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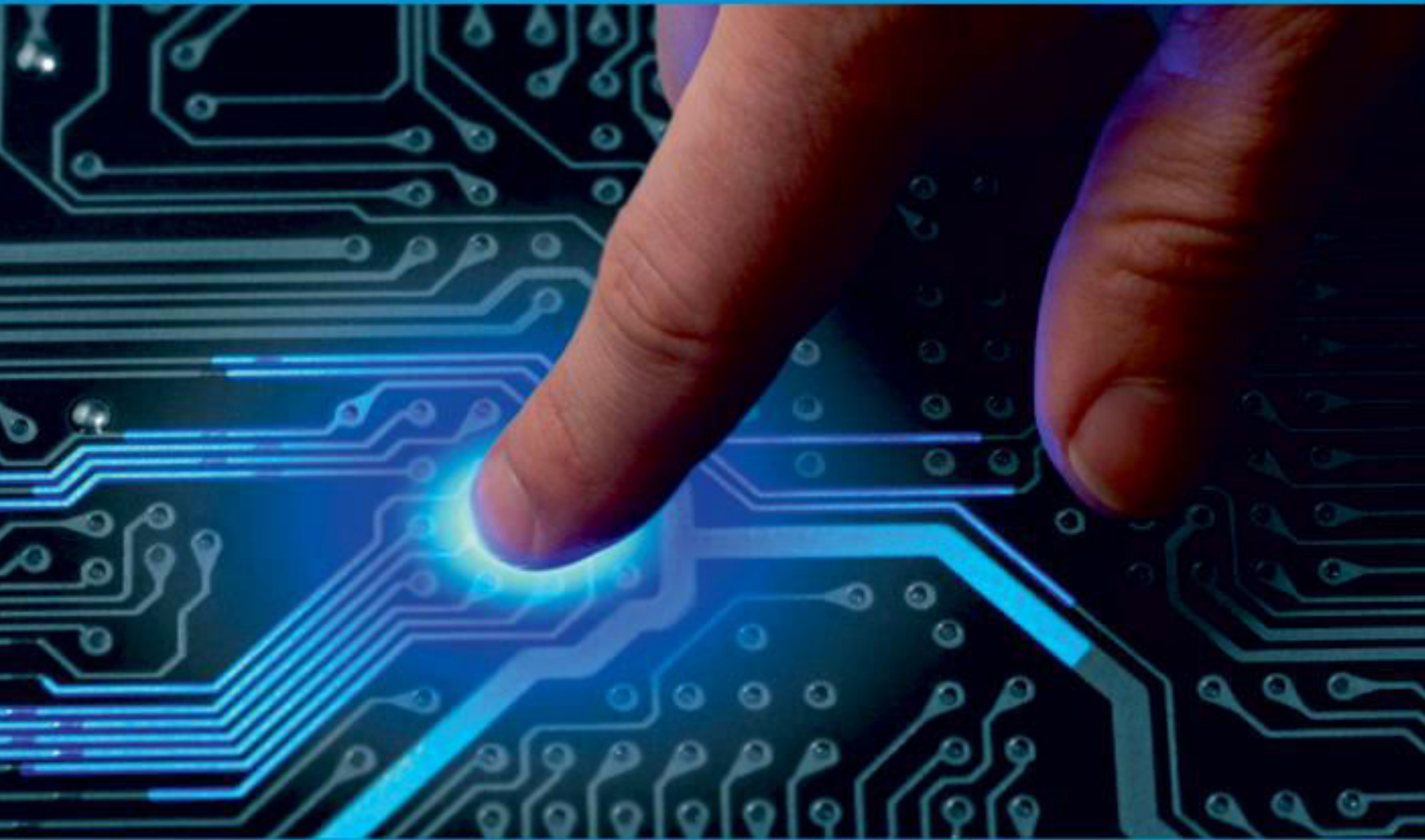

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A Review of Patient Health Monitoring Using IOT

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ABSTRACT: Remote healthcare is a rising analysis field because the world moves towards remote observance, period and quick detection of sicknesses. the benefits of remote monitoring of patients are: early and real-time detection of illnesses, ability to unendingly monitor patients, interference of worsening of illnesses and untimely deaths. Sensors for monitoring essential very important signs appreciate graph reading, heart rate, respiration rate, blood pressure, temperature; glucose levels and neural system activity are offered today. the most concern in noninvasive (NI) glucose monitoring ways is to realize high accuracy results despite the very fact that no direct blood or ECF glucose measurement is performed. Another approach to extend the accuracy of metallic element aldohexose measure through a mix of 3 metallic element methods: ultrasonic, electromagnetic, and thermal. alongside this the most challenges in web of medical things is knowledge accuracy, and secure data transmission for the analysis.

I. INTRODUCTION

Internet of Things (IoT) is now a reliable technological commonplace and a heavily researched field. Sensors are being used almost everywhere in the present time, from everyday products to industrial monitoring systems. The use of IoT and sensorbased intensive health care systems are increasing rapidly [1]. IoT makes our life smarter, more efficient and easier. Using a smartphone as the information computing platform, the prototype model [2] provides user-friendly voice recognition and alert functionalities. Several life-threatening diseases can be easily monitored by IoT based systems. Cardiovascular Disease (CVD) is a common disease which is the cause behind most of the deaths in the world. At present, with the revolution of information and technology, smartphone-based health monitoring systems are becoming more popular. These systems can be used to collect real-time health information and give feedback to patients and medical specialists [3]. Allowing every single person to examine their health, and advising them to find immediate treatment in case of emergencies, can result in saving that person's life. The use of these monitoring systems can decrease medical fees for the nation in the long run [4]. Nowadays, due to widespread mobile internet access, the combination of mobile internet with a health service system using Android open-source design has become very easy [5]. In recent years, Electrocardiography (ECG) has become an easily accessible service for everyone. By recognizing the little difference in voltage generated by the cardiac muscle, an ECG can properly determine the heart' functionality. Using a sensible device, doctors and patients can continuously observe the heart rate and can get important information and take proper steps to prevent severe damages [6]. Heart rate and body temperature are some of the most important traits of the human body which are major contributors to determining a patient' health condition. The number of heart bits per minute is denoted as the heart rate of the patient. It is also referred to as the pulse rate of the body. The normal pulse rate of a healthy adult is sixty to one hundred beats per minute. The average human pulse rate is seventy beats per minute for males and seventy five beats per minute are for females. Females aged twelve and older have faster heart rates than males [7]. The rate changes with illness, due to damage to body, heart, and exercise. Hence heart rate is essential in determining one' health condition. Diabetes is a very common disease throughout the world. According to the World Health Organization (WHO), there are about 422 million people in the world suffering from diabetes and the amount is increasing day by day [8]. sensible health monitoring devices determine the health condition i.e. rate of the pulse, body temperature, respiratory rate, blood glucose rate, the position of the body, ECG, EEG, and other things by using sensors. The sensors are connected and controlled through various microcontroller-based systems such as Arduino, raspberry pi, etc. The microcontroller collects the information using sensors. The collected biomedical data is typically stored in servers [9]. From the stored information, the device can decide whether the patient's condition is normal or abnormal. This device provides real-time health care observation for doctors and medical assistants where they can use the data anytime. Here the main advantage is that the device has low power consumption, better performance, high sensitivity and easy set up [10].

It is estimated that by 2020, there will be between 26 and 50 billion network-connected devices, and 100 billion by 2030 [11]. The most common platform for oT is Raspberry. It's a Linux-based low-cost device. In the field of health-

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care systems, Raspberry and oT have collectively ushered in a new era. A Raspberry can be transformed into a mini-computer using a combination of sensors such as a pulse rate sensor, temperature sensor, accelerometer, and response sensor. These systems are being used all over the world [12]. Microcontroller units (MCU) are being used as the system's main controller, although they do not support parallel data handling.

Handling many sensitive data sets in a parallel manner can save time. A feld-programmable gate array (FGA) is a crcut with real-time performance and a unique hardware logic control syste As a result, FGA is now more well-known than MU.

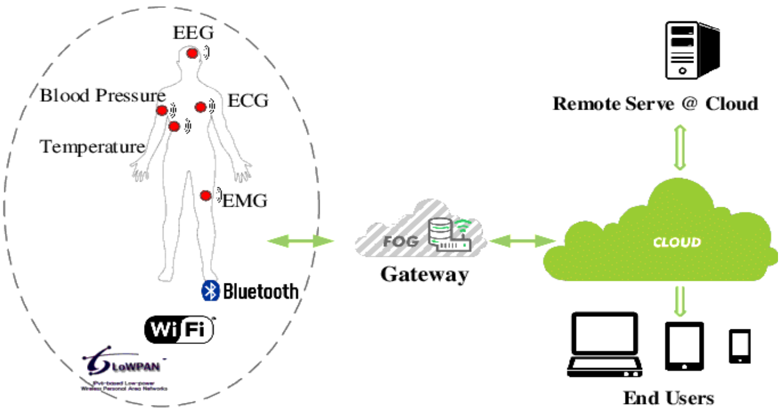

Figure 1: Architecture for a smart health monitoring system [13]

II. HEALTH MONITORING USING IOT

IoT in the health monitoring system has given us a big advantage in the development of modern medical treatment [14]. Due to advances in VLSI technology, the sensors have become smaller which has enabled the development of wearable solutions. Due to consistent internet connectivity, the devices are becoming more efficient and powerful. IoT based health monitoring devices monitor a patient 24/7. At any crucial moment, the devices generate necessary signals through analyzing statistical facts [15]. As IoT based devices are constantly connected to the internet, the patients can be remotely monitored and necessary measures can be taken in case of an emergency. IoT based devices can as a consequence provide both detection and emergency response services. There are significant differences between normal health monitoring systems and IoT based health monitoring systems. Incorporating IoT in health monitoring systems is a challenging task [16]. Some of the challenges are discussed below: Most of the IoT initiatives have not been successfully implemented yet. IoT generates a massive amount of facts, which requires specialized big facts and facts warehouse systems for proper management. Security is a big issue for IoT systems. Hackers can easily obtain sensitive private facts of users in case of buggy or outdated security protocols. Obsolete infrastructure can generate problems as they are not up to date with recent security protocols. In recent times, many health monitoring systems have been developed to monitor the health condition of patients. We are reviewing some recent works developed in this field. In this review, all the systems have been classified based on the priority of hardware components, that is, which components have been used more than the others. Therefore, all the systems have been categorized into three different categories as follows:

- Sensor-based health monitoring systems,
- Smartphone-based health monitoring systems,
- Microcontroller-based health monitoring systems.

III. SENSOR-BASED HEALTH MONITORING SYSTEM

The sensor-based health monitoring system collects information about the patient's health condition via an electronic data signal and notifies the patient via an audo alarm. Among the many types of sensors, G, temperature, and pulse rate sensors are often used. The majority of health-monitoring devices used body temperature sensors (Max 30205), pulse rate sensors, and temperature sensors (BM 680) [17]. Other sensors such as a humidity sensor, RFD sensor, bochemcal detecting sensor such as a glucometer, body position sensor, and respiration sensor are used in some health monitoring

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systems. [18] Wu et al. proposed a wrst wearable body area network (WBAN) archtecture for the health-care system based on cloud computing. The system works in both industrial and domestic settings. The developed systems, on the other hand, were linked. Making the device wreless would increase the system's flexibility.

IV. SMARTPHONE-BASED HEALTH MONITORING SYSTEM

Smartphones are one of the most useful resources in the world. A smartphone normally contains 14 types of sensors [20] and numerous more sensors are going to be added in the future. The voice monitoring system in a smartphone is a significant feature. Numerous hardware systems have been developed leveraging the flexibility of this feature. Some of the sensors that are included in a smartphone are the wireless sensor, Bluetooth module, Accelerometer, Fingerprint sensor, Gyroscope, Magnetometer, Barometer, Proximity, GPS tracker, Camera, NFC-near field sensor which are widely used in developing health monitoring systems [21]. Another main advantage of a smartphone is the mass storage facility of a smartphone. Modern smartphones can easily store the patient's information in primary storage. Android-based smartphones can be used for information streaming, device information management, and easy interaction.

Mehta et al. [22] developed a mobile voice health monitoring system using a smartphone that uses the accelerometer sensor. In the reviewed system a miniature accelerometer is used as a voice sensor and the smartphone is used as the information acquisition platform. The system is placed around the neck of the patient. Although this system utilized the frame based vocal parameters, the crude accelerometer information can also be used for monitoring purposes. Gao et al. [23] proposed a multi-lead ECG health monitoring system based on a smartphone. In this system, seven lead real-time ECG is used for acquiring the signal. The sampling rate is up to 500 Hz. Due to the massive amount of ECG information, it is very hard for doctors to detect abnormalities. So, an automatic caution system is used. The caution turns on if the system detects abnormal ECG information. However, an average caution delay (13.37sec) occurs in this system which reduces the accuracy rate. Moser and Melliar-Smith [4] proposed a personal health monitoring system using a smartphone named Wellphone. The device uses speech synthesis and speech recognition technology to communicate with the user. It keeps a record of the semantics and big-information that are related to the information obtained from the measurement device. The information is also stored on the mobile phone. However, the information of Well phone is non-clinical.

Kong et al. [5] designed a mobile phone-based wireless health service system. The system is designed for family health treatment. This system has three parts namely: data communication designation, android mobile client designation, and system server designation. The data communication system processes the communication between the server and the android terminal. The mobile client designation works on the intelligent terminal of the android system. The system server is the webserver which is responsible for the control center and the back-end data management system. However, as the amount of data is huge, SQLite cannot provide satisfactory results. MySQL can be used to overcome this limitation.

Turner et al. [6] introduced a continuous heart rate monitoring system. It is an embedded system that uses wireless signals for transmitting the heartbeat of an individual to a smartphone. As the device tracks the continuous heart rate, patients can easily get their real-time heart rate info from the device monitor. However, it doesn’t track heart rate continuously and cannot detect cardiovascular disease properly. Most of the reviewed systems used Android-based smartphones. Android is a mobile operating system based on a modified version of the Linux kernel and other open-source software, designed primarily for touchscreen mobile devices such as smartphones and tablets. Android provides easy access to sensor data of smartphones compared to other proprietary operating systems, which is required for easy development of smartphone based health monitoring systems. There are now more than 2.5 billion active Android devices. Android devices now hold 75.85% of the total mobile operating system market share. So, the development of android-based healthcare systems is very feasible.

V. MICROCONTROLLER-BASED HEALTH MONITORING SYSTEM

Microcontrollers are the most common and used devices in health monitoring systems throughout the world. MCU's are very useful for the fast processing of raw sensor data. FPGA is widely used for parallel processing of huge amounts of data. An MCU was used to interface among the sensors [24]. Due to the very small size of microcontrollers, it is effectively used for portable solutions. Today, raspberry pi is one of the most commonly used microcontroller-based platforms in the field of health monitoring systems.

Trivedi and Cheeran [25] proposed an Arduino based health parameter monitoring system controlled by a smartphone application. All the data obtained from sensors are in analog form. The data is sent to the Arduino Uno board. The

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collected analog values are converted into digital by inbuilt analog to digital converter. The digital values are transferred to a smartphone through Bluetooth. The system used a Bluetooth module which doesn't cover a large area.

Sabbir et al. [26] developed an m-Health solution for diabetes patients. It is a home environment system. This device allows a diabetes patient to monitor his/her health condition, physical activities, control diets, insulin dose and to consult with doctors. However, the developed system has no clinical validation.

Kumar et al. [21] proposed an IoT based smart health monitoring. The system application is divided into three layers. They are the detecting layer, the application layer, and the transportation layer. In the detecting section, a DS18B20 sensor has been used for detecting body temperature and a pulse sensor is used for detecting a pulse. In the transportation layer, the information is uploaded into the cloud from Arduino through the Wi-Fi module and Ethernet shield. At last, the application layer collects information from the server. However, the microcontroller in Arduino Uno is not suitable for handling too many sensors at the same time.

Penmatsa and Reddy [10] developed a system that detects abnormalities in ECG and transmits the signal via Bluetooth. It is a low-cost device. Here, three lead ECG signals are acquired. The signals are then sent to a circuit and finally presented in an oscilloscope. However, the small range of the used Bluetooth module is a limitation of the system. Using the Wi-Fi or IR modules might overcome the range limitation. Kumar and Rajasekaran [12] proposed an IoT based patient monitoring system. Raspberry Pi is the main logic unit of the system. The signals of sensors are sent to the raspberry pi through an amplifier circuit and signal conditioning unit (SCU). Using the internet, the data of the raspberry pi can be accessed from any part of the world. However, the system only works in indoor conditions. Desai and Toravi [13] designed a smart home and heartbeat monitoring system using a wireless sensor network (WSN). The system used Spartan 3 with FPGA architecture for parallel data computation. All the sensors are connected with a microcontroller and an LCD shows the result provided by the MCU. However, all the components of the system are not embedded in a single device.

Author	Year	Feedback Device	Major Hardware Components	Uses	Cost
Moser and Melliar- Smith [4]	2015	Smartphone	Blood pressure sensor, body weight sensor, pulse oximeter, glucometer, accelerometer	Chronic disease progression	Cost-effective
Kong et al. [5]	2016	Mobile phone	Wi-Fi module, Bluetooth, RFID, ECG, blood pressure	Chronic disease	Low cost
Turner et al. [6]	2017	Smartphone	Heart rate sensor, Bluetooth, microcontroller, electrode pads, display	Cardiovascular disease	Costly
Kumar et al. [9]	2017	Monitor	Arduino Uno, temperature sensor, heart rate sensor, body position sensor, Wi-Fi module,	Heart problem, noise detection	High cost
Penmatsa and Reddy[10]	2016	Smartphone, laptop, VGA display	ECG, Bluetooth, temperature sensor, heart rate sensor, Arduino, bio-sensor	Detecting abnormalities in heart	Low cost
Kumar and Rajasekaran [12]	2016	Monitor	Raspberry pi, heartbeat sensor, temperature sensor, respiration sensor, accelerometer	Respiration rate monitoring	Expensive
Desai and Toravi[13]	2017	LCD display	CPLD,ARM7TDMI-S, temperature sensor, gas sensor, heartbeat sensor, raspberry pi	Pulse, temperature and smoke detection	Expensive
Wu et al. [18]	2019	Smartphone	Raspberry pi, Lo-Ra module, temperature sensor, humidity sensor, pulse sensor, WSN, WDM, UV, CO2 sensor	Hearing loss, headache, rapid pulse rate detection	Costly
Ahouandjinou et al. [19]	2016	Monitor	ECG, pulse sensor, temperature, camera, environmental sensor, Bluetooth, ZigBee, RFID	Heart problem, fever detection	Costly

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Mehta et al.[22]	2012	Smartphone	Accelerometer, voice sensor, microphone,	Hyper functional disorder detection	Low cost
Gao et al. [23]	2013	Smartphone	ECG, Bluetooth, heart rate sensor,	Cardiovascular disease	Low cost
Trivedi and Cheeran [25]	2017	Mobile app	Body temperature, Bluetooth, Arduino Uno	Fever, hypothermia	Cost-effective
Sabbir et al. [26]	2016	Mobile app	Arduino Uno, glucometer, Bluetooth, display	Diabetes mellitus	Low cost

Glucose Monitoring

Diabetes is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use insulin [27]. Insulin is a hormone that controls the level of blood glucose which is used as an energy source to meet the needs of organs and tissues. Insulin helps our body take advantage of nutrients, especially carbohydrates. When this process is deficient, these nutrients, in addition to lipids and fats, cannot accomplish their goal, which is to be transformed into energy. With this abnormality, the glucose accumulates in the blood causing a significant deterioration in human health.

According to the WHO, in 2014, 422 million people in the world had diabetes, with a prevalence of 8.5% among the adult population [27]. In Latin America, in 2003, the number of cases was estimated at 19 million adults (20 to 79 years old) affecting 10% to 15% of the adult population; this suggests that there could be at least 33 million by the year 2030. This assessment is based only on demographic changes such as population age and urbanization and represents an enormous problem for older adults and a public burden [28].

There are two types of diabetes. Type 1 that can appear at any age and is diagnosed more frequently in children, teenagers, and young adults. It is caused by a loss or alteration of insulin-producing cells, called pancreatic beta cells. The suspicion of type 1 DM is based on the presentation of acute symptoms such as weight loss, major general affectation, ketosis, and hyperglycemia. The absence or insufficient production of insulin by the body is the result of the lack of control of the beta cells. Type 2 DM appears as a result of a defect in insulin secretion in an environment of insulin resistance. In the case of diagnosis in elderly persons, the guidelines provided by the International Diabetes Federation are an excellent reference to consider which suggests a complete assessment and timely follow up that must be carried out according to a category dependency. The role of the caregiver is also defined [28][29].

Methods to Measure Glucose

The main concern of a person with diabetes is to control the blood glucose parameter in order to avoid abnormalities in glucose boundaries. Methods for monitoring these levels are classified into three categories, invasive, minimally invasive, and noninvasive [30] described as follows:

- The invasive category includes techniques that are mostly used, because it o ers the greatest precision of results due to direct contact with the patient's blood. The traditional procedure is to prick a finger, which is painful for the patient. The measurements must be carried out under a rigorous cleaning regimen, since infections can occur [30][31].

- The minimally invasive category includes one of the techniques under investigation. This technique makes use of micropores, which are small holes on the skin caused by laser radiation. When the pores are open, a device applies a continuous vacuum pressure that extracts a small amount of transdermal body fluid. With the obtained sample, an enzyme-based electrode processes and measures glucose levels.

- The noninvasive category includes noninvasive glucometers in which the objective is to replace the blood variable with another to which access is obtained by external means. Its operation consists of placing a sensor on a specific region of the body to obtain a reading of the glucose. The reliability of the values is almost 100%, because experts have been assured that the amount of glucose in the blood is equal to the amount found on the skin of a patient [30][31]. Biofluids such as saliva, urine, sweat, or tears have been studied as noninvasive glucose tests, but with these, it is not possible to continuously track the glucose levels.

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It has been proven that continuous glucose monitoring improves metabolic control of the patient and provides a better profile of the glucose variations throughout the entire day. We can avoid critical values with the help of prediction, for example, analyzing the tendency of the levels with intelligent algorithms. Recently, approaches for monitoring patients' glucose parameter have been developed. The proposals make use of noninvasive methods, as well as transmission technology and data processing that provides timely readings. There are areas of opportunity concerning the use of more efficient algorithms for generating appraisals and more effective communication architectures [32]-[34].

VI. RELATED WORK

Platforms for wireless monitoring of glucose levels seek to optimize communication and the inclusion of different types of noninvasive sensors. This section describes the main proposals found in the literature review.

Noninvasive techniques that measure glucose look for variables that substitute blood as the main element, the aim is also to make the system portable for the patient. One of the first efforts was based on the principle of detecting the change in fluorescence resonance energy transfer efficiency of a protein synthesized as a function of analyte concentration [35]. Technologies such as GSM (global system for mobile communications) have been used in glucose monitoring. Different varieties of noninvasive sensors have been proposed to perform the sensing function. An arrangement of nanowires made of ZnO (zinc oxide) and an infrared emitter diode made of GaAs are examples of this category [36][37]. The efforts of the research community are not limited to keeping track of glucose levels. Additional parameters have been added to form a comprehensive system. In [38], besides glucose levels, cardiac-type diseases have been contemplated. Furthermore, communication is improved through the use of Zigbee, and display characteristics of the readings are added.

Real-time communication and low power consumption make WSNs (wireless sensor networks) an attractive technology for monitoring techniques. The integration of a WSN in conjunction with a minimally invasive sensor allows for portability and size reduction. With this application, the sensor is placed in the layer of the body's subcutaneous tissue to determine the amount of oxygen and, as a function of this, the glucose level [39]. Portability is an important factor when we are following up on elderly people. The noninvasive sensors attached to a miniature electronic mechanism allow for better follow up [40]. Sensors of the chronoamperometric type and ASIC (application-specific integrated circuit) designs make up a small battery-free device [41].

Smartphones and the characteristics of their operating system can be utilized for the connection and visualization tasks. The Android OS can be easily adapted to carry out the functions. Invasive and noninvasive sensors can be used for communication with a mobile device. In this way, patients themselves can monitor the readings. Moreover, the results can be sent to the cloud so that they can be viewed anywhere by a patient's doctor and relatives. Noninvasive sensors are still an area of opportunity, and therefore researchers continue to look for alternative designs that are more suitable for patients [42].

In [43], the authors proposed a design that employees an ion-sensitive field-e ect transistor which is connected to a microcontroller. The readings are sent to a doctor through a Wi-Fi module. Further research is required to overcome the limitation of the sensor being exposed to contamination. The sending of glucose estimations has been optimized using a wireless body area network (WBAN) [44].

To verify it, the authors used a commercial sensor and communication via Zigbee. Additionally, the system stored the data in a desktop-based application. In this way, the information was available to the doctor, nurse, and a patient's relatives. To achieve better precision in the readings, modifications to the traditional invasive glucose reader are possible. The amount of gluconic acid detected by the sensor produces a current that is converted to voltage, and this variable is processed by a microcontroller to show the glucose value [45].

Architectures based on the IoT have attracted the attention of researchers in recent years [46]. They make use of standardized technologies to monitor glucose levels, as well as body temperature. With this kind of architecture, it is possible to have readings in real time and to store the information in back-end type servers [47]. A patient's caregivers can track his or her evolution from their mobile device or by accessing a web page. The integration of an IoT architecture and noninvasive sensors allows for portability and data accessibility. An example of this interaction is an infrared LED that bases its operation on measuring the concentration of glucose in the blood depending on the intensity of the received light. Due to the LED operation and configuration, its connection to the architecture is very simple [48]. Implantable glucose biosensors for long-term use have been studied with success [49].

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These kinds of sensors represent a key element for reliable readings in monitoring systems. They have shown good results as compared with the finger-pricking readings. The impact of a real-time prognosis algorithm has also been analyzed in recent proposals [50]. In the case of wireless technologies, limitations persist for both personal use and short-range technologies, especially when they are handled by older persons. The importance of IoT technologies has been proven in recent studies, for example, in [51], authors developed an architecture based on a Raspberry Pi, and they analyzed the sensor's accuracy and the effectiveness of the transmission.

Another example, in [52] proposed a glucose data classification to validate the architecture using data classification techniques for a correct diagnosis bythe prediction system. The authors focused on appropriate transmission through SMS messages and the evaluation of the techniques used. In most cases, the drawbacks of traditional monitoring can be solved with this technology [53]. It is possible to use complex algorithms to perform the prognosis and to store data in the cloud. They are also a good option for closer tracking of many patients, reducing the charge for doctors and caregivers. However, policies and regulations are necessary for privacy and security issues [54]. A study using health information technologies on glycemic control with type 2 diabetes was considered in [55] reporting better control both clinically and statistically. A reduction of HbA1c was observed in all the interventions presented. According to the study, every 1% decrease in HbA1c over a ten-year period was associated with a risk reduction of 21% for diabetes-related death and 37% of microvascular complications. However, long-term studies should be carried out. These findings are a great incentive for future developments. With respect to systems that monitor older adults, an IoT system for heart rate, body temperature, and blood oxygenation was presented in [56].

Although glucose was not considered in the monitoring, the importance of the IoT system and the mobile application were emphasized. Commercial products such as Medtronic Guardian Connect Smart (CGM) also exist that claim to use a sensor based on interstitial fluid. The system transmits the glucose values wirelessly to a smart device to prevent hypoglycemia and hyperglycemia [57].

VII. CONCLUSION

Health of the patients are monitored using internet of things (IOT) and enables the doctor to monitor their patients outside the clinic and also apart their consulting hours. Connected healthcare devices utilize resources to provide an improved quality of care, leading to better clinical outcomes. Measureable benefits of connected medical devices include reduces clinic visits, including reduction in bed days of care and length of stay in hospitals. Using Internet of Things (IOT), patient conditions are obtained and stored for further analysis. In some research some physical parameters of patient are monitored and it is expected to monitor the whole body of the patient from remote location and improve the technology to world widely for patient monitoring by providing personalized and optimized services, which will promote a better standard of living. Nations across the world to improve patient care and IoT provides a timely and cost effective response to those critical situations. Healthy and active people can also benefit from IoT-driven monitoring of their well-being. It also enables features for the aged persons who want only a monitoring device that can detect a fall or other interruption in everyday activity and report it to emergency responders or family members.

Diabetes mellitus is a complex group of syndromes that have in common a disturbance in the body's use of glucose, resulting in an elevated blood sugar. Once detected, sugar diabetes can be controlled by an appropriate regimen that should include diet therapy, a weight reduction program for those persons who are overweight, a program of exercise and insulin injections or oral drugs to lower blood glucose. Blood glucose monitoring by the patient and the physician is an important aspect in the control of the devastating complica- tions (heart disease, blindness, kidney failure or amputations) due to the disease. Intensive therapy and frequent glucose testing has numerous benefits. With ever improving advances in diagnostic technology, the race for the next generation of bloodless, painless, accurate glucose instruments has begun. However, many hurdles remain before these products reach the commercial marketplace. Calibration of the instruments and validation of the results obtained by the optical meth- ods under different environmental conditions and used by different patient populations (i.e., different ages, sizes and ethnic origins) must be performed. The devices may have to be calibrated to individual users.

Recent instrumentation lacks specificity due to substantial chemical and physical inter- ferences. The devices use multivariate regression analyses that convert the optical signal to a glucose concentration. Large amounts of data are used to build the glucose model and must take into consideration the concentration range, sampling environment and other fac- tors involved in the analysis. First an instrument must be designed that accurately detects glucose concentration. Correlation and clinical interpretation of this value, in respect to the patient's true glucose value, is imperative for optimum therapy and disease management.

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Considerable progress has been made in the development of non-invasive glucose devices however, at this time, frequent testing using invasive blood glucose determination via finger- stick provides the best information for diabetes disease management. Industry spokespersons have said: anyone who can come up with a viable noninvasive or painless technique is going to make a lot of money. Peoples lives are involved ... and we don't want to suggest that this technology is right around the corner. This is very tricky, difficult work.

REFERENCES

1. Riazul Islam, S.M., Kwak, D., Kabir, H., Hossain, M., Kwak, K.S. (2015). The internet of things for health care: a comprehensive survey. IEEE Access, 3: 678-708. http://dx.doi.org/10.1109/ACCESS.2015.2437951
2. Agu, E., Pedersen, P., Strong, D., Tulu, B., He, Q., Wang, L., Li, Y. (2013). The smartphone as a medical device: Assessing enablers, benefits and challenges. 2013 IEEE International Workshop of Internet-of-Things Networking and Control (IoT-NC), pp. 48-52. http://dx.doi.org/10.1109/IoT-NC.2013.6694053
3. Benjamin, Emelia J., Salim S. Virani, Clifton W. Callaway, Alanna M. Chamberlain, Alexander R. Chang, Susan Cheng, Stephanie E. Chiuve et al. "Heart disease and stroke statistics—2018 update: a report from the American Heart Association." Circulation 137, no. 12 (2018): e67-e492.
4. Moser, L.E., Melliar-Smith, P.M. (2015). Personal health monitoring using a smartphone. 2015 IEEE International Conference on Mobile Services, pp. 344-351. http://dx.doi.org/10.1109/MobServ.2015.54
5. Kong, X., Fan, B., Nie, W., Ding, Y. (2016). Design on mobile health service system based on Android platform. 2016 IEEE Advanced Information Management, Communicates, Electronic and Automation Control Conference (IMCEC), pp. 1683-1687. http://dx.doi.org/10.1109/IMCEC.2016.7867504
6. Turner, J., Zellner, C., Khan, T., Yelamarthi, K. (2017). Continuous heart rate monitoring using smartphone. 2017 IEEE International Conference on Electro Information Technology (EIT), pp. 324-326. http://dx.doi.org/10.1109/EIT.2017.8053379
7. Reddy, G.K., Achari, K.L. (2015). A non invasive method for calculating calories burned during exercise using heartbeat. 2015 IEEE 9th International Conference on Intelligent Systems and Control (ISCO), pp. 1-5. http://dx.doi.org/10.1109/ISCO.2015.7282249
8. World Health Day 2016: Beat diabetes. World Health Organization, 2016. Available: http://www.who.int/campaigns/worldhealthday/2016/en/
9. Kumar, S.P., Samson, V.R.R., Sai, U.B., Rao, P.M., Eswar, K.K. (2017). Smart health monitoring system of patient through IoT. 2017 international Conference on ISMAC (IoT in Social, Mobile, Analytics and Cloud) (ISMAC), pp. 551-556. http://dx.doi.org/10.1109/ISMAC.2017.8058240
10. Penmatsa, P.L., Reddy, D.R.K. (2016). Smart detection and transmission of abnormalities in ECG via Bluetooth. 2016 IEEE International Conference on Smart Cloud (SmartCloud), pp. 41-44. http://dx.doi.org/10.1109/SmartCloud.2016.10
11. Rogers, E.A., Junga, E. (2017). Intelligent efficiency technology and market assessment. American Council for an Energy-Efficient Economy (ACEEE).
12. Kumar, R., Rajasekaran, M.P. (2016). An IoT based patient monitoring system using raspberry Pi. 2016 International Conference on Computing Technologies and Intelligent Data Engineering (ICCTIDE'16), pp. 1-4. http://dx.doi.org/10.1109/ICCTIDE.2016.7725378
13. Desai, M.R., Toravi, S. (2017). A smart sensor interface for smart homes and heart beat monitoring using WSN in IoT environment. 2017 International Conference on Current Trends in Computer, Electrical, Electronics and Communication (CTCEEC), pp. 74-77.
14. Tripathi, V., Shakeel, F. (2017). Monitoring health care system using internet of things-an immaculate pairing. 2017 International Conference on Next Generation Computing and Information Systems (ICNGCIS), pp. 153-158. http://dx.doi.org/10.1109/ICNGCIS.2017.26
15. Raj, C., Jain, C., Arif, W. (2017). HEMAN: Health monitoring and nous: An IoT based e-health care system for remote telemedicine. 2017 International Conference on Wireless Communications, Signal Processing and Networking (WiSPNET), pp. 2115-2119. http://dx.doi.org/10.1109/WiSPNET.2017.8300134
16. Yang, G., Øvsthus, K. (2017). The challenges of the IoT solutions in a home care project. 2017 International Conference on Computational Science and Computational Intelligence (CSCI), pp. 1771-1774. http://dx.doi.org/10.1109/CSCI.2017.309
17. Tsakalakis, M., Bourbakis, N.G. (2014). Health care sensor-based systems for point of care monitoring and diagnostic applications: A brief survey. 2014 36th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, pp. 62666269. http://dx.doi.org/10.1109/EMBC.2014.6945061

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18. Wu, F., Wu, T., Yuce, M.R. (2019). Design and implementation of a wearable sensor network system for IoT-connected safety and health applications. 2019 IEEE 5th World Forum on Internet of Things (WF-IoT), pp. 87-90. http://dx.doi.org/10.1109/WF-IoT.2019.8767280
19. Ahouandjinou, A.S., Assogba, K., Motamed, C. (2016). Smart and pervasive ICU based-IoT for improving intensive health care. 2016 International Conference on Bio-engineering for Smart Technologies (BioSMART), pp. 1-4. http://dx.doi.org/10.1109/BIOSMART.2016.7835599
20. Grossi, M. (2018). A sensor-centric survey on the development of smartphone measurement and sensing systems. Measurement, 135: 572-592. https://doi.org/10.1016/j.measurement.2018.12.014
21. Kumar, M.A., Sekhar, Y.R. (2015). Android based health care monitoring system. 2015 International Conference on Innovations in Information, Embedded and Communication Systems (ICIIECS), pp. 1-5. http://dx.doi.org/10.1109/ICIIECS.2015.7192877
22. Mehta, D.D., Zanartu, M., Feng, S.W., Cheyne, H.A., Hillman, R.E. (2012). Mobile voice health monitoring using a wearable accelerometer sensor and a smartphone platform. IEEE Transactions on Biomedical Engineering, 59(11): 3090-3096. http://dx.doi.org/10.1109/TBME.2012.2207896
23. Gao, H., Duan, X., Guo, X., Huang, A., Jiao, B. (2013). Design and tests of a smartphones-based multi-lead ECG monitoring system. 2013 35th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), pp. 2267-2270. http://dx.doi.org/10.1109/EMBC.2013.6609989
24. Sütő, J., Oniga, S., Orha, I. (2013). Microcontroller based health monitoring system. 2013 IEEE 19th International Symposium for Design and Technology in Electronic Packaging (SIITME), pp. 227-230. http://dx.doi.org/10.1109/SIITME.2013.6743679

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