VOL. 13, NO. 8, APRIL 2018 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences

www.arpnjournals.com

BODY SENSOR USING INTERNET OF THINGS (IOT)

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ABSTRACT

In recent proceedings in IT and communication have led to the birth of a new technology named Internet of Things (IOT) Healthcare is one of the most vital domains that are present today. Healthcare has seen a wide transformation over time. Body Sensor Network is definitely one of the most vital technologies used in studying a healthcare system which functions on IoT. It is basically a combination of very low-power and wireless nodes of a sensor that are essentially used to supervise the human body functions and the environment surrounding the patient. The nodes of Body Sensor Network are used to gather critical and proximate information which enables the system to function in unreceptive environments. Severe and appropriate security methods are used to prevent unnecessary interaction with the existing system. A controlled map of services with respect to health services should be enabled to make health care available to the human population. The main objective of this project is to talk about the problems linked to the usage of wearable and implantable sensors for distributed mobile computing.

Keywords: body sensor network, data confidentiality, IoT, data reliability, validation.

INTRODUCTION

The life expectancy has been increasing in this world rapidly since the past few years which has drastically raised the number of elderly people living currently. United Nations has also predicted that by the year 2050 arrives the world will have about 2 billion older generation. And also according to statistics a major portion of the old people live on their own without much assistance. And also most of them suffer from at least one continual disease which increases the list of living alone for them. Providing a good health and a life balance to the old and elderly population has become a very vital aspect in the society today. The advancements in technology is giving space to a lot of scope to develop better and appropriate solutions to various challenges faced by the people. Today, IoT, Internet of Things has turned out to be the most applied and efficient communication models in the present century. Various devices like micro controllers form an essential part of IoT environment due to their capabilities of computation and communication.

IoT mainly allows us to interface different types of devices. Various sensors, cameras, additional devices can be used in this setup where the IoT is used. This project is an application of Internet of things in the healthcare domain mainly targeting the elderly people. So with regard to healthcare we can use any combination of sensors depending upon the requirement of the patient. And besides these basic benefits this setup can be widely used at any place and also at any time. There are no spatial restrictions to this project. It mainly helps in enhancing the quality of life of the older people.

Body Sensor Network is a combination of very low-power and wireless nodes of a sensor that are essentially used to supervise the human body functions and the environment around the patient [1]. And in order to avoid errors strict mechanisms to implement security protocols are made available. So in this project we mainly talk about the various security needs in Body Sensor Network based healthcare system. We address the few security necessities in BSN based present day human services framework. At that point, we propose a protected IoT based human services framework utilizing BSN, called BSN Care which can ensure to productively finish those prerequisites [2].

In this way, whatever is left of the article is sorted out as takes after. In area II, we exhibit a rundown of security parameters which are required to be tended to in any IoT based medicinal services framework utilizing BSN. In segment III, we portray a portion of the related works in IoT based human services framework utilizing BSN. In segment IV, we exhibit our BSN-Care framework and consequently, in this area we additionally demonstrate to implement security in our BSN-Care model to accomplish all the basic security properties. Section V analyses the security of the proposed system. [3]

PRIMARY SECURITY NECCESITIES IN AN IoT BASED MODERN HEALTHCARE SYSTEM USING BODY SENSOR NETWORK (BSN)

Security is a standout amongst the most basic parts of any framework. Individuals have alternate point of view with respect to security and henceforth it characterized from multiple points of view. As a rule, security is an idea like well being of the framework all in all. Presently, the correspondence in sensor organize applications (like BSN) in medicinal services are for the most part remote in nature. This may bring about different security dangers to these frameworks. These are the security issues cloud posture major issues to the remote sensor gadgets. In this segment, we depict the key security necessities in IoT based medicinal services framework utilizing BSN.

A. Data confidentiality

Like WSNs, information security is thought to be most imperative issue in BSN. It is required to shield the information from exposure. BSN ought not to release patient's indispensable data to outer or neighboring

systems. In IoT-based human services application, the sensor hubs gather and advances delicate information to an organizer. An enemy can listen stealthily on the correspondence, and can catch basic data. This listening stealthily may make extreme harm the patient since the foe can utilize the obtained information for some unlawful purposes.

B. Data reliability

Keeping information classified does not shield it from outer changes. An enemy can simply modify the information by including a few parts or by controlling the information within a bundle. This adjusted information can be sent to the coordinator. Absence of reliability instrument is some of the time extremely unsafe particularly if there should be an occurrence of life-basic (when crisis information is changed). Bad environment may also lead to severe data losses.

C. Data newness

The foe may now and again catch information in transit and replay them later utilizing old key in more seasoned to befuddle the coordinator. Information freshness infers that information is new and nobody can replay the old message.

D. Validation

It is a standout amongst the most imperative necessities in any IoT based healthcare framework utilizing BSN, which can effectively manage the imitating assaults. In BSN based human services framework, all the sensor hubs send their information to a coordinator. At that point the organizer sends intermittent updates of the patient to a server. In this specific situation, it is profoundly basic to guarantee both the character of the coordinator and the server. Validation mainly helps in maintaining the uniqueness of each specific user.

E. Secrecy

A more agreeable property of the namelessness is the un-traceability, which ensures that the foe can neither recognize who the patient is not can distinguish whether two discussions start from same (obscure) quiet. In this way, secrecy shrouds the wellspring of a parcel (i.e. sensor information) amid wireless communication. It is a service that can empower secrecy.

F. Safe localization

Most BSN applications require exact estimation of the patient area. Absence of tracking mechanisms which are smart enables a foe to send in right reports about the patient area by announcing false flag strengths. Now, with a specific end goal to guarantee a safe IoT-based human services framework utilizing BSN, it is very basic that the framework ought to represents all the aforementioned security prerequisites and in the end can oppose different security dangers and assaults like information alteration, pantomime, spying, replaying and so forth.

LINKED WORK AND MOTIVATION

The headway of BSN in social insurance applications have made patient observing more doable. As of late, a few remote medicinal services inquires about and ventures have been ace postured, which can plan to give ceaseless patient screening, in-wandering, in-facility, and open condition screening (e.g. competitor wellbeing checking). This area depicts couple of mainstream research extends about medicinal services framework utilizing body sensor systems.

Code Blue is a mainstream medicinal services look into venture in light of BSN created at Harvard Sensor Network Lab. In this design, a few bio-sensors are put on patient's body. These sensors sense the patient body and transmit it remotely to the end-client gadget (PDAs, tablets, and PC) for further examination. The fundamental thought of the Code Blue is clear, a specialist or medicinal expert issues a question for patient wellbeing information utilizing their own computerized colleague (PDA), which depends on a distributed and subscribed design. In addition, Code Blue's authors recognize the need of security in therapeutic applications, however as of not long ago security is as yet pending or they purposefully left the security angles for future work.

In this way, a heterogeneous system engineering named Alarm-net was outlined at the University of Virginia. The examination is particularly intended for patient well being observing in the helped living and home condition. Alert net comprise of body sensor arranges and environmental sensor systems.

Also, the creators have built up a circadian action rhythms program to help setting mindful power administration and protection approaches. Encourage more; Alarm-net encourages system and information security for physiological, condition, behavioral parameters about the occupants. Nonetheless, Paietal have called attention to some secrecy encroachment situations on Alarm-net, for example, the reality it is defenseless to antagonistic privacy assaults, which can release inhabitant's area; allude to for points of interest. In the interim, Ngetal. Another BSN based human services framework UbiMon was proposed in the division of processing, Imperial College, London. The point of this venture was to deliver the issues identified with utilization of wearable and implantable sensors for conveyed versatile checking. Al-Ngetal. proposed and showed the pervasive medicinal services observing engineering, it is generally acknowledged that without considering the security for remote social insurance checking, which is a central necessity of human services applications, as indicated by government laws.

In 2006, Chakravorty outlined a portable healthcare setup called MobiCare. MobiCare gives a wide-region mo-bile quiet checking framework that encourages consistent and opportune observing of the patients physiological status. Despite the fact that, Chakravorty recognized the security issues in MobiCare, however just tending to security issues are not sufficient for continuous social insurance applications. Along these lines, security and protection is as yet not actualized in MobiCare

medicinal services checking or may have been forgotten for future work. By the by, there are numerous security issues, for example, secure restriction, namelessness, and so on, have not specified in MobiCare framework.

As we have seen, all the above progressing medicinal services monitoring ventures empower programmed tolerant checking and give potential nature of the human services without aggravating patient solace. Every one of the activities concentrate on the unwavering quality, cost adequacy and power utilization of their models, however albeit the majority of the social insurance ventures specified above locations the necessity for security and protection for delicate information, just a couple implant any security. Furthermore, nothing from what was just mentioned ventures tended to all the security prerequisites and their suggestion, which is enormously basic for basic applications. Thus, it can be contended that security and protection have not been examined in much profundity; challenges still stay for continuous remote medicinal services application. These are the actualities, incredibly propelled us to propose a protected IoT based healthcare framework utilizing BSN in which we will obviously show that how effectively and productively to accomplish all the aforementioned security prerequisites.

SAFE IoT- BASED HEALTHCARE SYSTEM USING BODY SENSOR NETWORK (BSN CARE)

Body Sensor Network permits the incorporation of intelligent, scaled down low-control sensor hubs in, close by human body to screen body capacities and the encompassing condition. It can possibly revolutionize the eventual fate of human services innovation and achieved various scientists both from the scholarly world and industry in the previous couple of years. By and large, BSN comprises of in-body and on-body sensor systems. An in-body sensor arranges permits correspondence between obtrusive/embedded gadgets and base station. Then again, an on-body sensor net-work permits correspondence between non-intrusive/wearable gadgets and a facilitator. Presently, our BSN-Care is a BSN engineering made out of wearable and implantable sensors. Every sensor hub is incorporated with bio-sensors, for example, Electrocardiogram (ECG), Electromyography (EMG), Electroencephalography (EEG), Blood Pressure (BP), and so forth. These sensors gather the physiological parameters and forward them to a facilitator called Local Processing Unit (LPU), which can be a compact gadget, for example, PDA, advanced mobile phone and so forth. The LPU functions as a switch between the BSN hubs and the focal server called BSN-Care server, utilizing the remote correspondence mediums, for example, versatile systems 3G/CDMA/GPRS. Furthermore, when the LPU identifies any variations from the norm then it gives prompt alarm to the individual that wearing the bio-sensors. For instance, as a rule BP not exactly or equivalent to 120 is typical, when the BP of the individual achieves say 125, the LPU will give a tender caution to the individual through the LPU gadgets (e.g. beep tone in a cell phone).

At the point when the BSN-Care server gets information of a man (who wearing a few bio sensors) from LPU, then it bolsters the BSN information into its database and examines those information. Subsequently, in view of the level of variations from the norm', it might connect with the relatives of the individual, neighborhood physician, or even crisis unit of an adjacent human services focus. Absolutely, considering a man (not really a patient) wearing a few bio sensors on his body and the BSN-Server gets a periodical updates from these sensors through LPU. Presently, our BSN-Care server keeps up an activity table for every class of BSN information that it gets from LPU. The activity table in light of the information gotten from BP sensor, where we can see that if the BP rate is not exactly or equivalent to 120 then the server does not play out any activity. Presently, when the BP rate ends up noticeably more prominent than 130, then it educates relatives of the individual. On the off chance that the BP rate ends up noticeably more prominent than 145 and there is nobody going to attend the call in the family, then the server will contact the nearby doctor. Besides, if the BP rate of the individual cross 160 and still there is no reaction from the relative or the nearby doctor then the BSN-Care server will educate a crisis unit of a medicinal services focus and safely gives the area of the individual.

SECURITY IMPLEMENTATION IN BODY SENSOR NETWORK SETUP

We partition the all security necessities (said above) into two sections: network security, and information security. Organize security involves verification, obscurity, and secure localization. Then again, information security incorporates information privacy, information trustworthiness, and information freshness. Presently, to the best of the information there is no two-party verification convention which can accomplish all the previously mentioned properties of the system security. Thus, so as to accomplish all the system security necessities here we propose a lightweight mysterious validation convention. In this manner, to achieve every one of the information security prerequisites we receive OCB verified encryption mode.

LIGHTWEIGHT ANONYMOUS AUTHENTICATION PROTOCOL

In our BSN-Care framework, when a LPU needs to send the periodical updates to BSN-Care server, then the server needs to affirm the character of LPU utilizing a lightweight anonymous confirmation convention. In this area we depict our unknown confirmation convention in points of interest. Our proposed confirmation convention comprises of two stages: In Phase 1, the BSN-Care server issues security accreditations to a LPU through secure channel, this stage is called enrollment stage. The following period of the proposed validation are protocol is the unknown verification stage, where before information transmission from the LPU to BSN-Care server, both the LPU and the server will verify each other.

Thus, the target of our proposed lightweight confirmation plan is as per the following:

- To accomplish common validation property.
- To accomplish secrecy property.
- To accomplish secure confinement property.
- To annihilation fraud assaults.
- To diminish calculation overhead.

SYSTEM BLOCK DIAGRAM AND DESIGN

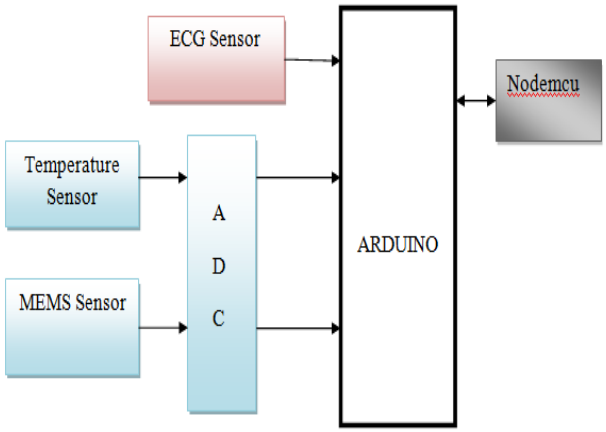

Figure-1. Transmitting node.

TRANSMISSION NODE

The transmission node is divided into four important parts. They are:

a. Sensing unit

b. ADC and interfacing unit

c. IOT

d. Nodemcu

A. Sensing unit

This unit consists of sensors like Temperature sensor, MEMS sensor and ECG sensor which help us in interpreting the conditions of the patient [4]. The sensors instilled here receive inputs from the body of the patient and send them to the microcontroller for further processing and decision making. [5]

The following are the different sensors we used:

a) Temperature Sensor

The LM135 arrangement are exactness, effectively adjusted, incorporated circuit temperature sensors. Working as a 2-terminal zener, the LM135 has a breakdown voltage straightforwardly corresponding to total temperature at 10 mV/°K. With under 1-Ω dynamic impedance, the gadget works over a present scope of 400 µA to 5 mA with for all intents and purposes no adjustment in execution. At the point when adjusted at 25 °C, the LM135 has ordinarily under 1 °C blunder over a 100 °C temperature go. Not at all like different sensors, has LM135 had a straight yield. Applications for the LM135 incorporate any sort of temperature detecting over a -55°C to 150 °C temperature extend. The low impedance and straight yield make interfacing to readout or control hardware are particularly simple. The LM135 works over a -55 °C to 150 °C temperature extend while the LM235 works over a -40 °C to 125 °C temperature go. The LM335 works from -40 °C to 100 °C. The LMx35 gadgets are accessible bundled in hermetic TO transistor bundles while the LM335 is additionally accessible in plastic [6].

b) MEMS sensor

The useful components of MEMS are scaled down structures, sensors, actuators, and micro electronics, the most remarkable components are the microsensors and microactuators. Microsensors and microactuators are properly arranged as "transducers", which are characterized as gadgets that change over vitality starting with one frame then onto the next [7]. On account of microsensors, the gadget ordinarily changes over a deliberate mechanical flag into an electrical flag.

c) ECG sensor

At the point when cell films in the heart depolarize, voltages change and streams stream. Since a human can be viewed as a pack of salt water and as such, a volume conductor changes in potential are transmitted all through the body, and can be measured. At the point when the heart depolarizes, it's advantageous to speak to the electrical action as a dipole a vector between two point charges [8]. Keep in mind that a vector has both a size and a heading. By taking a gander at how the potential differs around the volume conductor, one can get a thought of the heading of the vector. This applies to all intra-cardiovascular occasions, so we can discuss a vector for P waves, the QRS complex, T waves.

B. ADC and interfacing unit

Although we employed digital sensors like Temperature and MEMS, we also require ECG which gives analog output .The problem with this sensor is that it gives a very low output voltage (few mV) [9]. So first we have amplify the output of the ECG to sufficient level because the microcontroller cannot detect such low voltage. So, for it to be detected by the microcontroller we have to amplify the output of the ECG to around 5V. To do this amplification process we used an operational amplifier (IC741) which amplifies the signal and gives output high enough to be able to be detected by the microcontroller. Now we have sufficient analog output.

C. IOT

The trio of embedded systems, sensors and internet allows us to link the physical world with the cyber world expanding internet to internet of things [10]. To increase efficiency of the system and to reduce manual effort, internet of things plays a major role [11]. This paper describes the role of IOT for an effective waste management system. The inability for embedded systems

to network with limited memory has widened the scope for IOT in every field. Not just collecting information but also sensing things and taking action is the main part for IOT. [12]

Figure-2. Establishing a connection link.

The device is the input received from the sensors and gateway along with the cloud is established using MySql. Aim of gateway is to enable devices that are indirectly connected to internet reach the cloud server. Since the data is sequentially received there is a need for cloud storage and the benefit of cloud is two faced, it provides us with enormous space for receiving the data from sensors and also processes the data by combining it with data from other resources. The input information received is put into tables and viewed in the cloud.

D. NODEMCU

Nodemcu is less cost and efficient, easy to use, WI-FI enabled and open source in nature [13]. It basically helps us to prototype our IoT device. A Propelled API for equipped IO which can drastically decrease the repetitive work for designing and controlling equipment. Codes like arduino, yet very intelligently in Lua script.

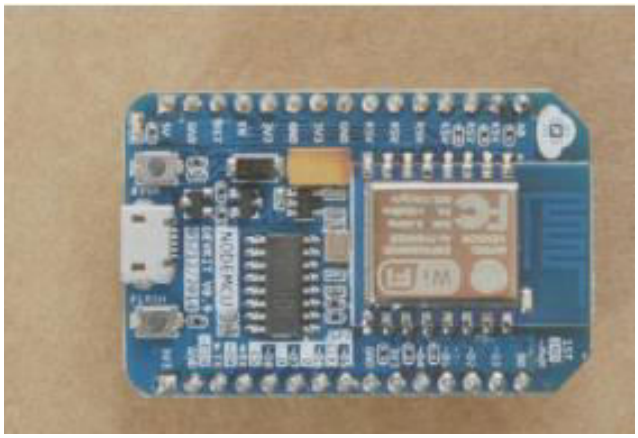

Figure-3. Nodemcu hardware design.

Receiving node

Figure-4. Receiving node.

This consists of a PC/device to view the data uploaded to the cloud server using webpage. The data is dynamically uploaded to the webpage with the help of Nodemcu with the help of Arduino. The data uploaded can only be viewed if the viewing device is connected to internet. Further the data is assessed and if any parameter exceeds its threshold an immediate action is notified to the authorities online. We can expand the project to hundreds of patients which are all connected with the sensors and microcontrollers as specified above and view their status in a website using IoT. This process reduces the physical work and it makes the life of the patients much easier with the help of automating wearable technology.

RESULTS AND DISCUSSIONS

We have collected the status of the patient at different times of the day. The system begins updating the new values to website according to the time interval we give, here it is 1 hour. The conditions of the patient are noted and updated on the cloud server. We have collected the status of the bin at different times of the day. The system begins updating the new values to website according to the time interval we give, here it is 1 hour. The fullness of the bin, presence of harmful gases and weight of the bin is sensed and updated on the cloud server.

Table-1. Real time tracking of body conditions.

S. NO	DATE	TIME STAMP	STATUS
1	11/04/2017	16:43:23	Temp:23 Mems:355 ECG: 78
2	11/04/2017	17:43:23	Temp:24 Mems:354 ECG:79
3	11/04/2017	18:43:23	Temp:24 Mems:356 ECG:78
4	11/04/2017	19:43:23	Temp:24Mems:355 ECG:80
5	11/04/2017	20:43:23	Temp:25 Mems:357 ECG:80
6	11/04/2017	21:43:23	Temp:30 Mems:356 ECG:80
7	11/04/2017	22:43:23	Temp:30 Mems:353 ECG:80
8	11/04/2017	23:43:23	Temp:31 Mems:354 ECG:81
9	12/04/2017	00:43:23	Temp:31 Mems:351 ECG:81
10	12/04/2017	01:43:23	Temp:31 Mems:356 ECG:82
11	12/04/2017	02:43:23	Temp:31 Mems:355 ECG:83

As we can see from the table below the status is being updated time to time. First column contains serial numbers, second column consists of date, third column has time stamp and fourth column has the status of the bin in which 'Temp' implies the temperature and 'MEMS' implies the positional values and ECG implies its own value. As we see the last column all the values keep increasing supposing the situation that the patient has body temperature and high heart beat rate. The table is created in the webpage and data is stored in the cloud. In this way the data is automatically stored and processed for optimizing the waste collection process. MEMS sensor in this particular project shows an average of the three coordinates X, Y and Z axes.

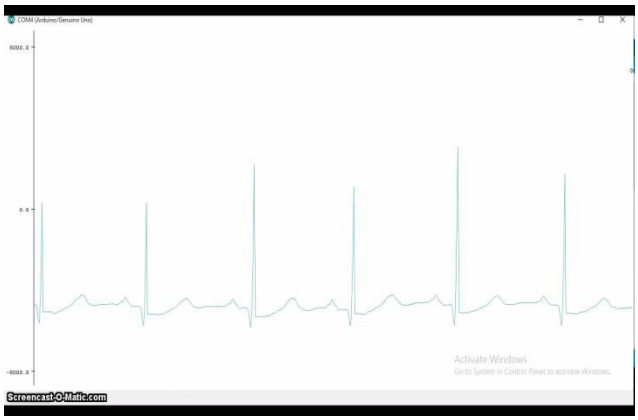

Figure-5. ECG output graph.

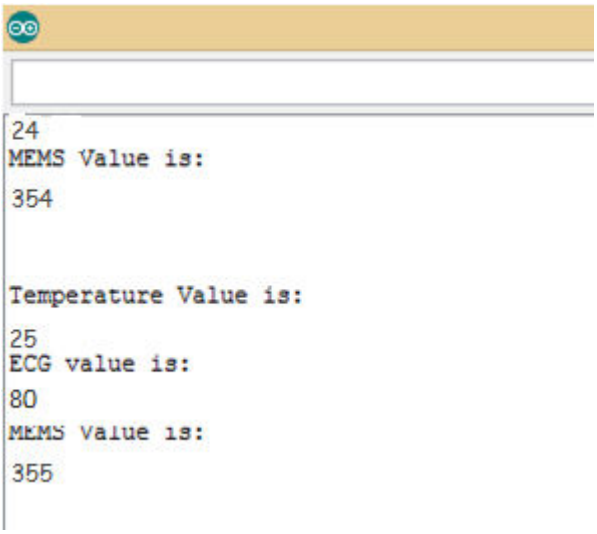

Figure-6. Arduino embedded output of sensors.

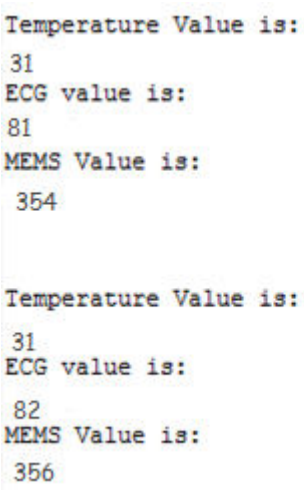

Figure-7. Arduino embedded output of sensors.

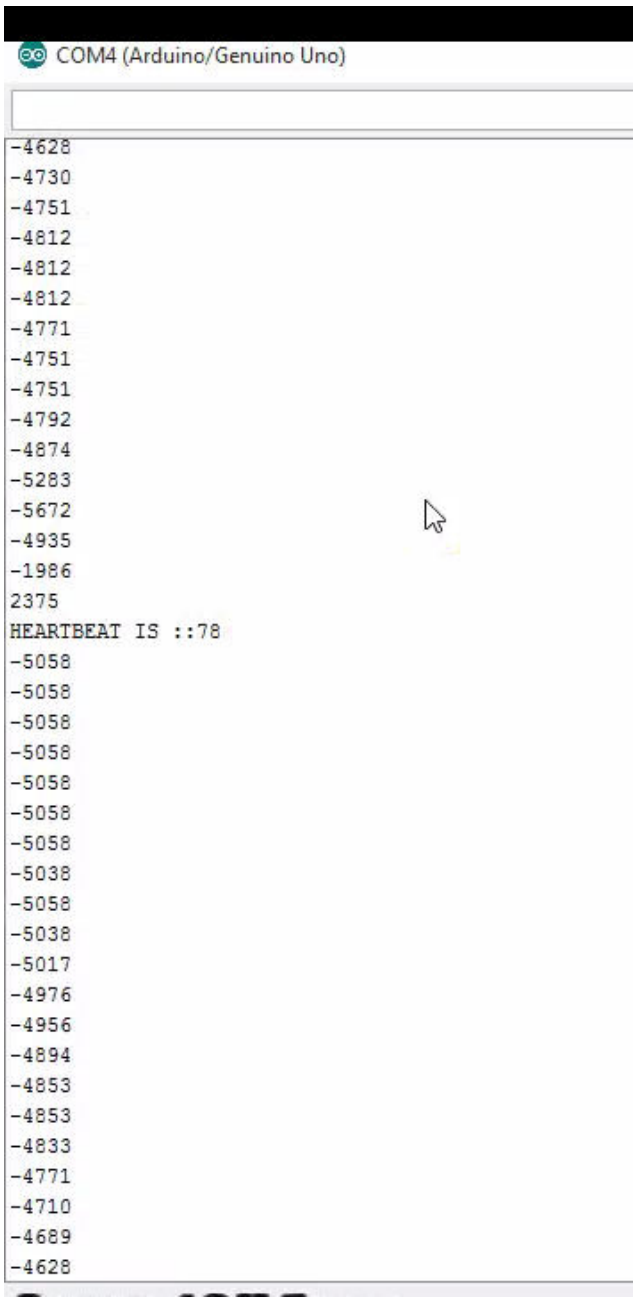

Figure-8. ECG value which shows heartbeat value.

CONCLUSIONS

In this article, at first we have portrayed the security and the protection issues in social insurance applications utilizing body sensor arrange (BSN). Thus, we found that despite the fact that the majority of the well known BSN based research ventures recognize the issue of the security; however they neglect to install solid security benefits that could be safeguard tolerant protection. At long last, we proposed a protected IoT based social insurance framework utilizing BSN, called BSN-Care, which can proficiently finish different security necessities of the BSN based medicinal services framework.

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