

activity observation dependant on PPG (photoplethysmography) and channel of measurement of body kinematics for routine motor functioning assessment, hence empowering multiparametric observation in non-obtrusive and non-invasive manners. Mary et al. [40] discussed the progression of a system of measurement of physiological parameter dependant upon smartwear devices to observe the temperature of the human body, oxygen saturation and heart rate using the signal of PPG. The suggested system also utilized an ECG three-lead to understand whether the patient had a regular heart rate, or conditions of bradycardia or tachycardia.

PPG also constitutes as a great resolution for continuous and concurrent detection of AF (atrial fibrillation), and commonest arrhythmia types. The discernment of the disturbance of cardiac rhythm can be dependant on the execution of statistical investigation, deep and machine learning perspectives. Pereira et al. [41] discussed various studies depend on these algorithms for detection of AF via the PPG signal evaluation. The reporters highlighted the important challenge that PPG-dependant detection of AF incorporated in clinical operations and how different approaches of classification address those restrictions.

Supplementary unobtrusive methods involve BCG (ballistocardiography), that is utilized to calculate the repetitive movements of the anthropoid body, connected with heart cycles. It's particularly non-invasive oldest technique for monitoring of cardiac-respiration and may be used to get details about the heart's activity, its state and patterns of breathing. Its representation in graphical form consists of force of the action-reaction caused due to beating of heart and the pumping of blood by the aorta [42]. The wave of IJK complex from the ballistocardiography represents the cardiac cycle's ejection phase. These principal waves and intervals of time between them shows the subject's heart's physiological condition and its principle vessels of blood. Systems of BCG may either need mechanical relation among the sensor and the subject's body or may be executed by contactless gadgets, which are e.g. radar of microwave Doppler [43] and ultrasonic sensors [44]. The principal gadgets compelling mechanical exposure are EMFi electromechanical film sensors, sternal accelerometers, load cells and piezoelectric sensors. The sturdiness of observation systems of BCG dependant on sensors of EMFi have been revealed in its huge number of applications [42,45-47]. Nevertheless, the promotion of this resolution in healthcare facilities is still restricted in current days.

Novel solutions is a fresh way to supply continuous and advanced acquisition of physiological signal depend on the advancement of soft electronic system and majorly stretchable network. Electronic circuits which may be connected to the epidermis allows a more accurate and comfortable assessment of conditions of human physiology, when contrasted to the conventional systems. The devices physical characters offers high thickness and stretchability which are acquiescent to the skin, permitting a more accurate and connection of non-invasive mechanicals with the surface, and consequently lower movement artifacts and another drawbacks generally offered by usual smartwear systems. Kim et al. [48] demonstrated the progression of platforms of multifunctional sensing for strain, temperature and electro-physiological calculations, near other system elements

dependant on elastic and ultrathin layouts. The authors are capable to acquire EEGs (electroencephalograms), EMGs and ECGs using the cited system of epidermal electronics. Xu et al. [49] put forward a stretchable, soft, thin electrical circuit for radio electrophysiological observation. The mapped device integrates a microfluidic establishment to allow flexibility and stretchability and mechanically separate strong electronic matters. The instrument is powered wirelessly, integrates capabilities of transmission of radio frequency and supply high accuracy calculation of EEGs, EOGs (electrooculograms), EMGs, ECGs and this multidimensional resolution allowing long-term monitoring of human health without compelling movements of body and hampering person's routine activities. Webb et al. [50] established an epidermal, flexible and ultrathin sensor technique for uninterrupted observation of the macrovascular and microvascular blood flow. The sensor depends on thermal calculations of flow of blood under the skins certain area. juxtaposition to commercial system of calculation of optical blood flow, and subjects under immobilization validated the accuracy of measurement of the given system.

Other novel solution is dependant on a lightweight, stretchable and smartwear device represented by Ha et al. [51] an e-tattoo (electronic tattoo) was designed for measurement of both SCG and ECG. Still, the previous SCG are dependant on non-stretchable and rigid materials, that was known to be not comfortable to wear, specifically for long-period use. In the present work, the authors depend on PVDF (polyvinylidene fluoride), piezoelectric polymer to built-up a vibration sensor (stretchable) able of obtaining signals of SCG. The simultaneous deposition of data via both SCG and ECG techniques increasing the efficiency of system on dictating the conditions of cardiac health. This concurrent accession of SCG permitted the validation of accuracy of ECG readings, also the removal of intervals of cardiac time, that may be utilized for concurrent blood pressure estimation. The innovative characters of these modern smartwear techniques are very encouraging for the implementation of future medical monitoring systems connected to ambient aided living. Next to gaining information regarding cardiovascular state, these techniques may also be utilized to calculate the response of ANS (autonomic nervous system) and the individual's emotional state. This is done via analysis of HRV, that is dependant on the variation study of the time span among successive heart beats (peak to peak or RR intervals). This investigation may quantify the parasympathetic and sympathetic neural system to recognize the ANS inclusive status. Its medical significance involves the probability of anticipating mortality after acute myocardial infarction occurrence, neurologic disorders and diabetic neuropathy [25, 26]. Both ANS branches are included in the HR regulation with the commiserating activity with a propensity of growing the HR and reducing HRV, although, the parasympathetic action reducing the HR and growing HRV [52]. The HRV can be calculated by three various methods [25, 26]: non-linear, frequency-domain, time-domain methods. It is simple to execute the measurement of time domain, where, time span among repetitive heart beats is detected. The commonest variables of time-domain for statistical calculation involves the mean interval of HR, RR, the differences among the longest and shortest intervals of SDD (standard deviation of successive NN interval differences), RMSSD (root mean square of successive NN interval differences), SDNN (standard deviation of the NN intervals), NN (where NN commensurate to intervals of time among peaks of normal pulse), and the

numeral of consecutive interludes differing greater than 50 ms (NN50). Methods of frequency domain are better to differentiate among parasympathetic and sympathetic actions of the HRV. The PSD (power spectrum density) is calculated, in many cases, utilizing a FFT (fast Fourier transform) and gives general information about the variance (i.e. power of distribution) over frequency. For periods of tiny recording, where 5 minutes is the standard, measurement of three spectral compounds is done [25]: the HF (high frequency is 0.15–0.4 Hz), the LF (low frequency is 0.04–0.15 Hz) and VLF (very low frequency \leq 0.04 Hz). Ultimately, non-linear techniques are utilized to examine HRV. The commonest estimations are the recurrence plots, correlation dimension, DFA (detrended fluctuation), (DFA), SampEn (sample entropy), ApEn (approximate entropy) and Poincaré plot [26].

Table 2. Types of system applications in healthcare

Reference no.	Method name	Activity	Observation	Implementation	Accuracy
28-33, 48, 49, 51	ECG (Electrocardiography)	Calculates the cardiac electrical activity and detects cardiac diseases, Detects regular heart rate, or conditions of bradycardia or tachycardia.	Heart rate (HR), heart rate variability (HRV), and RR intervals	Real time	High
38-40	PPG (photoplethysmography)	Measures volume of blood optically, microvascular blood changes.	Heart rate, oxygen saturation, body temperature, atrial fibrillation detection	Design	High
34, 51	SCG (Seismocardiography)	Calculates the micro-movements of chest wall due to flow of blood cardiac contractions	Validates accuracy of ECG readings, understand cardiovascular state, calculate ANS response, analysis of HRV	Design	High
39, 43, 44	BCG (Ballistocardiography)	Calculate repetitive movement of human body concerned with heart cycles, get hearts detailed activities and state patterns of breathing	Multifunction system of strain, temperature and electro-physical calculations	Theoretical	High

Body temperature is a critical parameter for ascertaining patient's normal condition of health and is recognized particularly crucial signs. It can calculate the "sickness" degree of an patient by examining the body hotness difference acquired

with the one which is recognized “usual” for humans. As stated by Geneva et al., [53] represented a structured review of verification-based usual ranges of temperature, which is a nonlinear outcome of respective variables, involving health status, ambient temperature, gender, age the individual’s circadian rhythm, between various others. The principal variables are the patient’s age and measurement site [53]. Various studies are reported and developed in the literature, smartwear systems which deliver both measurements of core and skin temperature concurrently.

Boano et al. [54] illustrated a system of monitoring for body and unobtrusive temperature dependants on a network of body sensor with skin attached sensor units. The researchers proposed to examine the influence of sleep impoverishment in the rhythm of human circadian. Drowsiness has demonstrated to persuade significant variations in temperature of core body. To calculate the precision of the outlined prototype, primary experimentation was carried out to observe subject’s circadian rhythms for 24 hours, and also the correlated mental action. In the first method, the unit for sensing was located in the inferior hand, and in another, temperature of skin was calculated at the house of the individual. These units can send and calculate the information of temperature to other central unit which is body-worn with more power of processing. A PC was utilized to obtain the information from the middle unit and subsequently liaise with a hospital facility on the net. The information was contrasted with thermometer and precision of 0.02°C above the range of $16\text{--}42^{\circ}\text{C}$ temperature was obtained by the authors. Sugimoto and Kohno [55] outlined a wireless system of sensing to observe the patient’s state of thermal physiology by utilizing an 4 skin warmth sensors, 2 thermo-hygrometers and ear-worn heat sensor. The sensors transfers information wirelessly in coordination with each one to a PC for the next investigation of temperature, humidity, skin temperature and tympanic temperature. Concerning the core temperature acquisition, that is a sign of health status, temperature comfort level, thermal stress. Looney et al. [56] represented an algorithm depends on an expanded Kalman filter which determined the temperature of body core from the cardiac rate. In accordance to authors, the technique can be calculate the body temperature of human core concurrently with a high precision.

5. Types of Biosensors in Healthcare

As long as its emergence in the 1960s, the field of biosensors field has developed to enclose a wide variety of sensors, from thermal biosensors to immunosensors to enzyme-based. Besides this, a varied applications set have finished, with roles of biosensors findings in environmental analysis, medical diagnostics and food safety to name just a few. “Biosensors, as defined classically, includes biologically procured or biological sensing compounds which tackle the excellent sensitivity and specificity of living systems in concurrence with electric processors and transducers, to either supply information or to straightly actuate an accurate response.

Table 3. Examples of biosensor based healthcare products in use

Model	Company	Board dimension	Weight (gm)	Battery type (number)	IT (Sec.)
Accu Chek Active 2x50 T. MIC	Roche Diabates Care	9.7 x 8.2 x 4.6 cm; 60 Grams	50	CR2030	5
Hesley Pulse Oximeter	Hesley Inc	5 x 4 x 3 cm; 90 Grams	90	AAAbatteries (2)	6-8
CardioChek Analyzer Starter Cholesterol kit	CardioCheck	7.62 x 13.97 x 2.54cm	113.4 - 170.1	AAA 1.5 volt high-quality alkaline batteries (2).	45
Dr Trust (USA) Forehead Digital Infrared Thermometer	Dr Trust	2.3 x 1.6 x 1 cm; 798 Grams	798	AAA batteries (2)	5
Generic Sensitivity Professional ALC Smart Breath Alcohol Tester Digital LCD Breathalyzer	Generic	11.3 x 6.8 x 2.9 Centimeters	300	AAA batteries (3)	45

IT: Interpretation time (Seconds)

Table 4. Types of biosensors in healthcare based on the sensor used

Reference	Class of sensor	Biomedical sensors	Accuracy	Reliability	Type of technology
57-61	Biological recognition element	DNA biosensors	Medium	High	Biosensing
		Whole cell	Medium	Medium	Immobilization
		Immunobiosensors	Medium	Medium	Immunosensation
		Enzymetic biosensors	High	High	Enzymatic
62-64	Method of signal transduction	Mass dependant biosensors	Medium	Medium	Mass
		Thermal dependant biosensors	Medium	Medium	Heat
		Optical biosensor	Medium	Medium	Spectrophotometer
		Electrochemical biosensor	High	High	Electrochemical change

The first report of biosensor was done in 1962 by Clark and Lyons [65] for the measurement of glucose in blood. Henceforth, the categorization of biosensors can be done according to element of biological recognition (Whole cell and DNA

biosensors, immune biosensors, enzymatic biosensors) [57]. Method of signal transduction (mass & thermal dependant biosensors, optical biosensor, electrochemical biosensor) [63].

5.1 Glucose biosensors lead the way

The biosensors strongest example to date, is the emergence of the “bionic or artificial pancreas”. Since enzymatic electrodes were firstly launched for diabetics use in their house in 1987, biosensors of glucose have perceived huge success, preparing smartwear instruments in 2005, and currently synthesizing the world’s earliest closed loop system of insulin conveyance. Research of marketer commends that monitoring of glucose can hold the huge share of the market of biosensors for point-of-care solicitation by 2022. “While biosensors of glucose are the highest success profile so far, which are away from the sole example and the biosensors are extensively profit oriented for utilization in law enforcement, defence, monitoring of environment, quality control of food, process monitoring and medicine and adds Professor Turner. This flexibility looks set to increase, with the appearance of a new fields “where biosensors considered to have a promising key role” like in biologics production, tissue engineering and robotic surgery.

6. Analysis of Health Smart Homes

Elderly populations fast growth has caused a vast increase in personal care demand, specifically for people having a chronic ailment like dementia [66]. Consequently, care costs carry on to increase putting medical organization under monetary pressure [67]. A comparatively systematic solution to lower these prices is to turn the prominence from authorized care in healthcare systems and care houses to unauthorized care in privatized homes. Investigations [68] disclosed that many people requiring care prefer less interruptive unauthorized care. The normal discernment is that unauthorized care of the house is inexpensive. Although, as per statistical description [67], traditional unauthorized care for a variety of chronic diseases (e.g., dementia) is not compulsorily economical than another varieties of care given in care houses or hospitals.

SH (Smart Home) technique focuses to help people get a good quality life and to confirm elderly to survive independently and comfortably [68]. The technology of SH is recognized as a solution to lower the cost of care and living and to enhance the life’s quality for people needing care. It is appealed for various purposes [69] like fire and smoke detection, management of light, fall detection, safety and security energy saving, etc.; utilizing variety of solutions, like reminders, calendars, smart planners, alarms, video monitoring, etc. provided with actuators, sensors, and ultimately cameras to gather various types of information about the residents and homes. SHs can permit caregivers or mechanized systems to control the surrounding representing the residents, actions prediction and tracking their condition of health. Every system layer having it’s own role and comes with their own provocations to be dealt with. Data is gathered as physical layer via sensors, transferred through the layer of communication to the unit of processing in the layer of processing where, it is calculated for recognition of activity and discovery of behaviour patterns. The analysis outcome in the

particular information form, warnings or alerts can be transmitted via the layer of interface to variety of stakeholders (resident, caregivers, resident's relatives). There exists some surveys of research dedicated to SHs and surrounding intelligence [70-72].

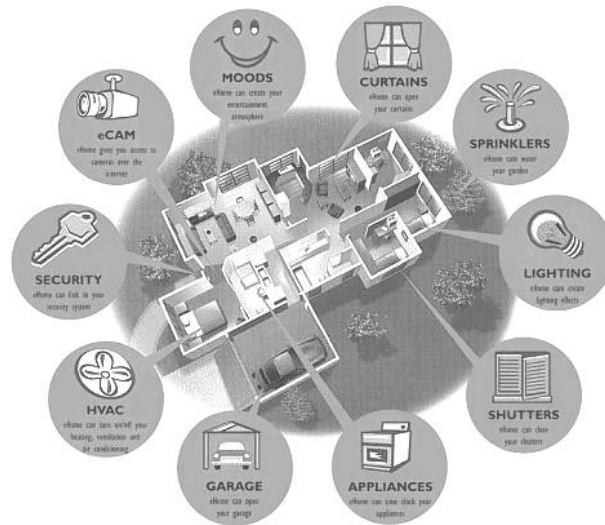


Figure 1. Smart home technology automation [73].

The current survey goes far away of these by (1) representing the art studies state at all extents: human computer interface, reasoning, knowledge engineering, networking and hardware; (2) as much as focusing as possible on work connected to hospital; and (3) safeguarding a recent and complete description of methods, technologies, techniques. We trust that current paper supplies an intuitive overlook of the existing work, revitalize the comprehension in this area and gives the different coordination of the coverage and material.

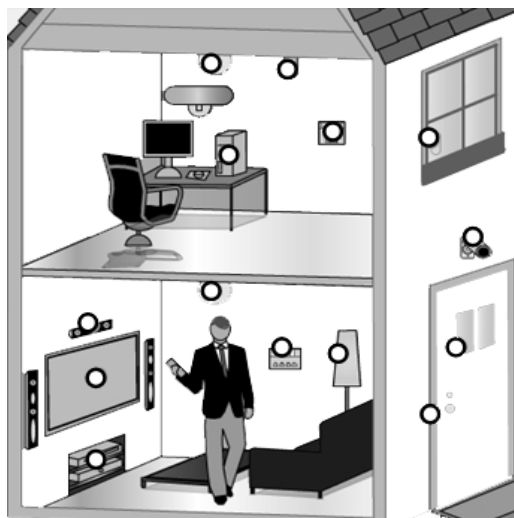


Figure 2. The dots represent devices that could be connected to your smart home network [73]

7. The challenges of health care based on cloud computing

Current research shows that 75% of chief information officers described that all will use and need the mesh computing in the coming future [74,75]. The prediction, carried out by Mark Beccue, proposed that the lot of people subscribing to applications of mobile cloud will increase from 7.1 crores to almost a billion upto 2014 [76]. In medical services, experts, managers, many organizationstrust that the approach of mesh computing may also amelioratefacilities and profits research [77-83]. Additionally, a survey by the ENISA (European Network and Information Security Agency) expressed that this new model of computing is set to discern massive global expenditure in various sectors, involving health care [84]. The narration also approximated that, until 2013, US \$44 billion are spent universally on mesh computing, possibly providing immenseadvantage to health care. As with any transformation, mesh computing must be stringently calculated before its extensive adoption. Hardly any research papers have studied systematically the influence of meshcomputing, on healthcare IT in terms of its challenges and opportunities.

8. Discussion

As cloud computing's most important advantage is huge capacity of data storage, cloud based frameworks proposed in papers for sharing of healthcare data. In this area one of the pioneers, Rolim et al., [85] disclosed a data collection framework by utilizing sensors connected with healthcare equipment, and the aggregated data may be stored directly [86,87] designed a framework of national level for eHealth dependant on models of cloud. E.g. Patra et al. [87] specially argued that national level cloud dependant solution can give cheaper way to deal with information of patients for remote areas. The remote area people's encouragement for uploading the individual's information cloud, that can be examined by authorized healthcare staff, similar idea is proposed in the current paper. Some of the studies Hendrick et al [88] on of healthcare to the cloud, the caregivers can supply them with accurate services of healthcare, like remote supervision, diagnosis and urgent calls.

Similarly like present work, the pertinence by Wooten et al., [89] designed sufferer to sufferer information and support sharing within their community. The proposed solution by Beharref et al, [90] utilized the seniors mobiles to share the data of patients mechanically to cloud, and the patients ownly can decide with whom the data can be shared. Mohammed et al, [91] proposed a system of Health Cloud Exchange (HCX) that shares records of healthcare among consumers and services with controls of privacy as explained in present work.

For private cloud dependant applications, Bagha and Madisetti [92] represented a sematic interoperability achievement betwixt various types of medical data. Vilaplana et al, [93] utilized theory of queuing as a primary means to plan the eHealth system performance dependant on the private cloud as explained in cloud computing in the current paper. Van gorp et al, [94] proposed technique of virtualization to allow sufferers to only build their lifelong PHR's. The PHR's may be then shared with other stakeholders, who are interested and authorized. Wu et al, [95] presented an approach to scheme composition to EHR (electronic health

record) data with a broker dependant ingress control. In the present work the problem or solution has been targeted/ discussed [96].

9. Conclusion

In the current paper we reviewed the use of cloud computing in the healthcare based biosensors. In the healthcare sector a precise disease diagnosis is necessary to design a path of treatment for patients recovery. Although, the methods used for diagnosis should be sensitive and simple, and they should be able to detect various biomarkers present biological fluids in very low concentrations. These requirements can be fulfilled by biomarkers although needs more improvement. The biosensors are widely used in the field of healthcare. Used in measurement of creatinin, urea, lactate, glucose, and blood metabolites, etc. most of the epidemics affect rural and remote communities due to lack of access to medical diagnostic equipments and tools. Where, cloud computing provides a promising approach in solving problems in healthcare system. The application of CRISPR based biosensor, artificial intelligence, cloud computing, big biomedical data and IoT helps in futuristic approaches concerned with the healthcare.

Author Contributions

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