

# Implementing Context Awareness in Health Monitoring System

Sonia Suddala, Satyannarayana Penke, Krishnaveni Kommuri

**Abstract:** The medicinal fields brings out the solving for effective patient monitoring system at reduced cost and also reduces the communication between patient outcome and disease management. The context awareness is a feature of mobile devices that describe the complementary to location awareness and determine its environment at any given time and adapt behaviors accordingly, the context-aware computing has proven to be successful in understanding sensor data. However in order to add value to raw sensor data we need to understand it. Some of the applications of IoT is smart parking, smart homes, smart city etc. One of the most application in IoT health monitoring system. In this paper I am implementing the context awareness with in health monitoring system by using two sensors, body temperature and Galvanic skin response (GSR).

**Keywords:** Health Monitoring System, GSR, Body temperature.

## I. INTRODUCTION

Advanced information and communication technologies, offering anywhere and anytime Connectivity, play a key role in the development of a modern healthcare systems [1] Now a days, the health care sensors playing an essential role in hospitals. The patient monitoring system is one of the major developments. Medical equipment's more efficient by allowing real time monitoring of patient health. A wireless health monitoring system is used to check patient's condition by using embedded technology. More than urban areas, rural communities depend on a system of small clinics and health centers to provide primary care services. It will reduce the human error, cost, tradeoff between patient outcome and disease management. Various online systems for monitoring and collecting patient data exist nowadays. This kind of solutions is very useful especially when a treatment includes monitoring of some vital parameters for long period of time [2]. By this health monitoring system monitor about the patient body temperature and GSR (galvanic skin response). There is the difference in body temperature to person to person. By some survey almost 35,500 people has the less temperature in older adults. They found the some medicinal conditions can overcome a body temperature. For an example, people with hypothyroidism they will have lower temperature, the people with cancer has the high temperature. The surrounding of the brain is known as hypothalamus order

body temperature. The hypothalamus bang into order the body temperature has the above or below the 37<sup>o</sup> F. It will forward the signal to the hypothalamus to make shiver the body, to warms the body. If the patient body is very hot it will forward message to start sweating then it will leave the heat body. A fever creates as the common way of responding to the infection. 98.6<sup>o</sup> F is the normal body temperature in adults; it will be based on the person sex, physical activity & age. The temperature wills various throughout the 24hrs. If the body temperature was >100<sup>o</sup> F then we consider as high fever. The body temperature values with varies provide on the place where the person takes the measurement like oral, rectal etc. [3]

One of the fundamental systems in medicine is the monitoring system that can help the medical checkup do the diagnosis for the data collection[4] Providing healthcare services is very important for people specially who have and being suffering from chronic diseases. Those people need continuous healthcare which cannot be provided outside hospitals. There are a variety of technologies, so to get benefits from connecting such technologies to build a new e-health system platform help to achieve high quality health care services. There are many reasons which motivate us to build this platform

- (1) Performing healthcare more accessible for people who do not have access to healthcare providers in their communities
- (2) Building healthcare easier for people who do not have access to public transportation in order to go to hospitals
- (3) Increasing bed capacity in hospitals, especially during public events where a large number of people are meeting in one place
- (4) Allowing medical staff more times to be attentive to patients who need more care
- (5) Avoid delays in the arrival of patients' medical information to the healthcare providers, particularly in accident and emergency situations
- (6) Decreasing manual data entry for patients' data which prevents real-time monitoring and restricts medical staff to monitor their patients efficiently. Constant monitoring the wearable sensors like body temperature, heart beat are the main body specifications. If the body temperature values would cross beyond the limit. Then it would compulsorily alter the information to the doctor. Continuous monitoring helps Doctor-patient efficiency [5] although many wireless standards can be used, there are important considerations such as range, throughput, security, ease of implementation and cost. The patient monitoring involves handling of sensitive data. These data should be transmitted securely without any intrusion [6].

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## II. RELATED WORK

The body temperature readings vary depending on where on the body of the person takes the measurement. There are 4 types to measure the body temperature.

1. Oral
2. Rectal(it is used to check the children temperature below 5 years)
3. Armpit(under the arm)
4. Ear

To check the body temperature we check in oral (under the tongue).The body temperature for normal person is around 98.6 (37 in degree Celsius)

The normal temperature in babies (0-2) years -----95.9-99.5 f (35.5-37.5 in degree Celsius)

The normal temperature in children (3-10) years -----95.90-99.5 f (35.5-37.5 in degree Celsius)

The normal temperature for adults (11-65) years -----97.6-99.6 f (36.4-37.6 in degree Celsius)

The normal temperature for over 65 years -----96.4-98.5 f (35.8-36.9 in degree Celsius)

In rectal, armpit and ear have the different ranges of body temperature.

The height of the body temperature indicates the type of problem.

- Low grade fever-----100.5-102.1 f (38.1-39 c)
- Moderate fever-----102.2-104.0 f(39.1-40 c)
- High fever-----104.1-106.0 f(40.1-41.1 c)

The body temperature was slightly high compared to the men (less than 65 years).The body temperature varies based on age, sex, physical activity, and health. Based on the above data the fever has the various types depend on the body temperature.

If to continue a stable body temperature, the person body temperature is to be able to answer to change in the surrendering areas temperature. Based on the outdoor temperature the skin body temperature change and correspond or connect it to the hypothalamus. The hot weather is regulate to the blood and separated to the whole body. And the body deed to maintain its heat, if the blood will pass near the body surface with low blood then the body skin will turn into cold & pale. In some conditions it turns into a bluish colour, the colour change occurs in the blood when the blood was running slow, less oxygen compare to usual.

Brain resemble muscular activity which discharge heat activity that production heat is a form of shivering. If the outdoor temperature increases then the body temperature also increases. Sweat glands discharged the sweat and it will evaporate, the skin is refreshing. Heat is also defeat by the melting in the lungs. This process is increased by panting. The vessels of this system form a network just under the skin. When these vessels dilate, they allow more warm blood from the interior of the body to flow through them, here it is cooled by the surrounding air [7]. Body temperature generally oscillates over the day, follows to biorhythm with the lower elevation in over 4am and the above in the late post-meridian in between 4:00pm & 6:00pm. If the oral temperature is 37.3<sup>0</sup> C for a normal active temperature in

post-meridian but not in the early mornings. The body temperature will change by about 0.5<sup>0</sup> C (0.9<sup>0</sup> F) to one person to another person in between its high to low levels of each day. Many hormones the body temperature is delicate. So, ladies have a body temperature rhythm that changes with menstrual cycle is known as Circannual rhythm.

Woman's body temperature rises fall after ovulation, these changes to find when a woman has ovulated in order to annals or hide the pregnancy during the luteal phase of that cycle, both the lower and the moderate body temperatures are marginally higher than during alternative parts of the cycle. The body temperature was increases during the fever it will varies every day and it is somewhat lower than usual body temperature. So the body temperature of everyday is not very much above than usual. Based on the surroundings temperature and based on the period of time also body temperature wills varies. This cycle is known as Circannual rhythm [8].

More outdoor factors disturb the consistent temperature regular values are commonly given for an alternatively healthy. The body temperature is expanded after taking food or drinking anything. If the person was loss-weight diet reduction complete body temperature. Taking alcoholic reduces the load of everyday difference, marginally decreasing day-light temperature and noticeable elevate night-light temperature. And if the person as doing the body exercise then it will also rises the body temperature [7].

### 1.1 Biosensors:

The Biosensor is used to identify the analyst, the biosensor is an analytical gadget & it will gathers the organic factor with physicochemical identifier. The detected components convert the signals from the attachment of analyse with the biological elements into alternative signals like transducer. It can be consistent more freely and capable. The biosensor equipment are correlated with electronic components and the noticeable processors and it is used for revel the results and they are convenient. The sensor has an important role in the growth of modernized electronics. A biosensor is an interpretive device. The biosensor which coordinates the organic elements with the physiochemical transducer to production and signal is prepotence to an individual analyte and which is felted into a detector [9].

#### 1.1.1 Types of Biosensors:

Based on the sensor devices and organic materials there are peculiar biosensors. They are:

1. Electrochemical Biosensor
2. Amperometric Biosensor
3. Blood Glucose Biosensor
4. Potentiometric Biosensor
5. Conduct Metric Biosensor
6. Thermometric Biosensor
7. Optical Biosensor
8. Fiber Optic Lactate Biosensor

- 9. Optical Biosensors for Blood Glucose
- 10. Piezoelectric Biosensors
- 11. Immuno-Biosensors [10]

The vitro and vivo system are normally motorized as biosensors in medicinal fields. In vitro, biosensor density takes part in artificial insemination, cultured dish, micro titer plate (or) where else outside a living organism. In this the bioreceptor and transducer sensor used. The enzyme conduct metric biosensor is example for vitro biosensor. The enzyme-conduct metric is used for monitoring blood glucose. The illumination of lab examination can so reduce the time and money. The biosensor of POCT can be used for testing HIV in surrounding where it is problematic for patients to be proved. The biosensor will send straightly to the locale and an immediate and simple test can be used. The vivo biosensor is an implantable material that work inside the body. In order to escape an initials incensing response on biosensor have to fulfill the astricts adjustment. The glucose biosensor is the familiar example for an economic biosensor which benefits. The enzyme glucose oxidize to cut glucose less the first oxidize glucose and usage of two electrons to lower the FAD to FADH2. This in change is corrode by the electrode in a different steps the proceed current is a part of the establish of the electrode is the transfers and the enzyme is the biologically effective composing.

There is new technology of biosensors in the medicinal development. The biosensors are axiomatically and continuously allowance clinics suitable vitals. The biosensor gathers the information from heart rate, body temperature, skin response, respiration. These collected data is too linked with clinical agreement support software appliance. This has the limits to configure. And it has an improper values inform the specialist to allow them to take the proper action. As comparison to the long before years there is no medicine for the disease like jaundice, cancer etc....but now a days it has the medicine and good treatment regarding the every disease to the people. We have everywhere hospitals and healthcare services increasing every year [9].

**1.2 Arduino:**

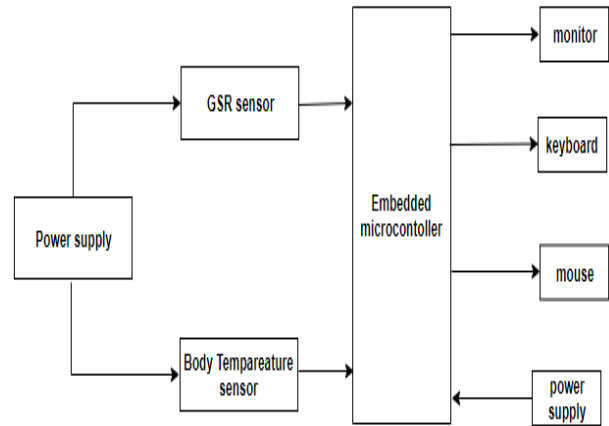
Arduino is an open space hardware and software association. They are accomplishment the single board microcontrollers and microcontroller apparatus are used for construction digital equipment and bilateral objects that can sensibility and handle both physical and digital. This devices lice's under the GNU LGPL or GNU GPL, allowing the making of Arduino boards and software marketing by anyone. The Arduino boards are convenient in the form of DIY kits. Arduino uses the different types of microcontrollers. It has the digital and analog I/O pins. It can be combining to different breadboards. It also has the USB port on some models. It can load the program through computers. It has the programming languages C & C++. The Arduino project design an IDE based on the processing language [11]

**1.3 ESP8266 NodeMCU:**

NodeMCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espress if Systems, and hardware which is based on the ESP-12 module. The term "NodeMCU" by default refers to the firmware rather than the development kits. The firmware uses the Lua scripting language. It is based on the eLua

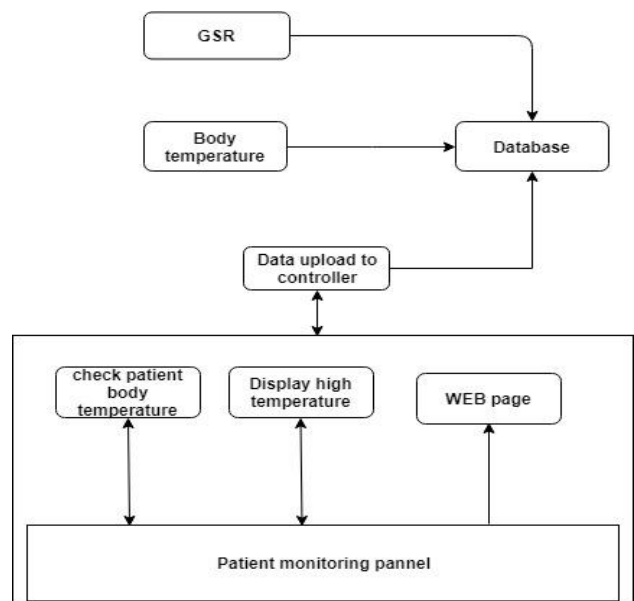
project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open sources. Projects, such as lua-cjson and SPIFFS. Connecting DHT11/DHT22/AM2302 sensor to ESP8266 NodeMCU is fairly simple. Start by placing the NodeMCU on to your breadboard, ensuring each side of the board is on a separate side of the breadboard.

**III. Proposed work**



**Fig1: block diagram of H-Signal**

The above block diagram represents the hardware to dump the values of the body temperature from the software simulation. It has the power supply from that to its was connected to sensors GSR (galvanic skin response) sensor and body temperature sensor. Then that value from sensors are connected to the embedded microcontroller to display the output. And the mouse, power supply, keyboard, monitor was connected to Embedded microcontroller.



**Fig2: Block daigarm of patient monitoring**





# Implementing Context Awareness in Health Monitoring System

In the above block diagram the body temperature values and GSR(galvanic skin response)are store in the database. And from the data base it will upload to the database upload to arduino from that to patient monitoring panel. From that it will displays the patient body temperature and displays the high temperature in the webpage

TYPE OF READING	BODY TEMPERATURE IN FAHERENHEIT	DISEASE	SYMPTOMS	TEST
oral	105.8 – 107.6 f	Malaria	Headache Muscle aches Tiredness Vomiting, it is upto 10-15 days	Molecular test Antibody test Blood test Drug resistance test
	102.02- 104 f	Typhoid	Fever Rash Weakness Abdominal pain Headaches, it is between 3- 30 days after exposure to the bacteria	Blood test Urine test
	102.02-105.08 f	dengue	Fever Painful muscle Joint aches Headache Pain behind the eyes Vomiting skin rash, it is upto 3 to 15 days	Dengue NS1 antigen test  Dengue IgM/IgG serological test
	Beyond 100 f	Chicken pox	Fever Small red bumps Tiredness Loss of appetite Headache Skin rash Body pains, it was up to 3-6 days(for children)	Rash examination  Blood test  Viral culture
	Less than 95 f	Malignant hyperthermia	Shivering Slow shallow breathing Very low energy Weak pulse Bright red cold skin	Muscle biopsy test  Blood test  Physical test
	100 f	Swine flu	Cough Fever Sore throat Headache Body pains Chills Runny nose	Blood test

		problem	
	68-104 f	Abdominal cramping Vomiting Fever Chills illness	testing of stool, wound, or blood specimens
	Above 106.0 f	Increased thirst, Extreme sweating dizziness, Muscle cramps Weakness, Light headedness	Blood test

Table1: body temperature with symptoms

## 2.1 HYPOTHERMIA:

- It is defined as a body core temperature bellow 35.0 c
- Shivering & mental distraction are occurs in mild hypothermia.
- In moderate hypothermia there is shivering stops and confusion increases.
- In severe hypothermia there may be a paradoxical undressing.

➤ Chills: feelings of coldness accompanied by shivering

➤ Paradoxical dressing: person removes their clothing

## 2.2 VIBRIO:

- Usually associated with undercooked seafood.

## 2.3 HYPERPYREXIA:

- In some cases, your body temperature can rise greatly above its normal temperature due to things other than fever.
- This is referred to as hyperthermia.

➤ When your body temperature exceeds 106°F (41.1°C) due to a fever, you're considered to have hyperpyrexia.

## 2.4 SWINE FLU:

➤ Swine Influenza (swine flu) is a respiratory disease of pigs caused by type an influenza virus.

➤ Swine flu viruses do not usually infect humans, but rare human infections have occurred.

➤ But most outbreaks occur during the late fall and winter months similar to outbreaks in humans.

## IV. SIMULATION

Firstly, taken the some peoples body temperature values and GSR (galvanic skin response) values. By that values plotted the graph between the body temperature and GSR values on x axis- time and y axis- GSR values.

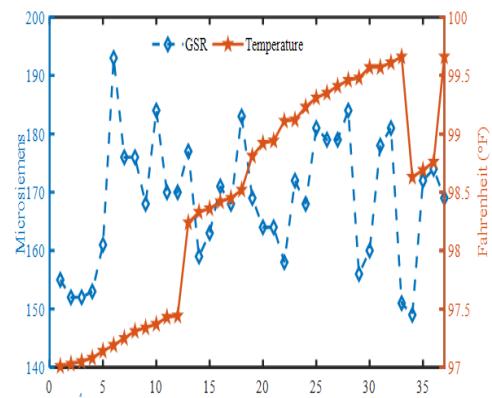


Fig3: Temperature skin response values simulation scale1

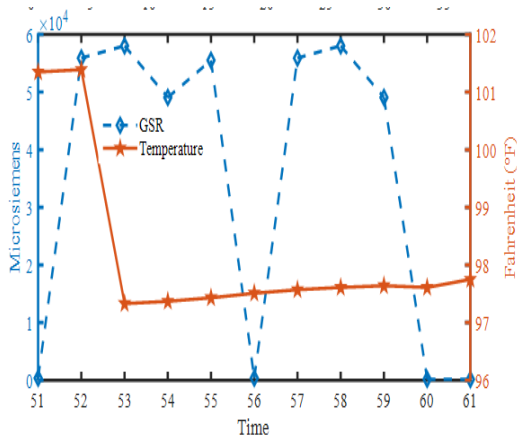


Fig4: Temperature skin response values simulation scale2

By the Arduino software, track the values for different age groups of people. The temperature values are measured in Celsius units. The GSR values are measured in micro-Siemens units. After that, that values are simulated in the Matlab Software. The graph had been generated. There are different types of vital signs like body temperature, blood pressure, heart beat, GSR etc. But the most common sign used to check the person health is body temperature. The normal temperature for person is 97 to 99 degree Fahrenheit. By some survey I had found the different types of Persons body temperature. I had plotted the body temperature among the normal person, blood pressure person, sugar person and allergy person.

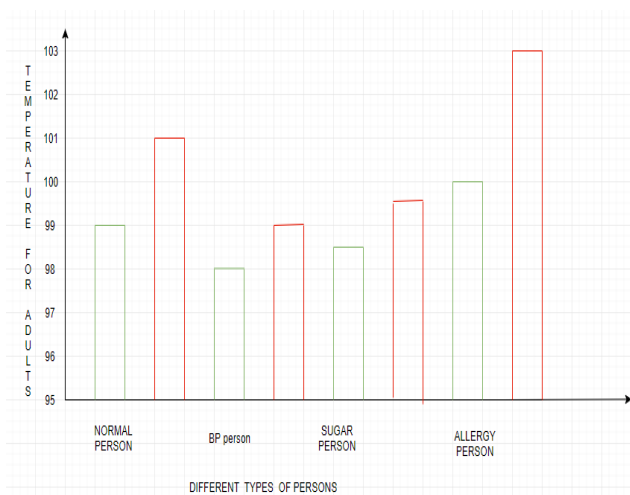


Fig5: temperature values for different persons

By this above graph we can tell that body temperature values for the different persons. The normal person has the body temperature up to 99 degree Fahrenheit and if it will goes beyond the temperature was 101degree Fahrenheit. For the BP person the body temperature is 98 degree Fahrenheit and if it cross beyond the normal temperature then it will rises up to 99 degree Fahrenheit. The sugar person body temperature is 98.7 degree Fahrenheit if it's beyond it rises up to 99.6 degree Fahrenheit. The allergy person has the body temperature is 100 degree Fahrenheit if it beyond the normal temperature it has 103 degree Fahrenheit. By this graph, we can tell how the person body temperature. If it was beyond

the temperature then doctor can take action for that particular person the doctor will get message alert if the body temperature was beyond values by the dash board. By this we can implement the context awareness.

Next actually collected some peoples body temperature data and store in the excel sheet, then python software to display the body temperature values above 100. After converted the excel file to CSV file then run the code then the values displayed as below.

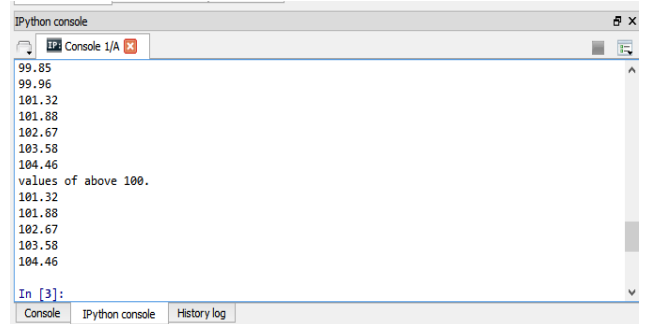


Fig6: body temperature values above 100

Next, taken the patient body temperature values for every 1 hour and then I just created the database by using MYSQL software. By this I can retrieve the data to create the webpage from MYSQL

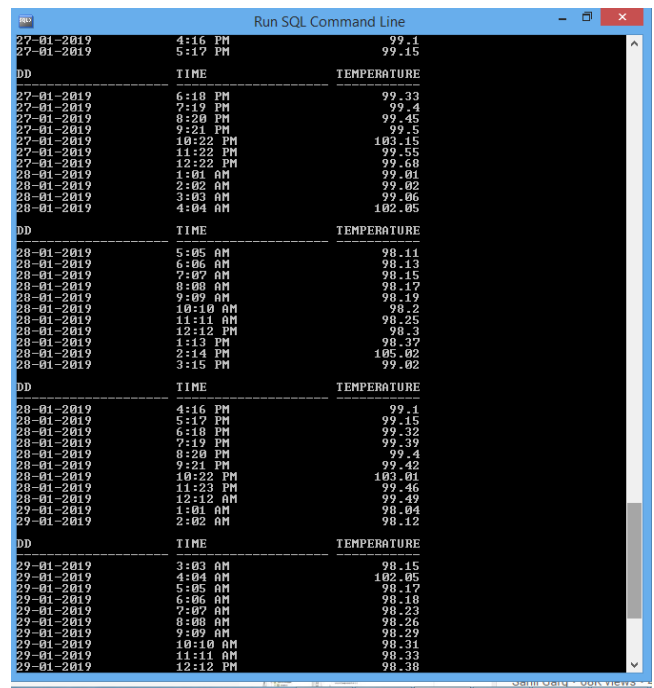
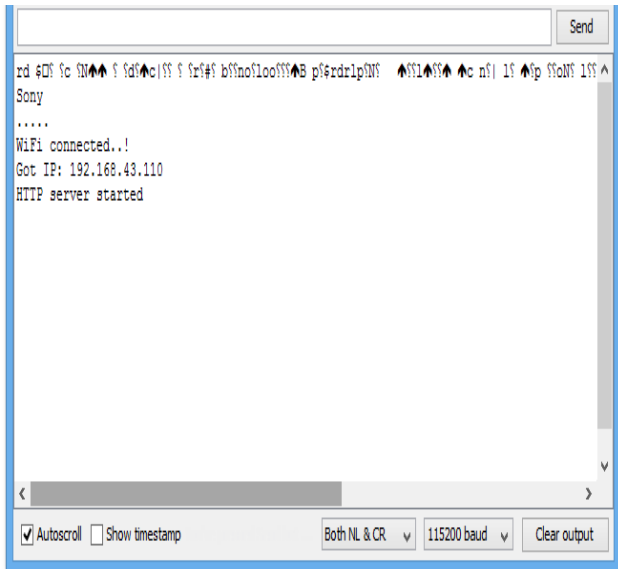


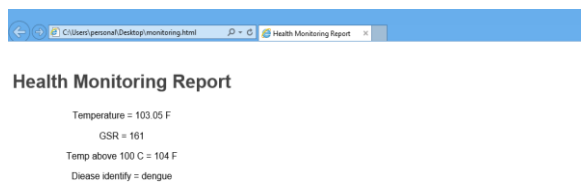
Fig7: database values

by using the Arduino software we had written the code in that and dump the code in NODEMCU module and run the program and then open the COM5 port then it will displays the http IP address to open the webpage , if u run the http IP address it will displays the webpage like has given below.





**Fig8: http code for webpage**



**Fig10: Dashboard of patient monitoring system**

### 3.1 HARDWARE:

Connecting DHT11/DHT22/AM2302 sensor to ESP8266 NodeMCU is fairly simple. On the breadboard now place the sensor on to your breadboard besides NodeMCU. Connect VCC pin on the sensor to the 3.3V pin on the NodeMCU and ground to ground. Also connect Data pin on the sensor to D8 pin of the ESP8266 NodeMCU. Finally, we need to place a pull-up resistor of 10KΩ between VCC and data line to keep it HIGH for proper communication between sensor and NodeMCU. If you happen to have a breakout board of the sensor, you need not add any external pull-up. It comes with a built-in pull-up resistor.

### 3.2 H-signals:

H-signals is known as the health signals. The H-signals is an improvement floor for medical devices and H-application. The H-signals is to create your H-signals web. It is to allow measuring the 20 types of biometric signals such as heart rate, oxygen in blood, pulse, breath rate etc. All these collected data by the H-signals is encrusted and send to the user's confidential account. This collected data can be displays in a tablet or smart phone. It consists of hardware and software kit. The labellum action two various API's for planners to approach the data. The Android / IOS API grant to get data directly from H-Signals using Bluetooth Low Energy (BLE).

The Cloud API grant to access to the user's confidential account and get the information previous stored to be create in a third party floor [12].

### V. FUTURE WORK

To identify more diseases by measuring the body temperature. And to send the automatically information to the webpage.

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