An IoT Framework for Healthcare Monitoring Systems

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Abstract— **Internet of things (IoT) is a fast growing, a user-friendly technology which allows everything to is connected and also allows effective communication between the connected "things." The Internet of Things, likewise called The Internet of Objects, alludes to a remote system between items, as a rule, the system will be remote and self-designing, for example, family unit machines. The term "Internet of Things" has come to describe some technologies and research disciplines that enable the Internet to reach out into the real world of physical objects. IoT has top five applications are Traffic monitoring, Healthcare, Security, Transport and logistics, and Daily life. In this paper, we are going to develop Health Care application. The Internet of Things could be a game-changer for the healthcare industry. It is transforming healthcare industry by increasing efficiency, lowering costs and put the focus back on better patient care. IoT in Healthcare is a heterogeneous computing, wirelessly communicating system of apps and devices that connects patients and health providers to diagnose, monitor, track and store vital statistics and medical information. This paper describes E-Health Monitoring (EHM). This paper presents an architectural framework to describe the entire monitoring life cycle and highlights essential service components. It serves as a fundamental basis for achieving robust, efficient, and secure health monitoring. The main primary aims of this paper to design an IOT based architecture for health related issues such as Diabetics, Heart Monitoring system, Pulse rate measurement, Daily Activity, kidney functioning. The Data obtained through sensors are uploaded to the cloud and shared with others. Data obtained through sensors are processed and accessed through a smart phone.**

Keywords- ***Internet of Things, Internet, Healthcare, E-Health Monitoring (EHM), Smart environments***

I. INTRODUCTION

Internet of Things (IoT) devices can be mostly used to facilitate further health monitoring and emergency healthcare systems. The Internet and World-Wide Web (www) has been a primary driver of globalization and has promoted the convergence of electronic communications and media services. The internet has now become a medium of social interaction. It is a significant development which can change and impact the way people work, learn and live [1]. In the recent years, The Internet has become the most important thing in people's life. In the Internet of Things (IoT) paradigm, many of the objects that surround us will be on the network in one form or another. The recent advances in wireless sensing technology have led to the emergence of a broad range of applications in different domains such as medical, sports, consumer electronics, social networking, and enterprise usage [6]. E-Health recognized as the most important and promising for these applications due to its potential for health monitoring of chronic illnesses, lifesaving in emergency situations, and its ability to provide round the clock healthcare to rural and disadvantaged areas. As one of the consequences of such mechanical merging, the therapeutic range has benefitted from recent advances in sensors outline and remote correspondence advances. In particular, the constant miniaturization of electrical devices has empowered the development of e-health monitoring. These incorporate different sorts of therapeutic and non-medicinal sensors inserted in cell phones, wearable gadgets in, close by the patient's bodies, filling in as critical components of remote body zone systems, or WBAN in short [8]. Late years have seen a quick advancement of cell phones sensors, body sensors, and remote correspondences, which make a path for productive wellbeing observing [3]. The human services errands are accordingly moved from traditional clinical environment to pervasive easy to use environment. Likewise, the scope of observing subjects could be fundamentally extended, shifting from the patients at critical care, e.g., in an emergency vehicle, to those with incessant maladies. Specifically, the body sensors conveyed in, close to the human body, too as the setting mindful sensors like the ones inserted in cell phones, can be utilized to gauge the basic wellbeing parameters or key signs, for example, pulse, temperature, circulatory strain [5]. Besides, other IoT sensors conveyed in warm homes or at healing facility rooms may give extra profitable data about nature where the observed patient found. For example, the temperature, the level of moistness, the lighting and additionally some patients sweat which can be measured by cutting edge shrewd beds and so forth, permitting the medical stuff to accomplish more precise analysis and hence convey more effective treatment.

For better description, a general eHealth checking system is given in Figure 1, which contains the accompanying significant segments.

A. Situational awareness sensors: Ranging from implantable devices and wearable sensors to IoT sensors or smartphone sensors, gathering information of enthusiasm from the patient and transmitting them to the base station.

B. Communication networks: these include short range wireless communications of WBAN (inter-WBAN communications), WBAN-IoT communications, IoT-IoT communications, as well as various relaying networks (connecting a base station with cloud servers) and access networks (enabling clinicians to access remotely data servers) like 3G and wireline networks [11].

C. Medical data processing servers: the data is usually stored and Processed in remote cloud data centers, which must ensure secure and privacy-preserving computation and storage.

D. Clinic terminals: the end clients could be attendants, specialists or whatever other doctors, who will recover the restorative data from cloud server farms through access different hardware that could convey in healing facilities, services, ambulances or any therapeutic consideration focuses.

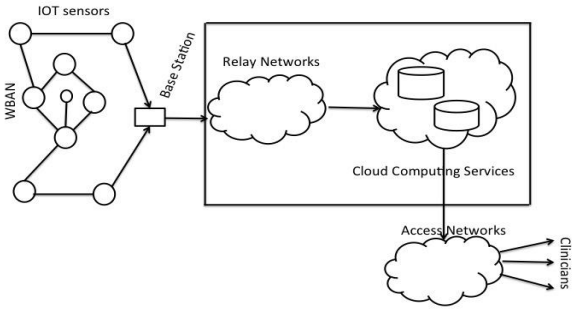

Figure 1. CPS Architecture for eHealth Monitoring

For example, WBAN IEEE standard released in 2012. In addition, to remote interchanges advancements, vitality proficiency, and patient protection is dependable among the top worries of e-Health care administrations [13]. In light of the commitments from various applicable exploration handle, this paper plans to research the fundamental difficulties in accomplishing reliable, productive and secure patient checking, which we contend that it merits a larger number of endeavors than it as of now gets. We mainly look at an assortment of arrangements handling those distinguished difficulties and at last propose the potential combinations of those multidisciplinary approaches for developing a comprehensive e-Health care oriented, understanding driven, Cyber-Physical System (CPS) structure [8].

II. IoT System Architecture

The extent of the reference architecture examined here incorporates the whole cycle of IoT applications, from detecting to application administrations.

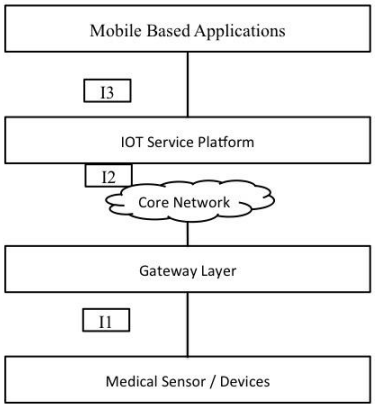

Figure 2. IoT Reference Architecture

It is apportioned into three layers to be respective device layer, Gateway layer, and Service Platform layer. This paper additionally talks about issues including IoT centers system as follows.

A. *IoT Device Layer:* IoT gadgets incorporated into this layer. This layer comprises of individual sensors; system empowered articles and hair like systems consisting of information sources that are close to the physical environment. It includes different gadgets (counting sensors and actuators) supporting different correspondence measures, for example, Zigbee, Z-Wave, ANTS, and Wi-Fi, etc [2].

B. *IoT Gateway Layer:* This layer comprises of IoT gateways. The significant heterogeneity of gadgets and advances facilitated by the gadget layer is preoccupied utilizing entryways that can give a more uniform interface to IoT administration stage layer. It is additionally conceivable that an able gadget can execute both IoT gadget and entryway layer/usefulness into an individual physical element and interfaces with the IoT administration stage layer through the center system.

C. *IoT Service Platform Layer:* This defines and gives perfect IoT administration reflections that can be utilized by different applications [12]. There can be an arrangement of stage administrations from the IoT stage base. Further, the same structure can be reached out to application administrations where a portion of the reusable application parts is accessible as administrations.

D. *IoT Core Network:* The physical elements included in the above three layers need suitable correspondence framework for data trade. While the gadget layer addresses this necessity utilizing different legacy innovations which are out of degree

for this study, the portal layer and administration stage layer are relied upon to be associated with an IoT Core/Backbone system. The IoT Core is visualized to be overwhelmingly an IP based system and that is under the vision of IoT [11]. This IP availability could bolstered by huge numbers of telecom bases, for example, DSL, Cellular systems (2G, 3G, 4G) etc.

III. METHODOLOGY ADAPTED

This paper proposes the IoT Platform for human services as a suitable self- management model for perpetual sickness, for example, hypertension, heftiness, diabetes, as appeared as Figure 3. The proposed stage is involved 5 segments. The main component is a medical sensor device to quantify and send the therapeutic information, and the second component is a virtual medical sensor which is a software sensor having a wise conclusion calculation and mashup information from different physical medical sensors and server [4]. Furthermore, the following segment is a portable application that is searching medical information about patient or client from medical IoT gadget and additionally utilizing for self-administration. The last part is a stage and its director that empowers all segments to speak with one another by utilizing brought together API.

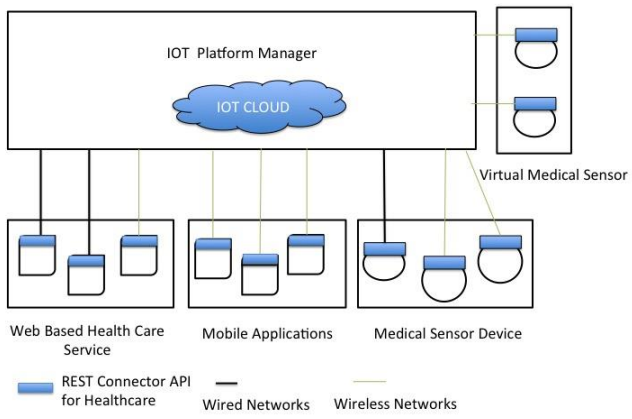

Figure 3. IoT Platform framework for healthcare service

3.1 *Medical sensor device and virtual medical sensor:* Medical sensor gadget, for example, blood pressure monitors and glucose meters interfaces physically to IP-empowered system by utilizing IPv4 or IPv6 as a part of request to use at home or medical office [9]. Likewise, versatile application is associated with some other gadgets and administrations utilizing the REST (Representational State Transfer) API on the stage [4]. Recognizable proof and validation are essential for a family to share and utilize medical sensor gadgets at home. NFC (Near Far Communication) is an exceptional system answer for validation in the middle of client and gadget. Also, with a specific end goal to bolster the versatility of the gadgets and administrations, it is more powerful way that they interface straightforwardly to the IP arrange instead of associate with Zigbee entryway or Bluetooth portal. New virtual therapeutic sensor, for example, virtual sensor for diabetes, builds the interest for administrations. Virtual sensor is sorts of programming construct sensor in light of IoT stage [10].

3.2 *Mobile application and service application:* Mobile application gives a significant part of the user interface of the medical sensor gadget and in addition data sign channel from the server at doctor's facility [2]. Administration application gives data a specialist to break down and analyze patient's illness and in addition giving data patient to illuminate his wellbeing condition. In any case, all medical data is put away in his own cell phone and doctor's facility information server indicated by the client, yet not cloud server [7]. Most clients would prefer not to store their medical data in the cloud server in light of security, as appeared as the failed case, Google health service.

3.3 *Platform manager for healthcare and REST API:* It is critical for a stage to give an open API as a bound together way to various gadgets and administrations, paying little respect to what system they have. None the less, IoT stage utilizes REST API as an interface as there is no standard for them to access to the stage. All gadgets and administrations including portable applications access to the stage by REST API [4]. It is a light weight interface of exchanging data over solid https system convention in the IP-enabled system, so little measured gadgets can utilize the API regardless of the fact that they have a few imperatives like low figuring force and little memory limit. Likewise, the stage has capacities which have administration disclosure, asset enrolment, access control, and power control by stage director.

IV. HARDWARE AND SOFTWARE REQUIREMENTS

Hardware Requirements:

i. *Arduino Uno*: Arduino is an open-source gadgets prototyping stage taking into account adaptable, simple to-utilize equipment and programming. It's expected for specialists, fashioners, specialists, and anybody keen on making intelligent items or situations [9].

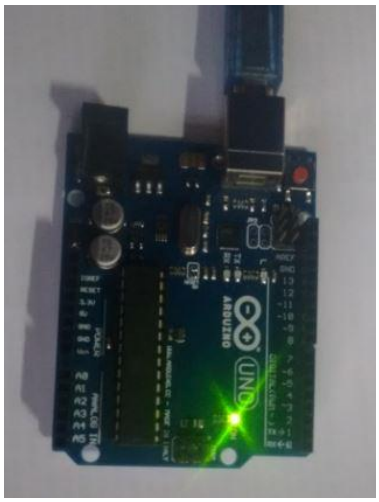

Figure 4. Arduino Uno

ii. *Body Temperature Sensor*: The DS18B20 digital thermometer provides 9-bit to 12-bit Celsius temperature measurements and has an alarm function with non-volatile user-programmable upper and lower trigger points. The DS18B20 communicates over a 1-Wire bus that by definition requires only one data line (and ground) for communication with a central microprocessor. In addition, the DS18B20 can derive power directly from the data line ("parasite power"), eliminating the need for an external power supply.

Figure 5. Body Temperature Sensor

iii. *Pulse Sensor*: Pulse Sensor is a well-designed plug-and-play heart-rate sensor for Arduino. It can be used by students, artists, athletes, makers, and game & mobile developers who want to easily incorporate live heartrate data into their projects. The sensor clips onto a fingertip or earlobe and plugs right into Arduino with some jumper cables. It also includes an open-source monitoring app that graphs your pulse in real time [12].

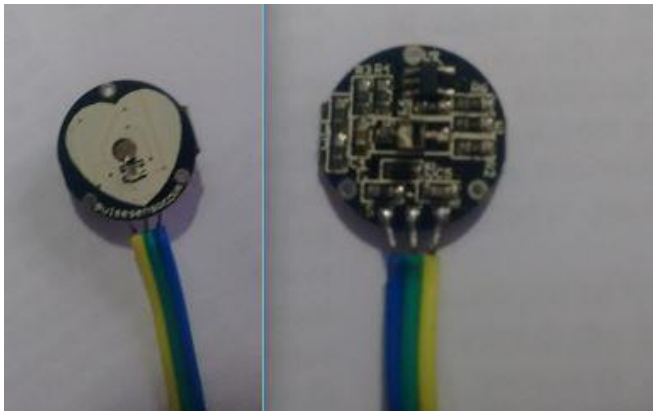

Figure 6. Pulse Sensor

- Smart Phone

- Software:
  - JDK 1.6 for Java class libraries and Java runtime environment
  - C
  - Eclipse
  - Android SDK
  - Cloud Interface
- Operating System:
  - ♦ Linux
    32-bit
    64-bit
  - ♦ Windows
    32-bit
    64-bit

V. RESULTS and Analysis

Heart rate data can be really useful whether you're designing an exercise routine, studying your activity or anxiety levels or just want your shirt to blink with your heart beat. The problem is that heart rate can be difficult to measure.

Luckily, the Pulse Sensor Amped can solve that problem. The Pulse Sensor Amped is a plug-and-play heart-rate sensor for Arduino. It can be used to easily incorporate live heart-rate data into the projects .It essentially combines a simple optical heart rate sensor with amplification and noise cancellation circuitry making it fast and easy to get reliable pulse readings.

Also, it sips power with just 4mA current draw at 5V so it's great for mobile applications. Simply clip the Pulse

Sensor to your earlobe or fingertip and plug it into your 3 or 5 Volt Arduino and you're ready to read heart rate.

Clinical significance: Reduced HRV has been shown to be a predictor of mortality after myocardial infarction although others have shown that the information in HRV relevant to acute myocardial infarction survival is fully contained in the mean heart rate. A range of other outcomes/conditions may also be associated with modified (usually lower) HRV, including congestive heart failure, diabetic neuropathy, depression, post-cardiac transplant, susceptibility to SIDS and poor survival in premature babies.

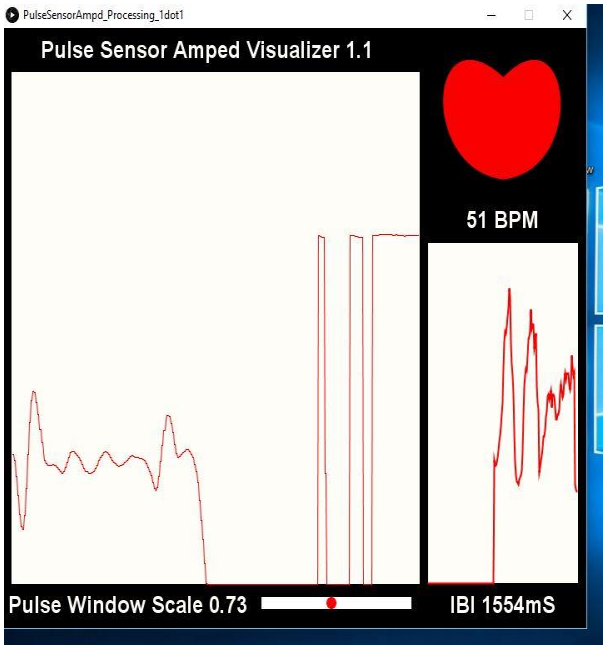

Figure 7. Shows BPM and IBI on Processing 3.0

Also, The Body Temperature of Human Body is measured by the DS18B20 sensor. The results of this Sensors are in degree F and in degree C. The temperature so obtained is used for various purposes and to diagnose human body carefully and precisely.

VI. CONCLUSION

This Paper presents the importance of the Healthcare through IOT devices. This Paper focus on how to deal with health issues to the people who are residing in the remote areas or away from the doctors. The IOT provides the lifeline to such people. Through this paper significant efforts are made to synchronize data from the sensors to the cloud and can be accessed through mobile application. The data so obtained are carefully analyzed and according to this patients are diagnosed from different geographical locations. All the details related IOT framework are mentioned step by step. In future more sensors can be attached to Prototype to enhance the capability in monitoring the patients with different prospective from different locations with ease, efficiency and economical.

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