Smart Health Monitoring System for elderly people Using IBM Cloud

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Introduction

1.1 Overview

The world of medical science is an emerging area that has accelerated with new technologies and this is the time when the vision of "The Internet of Things" has turned into reality. IoT can play a significant role in healthcare domain by managing chronic diseases at one end as well as preventing diseases on the other hand.

The "Internet of Things"- IoT is a concept and model consisting of sensors, actuators, and development boards interacting with each other connected over the internet without any human intervention resulting into a more intelligent system. The main principle of Internet of Things (IOT) is that the objects/things i.e. sensor nodes identify, sense and process and communicate with each other. IoT has a substantial influence in healthcare domain.

Still, there are so many people who do not have access to quality healthcare services, thus remote patient monitoring becomes a need. Presently, Healthcare system is shattered with the lack of communication between the patients and the doctors. Healthcare services can be improved a lot with IoT-enabled healthcare devices. By applying IoT concepts in healthcare, there is a great possibility of virtually saving the lives. E-health solutions based on IoT should provide worth information about health to the patients and the doctors can make better decisions irrespective of the patient's position.

1.2 Purpose

People demand more care at reduced clinical costs, remote health monitoring(using IoT) is one of the possible solutions to this demand. Remote health monitoring can be best utilized provided if the device is wearable.

This project aims to develop a Smart Health Monitoring System with the Internet of Things(IoT). The health monitroing system proposed focuses on healthcare domain of IoT. We can provide good healthcare support to the people especially senior citizens at their homes with the intervention of latest technologies like IoT.

In this project, we propose a system for monitoring of Body temperature, pulse rate and blood pressure(vital body parameters) of the person using IoT and IBM Cloud. Remote Health monitoring is attained by storing the collected data to IBM cloud. The temperature, pulse rates and blood pressure at different instants are measured by the sensors and the readings are shown in the form of graphs at IBM Watson IoT platform.

2.LITERATURE SURVEY

2.1 Existing Problem

Today's hospital personnel are working in crowded hospitals with a tight time schedule. Their work includes diagnosing patients, giving the patient the correct treatment, keeping track of treatments given and also quite a lot of administrative work like updating the patients' medical record.

A lot of concerns could be brought up when designing a system that is supposed to be able to handle sensitive data (like medical records). Due to this the following questions are asked:

- Will a system, where devices are interconnected to each other and to a patient's medical records, be more efficient than today's ways of noting down a patient's data?
- Will an efficient medical-records-system help reduce the amount of mistreatment caused due to human error?
- Can a more efficient medical-records-system improve treatments to patients?
- Could enough reliability be insured for this kind of device to be used in a medical environment?

Efficiency becomes an even more important factor in a society with a growing population. Whenever humans are involved there is always a possibility for human errors, and this especially in hectic and stressful situations. Mistreatment can easily happen and these can be caused by misreading medical records, writing down wrong values.

2.2 Proposed Solution

Our goal is to design and develop a system that would connect different devices with each other and enable a flow of communication from one device to another. The criteria can be generalized as follows:

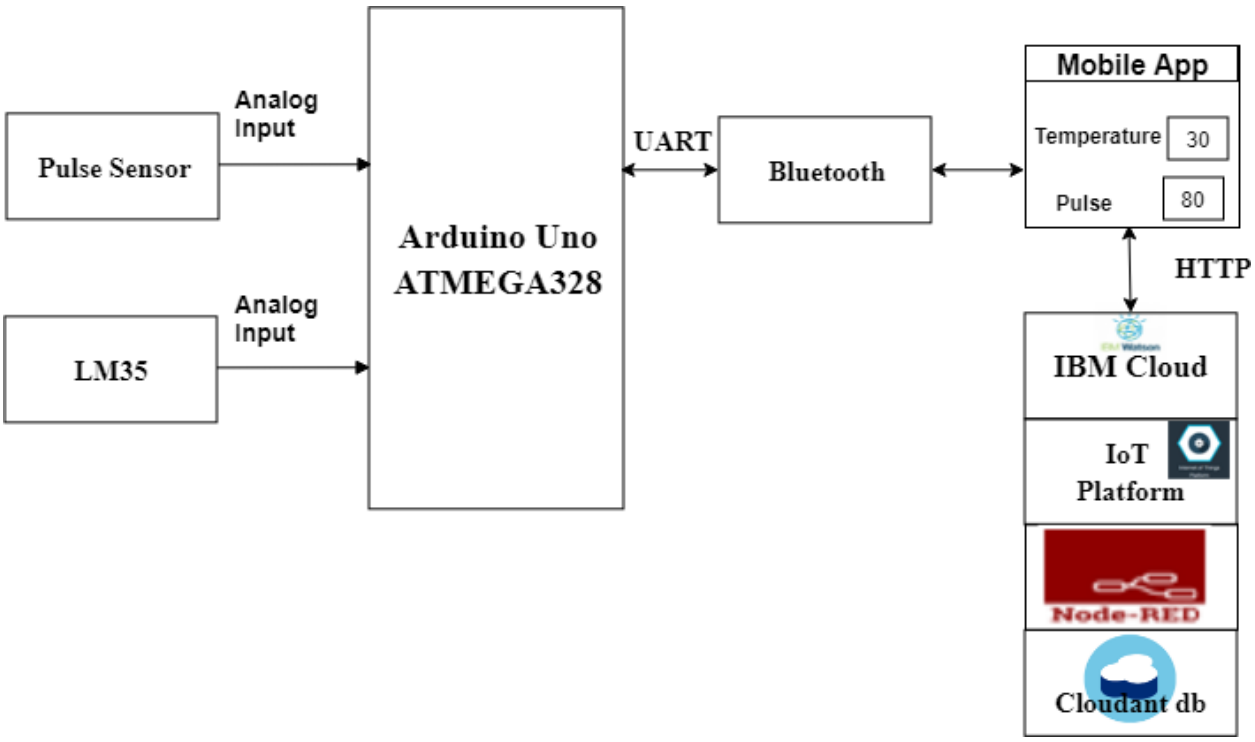
- The proposed system had to be integrated with Node-Red (NR)
- It must be able to output data with a http request
- It should be ease to use/user friendly
- It must consist of cheap hardware
- The proposed system had to be flexible/scalable

One of the main requirements was that NR had to be used to handle the flow of communication between devices. Also NR seemed like a suitable interface for the project allowing for easy configuration, scalability and also a user friendly interface.

The other two important requirements were that the proposed system had to be user friendly and be able to handle http communication. This means that the resulting system needs to be easy to use, intuitive and preferably fast. The importance of http communications is because it is vital for its functionality to be able to update patients' medical records.

3.THEORTICAL ANALYSIS

3.1 Block Diagram



The proposed system is composed of several connecting parts on both a hardware level and on a software level. This block diagram shows how a hardware and software are integrated together to develop a real-time application.

The person is equipped with a wearable device in favour of monitoring his/her temperature levels, heart rate and blood pressure. The pulse sensor is integrated with the Arduino UNO board which senses the pulse and gives the input in the form of analog input. Similarly, the LM35 sensor takes the temperature value of a human body and gives it to the hardware. the Arduino board is connected with the Bluetooth as a medium of connectivity and then it is integarted with the Mobile App. The mobile app would show the values sensed by the sensors. Since, we won't be using the hardware, we will be integrating it with the IBM Cloud and establish a flow using the IoT paltform and Node red services.

3.2 Hardware/Software Designing

Instead of using the Arduino board to sense the values and send it to the IBM cloud, we here have integrated a python code with IBM IoT platform which would generate real time random values for us. In the python, we'd be entering the IBM Watson device credentials to integrate it with the cloud. Using some modules such as ibmiotf we'd be using the required codes to set up the device.

On the software side, NR is to be used. This is probably the heart of the project. It is through NR that all the integration between devices and external parts will occur. Node-Red (NR) is an open source graphical-browser-based tool for wiring Internet of Things (IOT) developed by IBM Emerging Technologies. NR was developed due to the realization that today, many IOT devices often tend to interact with their close and/or distant environment. Having a device interact with other hardware devices, online services or even accessing its own serial port used to require a lot of time writing code just to enable communication between these media.

NR offers a palette of nodes that can be wired together into a sequence and create flows. A node gets triggered and executed when input arrives. The input contains a JavaScript object and carrying the payload-parameter. The payload is usually connected to msg as a parameter holder.

Designing:

An IBM IoT.in node is used to extract the values from the IBM IoT device for for which they both are integrated using the device credentials. An API key is generated which is entered as an authentication to the input node. Three functions are taken each for the parameters temperature, heart rate and blood pressure setting the values globally getting from the hardware and thus displaying it. Three gauges are also connected to each of them so as to obtain a graphical representation of the parameters with the minmum and maximum ranges.

A debug node is connected to obtain the messages in the debug column. To get the data being displayed, HTTP protocol has been used. A http.get and http.response node has been placed to get an url and post it in a new website. A function which links both of them displaying in whichever format a person wishes(here, we've used the json{} format).

A mobile application has also been created to view the data and simultaneously operate it. To create the mobile application, MIT App Inventor has been used since it is hassle free and user-friendly. To integrate with the mobile app, a web url is being linked. An IBM out node is used to collect the data and send. To control the application(device), two buttons have also being created to power ON and OFF the device using the command url and it is being fed to the MIT App while designing.

4.EXPERIMENTAL INVESTIGATIONS

To see if our project lived up to our expectations, we comapred the sytem with the criterias it had to meet in the beginning.

1) Integration with Node-Red and handling the HTTP request and communication was fulfilled since we used NR for the routing of data between devices and we also used HTTP-Requests to handle communication with distant servers to send data.

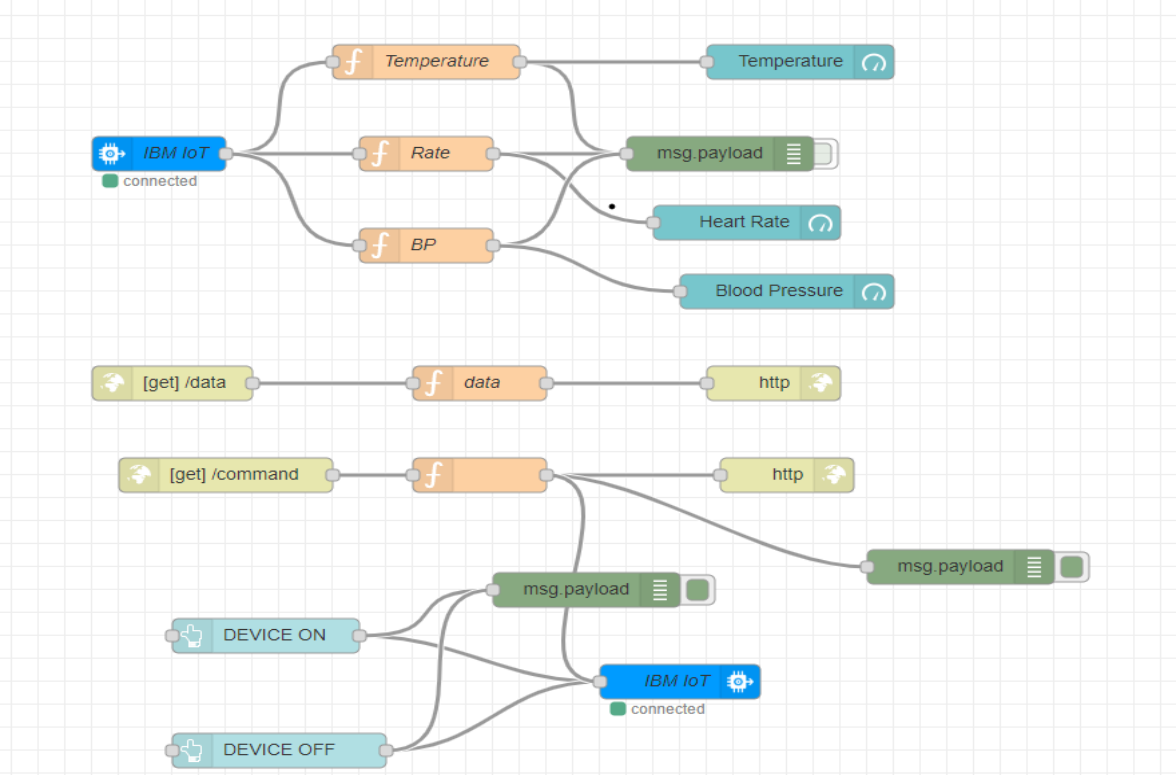
2) We found our system to be both user friendly and intuitive. This is because there are no major configurations that needs to be done to be able to use it.

3)All the necessary information were displayed on the screen and one selects application by tapping the screen(provided that the touchscreen is used).

4) We were able to use the system in different scenerios with minor changes to no changes to the system.

5)The scalability factor means that one should be able to connect to several external devices and collect information from them simultaneously. This is where the systems fall a bit short which could be worked upon.

5.FLOWCHART



6.RESULT

As the title says, the Smart Health monitoring system is of extreme use to patients and doctors as well. The patient can check their health status anytime from the comfort of their homes and visit hospitals only when they really need to. This can be done by using our system whose results are brought online and can be seen anywhere around the world. Since, it is a prototype model, our sytem shows the almost real time values of various health paramters and emulates how the same can be implemented in the real world. The doctors can also use the log of the patient body condition to study and determine the effect of medicine or other such things.

7.ADVANTAGES AND DISADVANTAGES

Adavantages:

- IoT monitoring proves really helpful when we need to monitor and record and keep track of changes in the health parameters of the patient over a period of time. So, we can have the database of these changes in the health parameters.Doctors can take the reference of these changes or the history of the patient while suggesting the treatment or medicines to them.
- Hospital visits for routine checkups are minimized.
- Smart sensors analyze health conditions, lifestyle choices and the environment and recommend preventive measures, which will reduce the occurence of diseases and acute states.

Disadvantages:

- Security and privacy: Security and privacy remain a major concern deterring users from using IoT technology for medical purposes, as healthcare monitoring solutions have the potential to be hacked pr breached.
- Risk of failure: Failure or bugs in the hardware or even power failure can impact the performance of sensors and connected equipment placing healthcare operations.

8.APPLICATIONS

This monitoring system can be used at various places and situations according to the need. If there's a sudden ailment like a person faints or such, the sensors can be connected to that body and immediately his temperature and pulse rate can be known and according medicines could be given to him/her instead of waiting for a doctor to arrive and check him/her.

In general, IoT can be used for a lot more applications like Symptom-tracking apps that send responses to cancer treatment to the physician and which can avoid hospitalization. Remote temperature monitoring ensuring the correct transportation and storage of vaccines. Healthcare IT solutions that remind patients to refill medication and digestible sensors that trigger a notification if the medication hasn't been taken on time.

Continuous Glucose monitors(CGM) and smart insulin pens that record and recommend the time and the amount of insulin dose injection which come to the rescue to diabetics.

9.CONCLUSION

Hence, a prototype for the Smart Health Monitoring System using IBM IoT has been built successfully. many advancements and further changes can be made to it.

10.FUTURE SCOPE

According to a Business Insider report, the market for IoT Healthcare technologymwill rise to $400 billion by 2022. Such growth will be due to the increasing demand and the growing acceptance of healthcare IT software. The plans of Tech giants liek Apple, Google and Samsung to invest in bridging the gap between fitness tracking and actual medical care sure to contribute to the process too.

Despite th edownsides, further digital tranformation in healthcare is inevitabel and th econcept of IoT will continue to capture and change the landscape of healthcare services. Thus, ot seems to be high time to ook beyond the challenges and embark on the journey to connected healthcare devices.

11.BIBLIOGRAPHY

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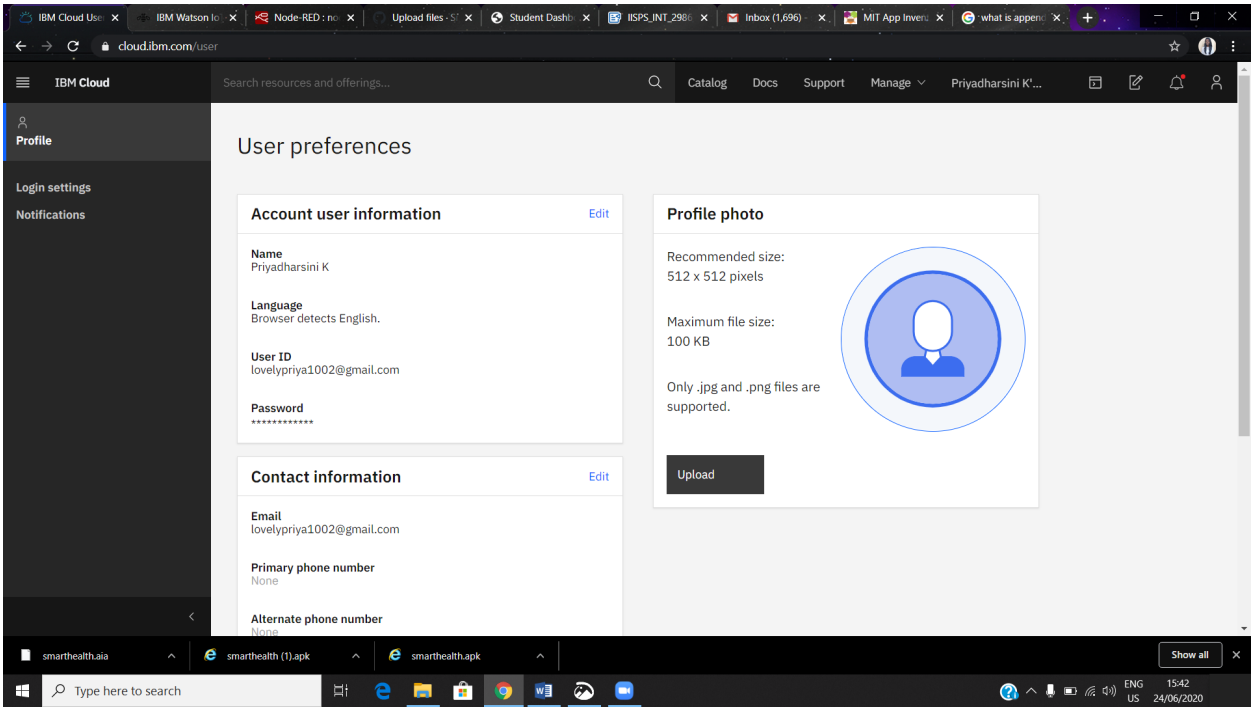
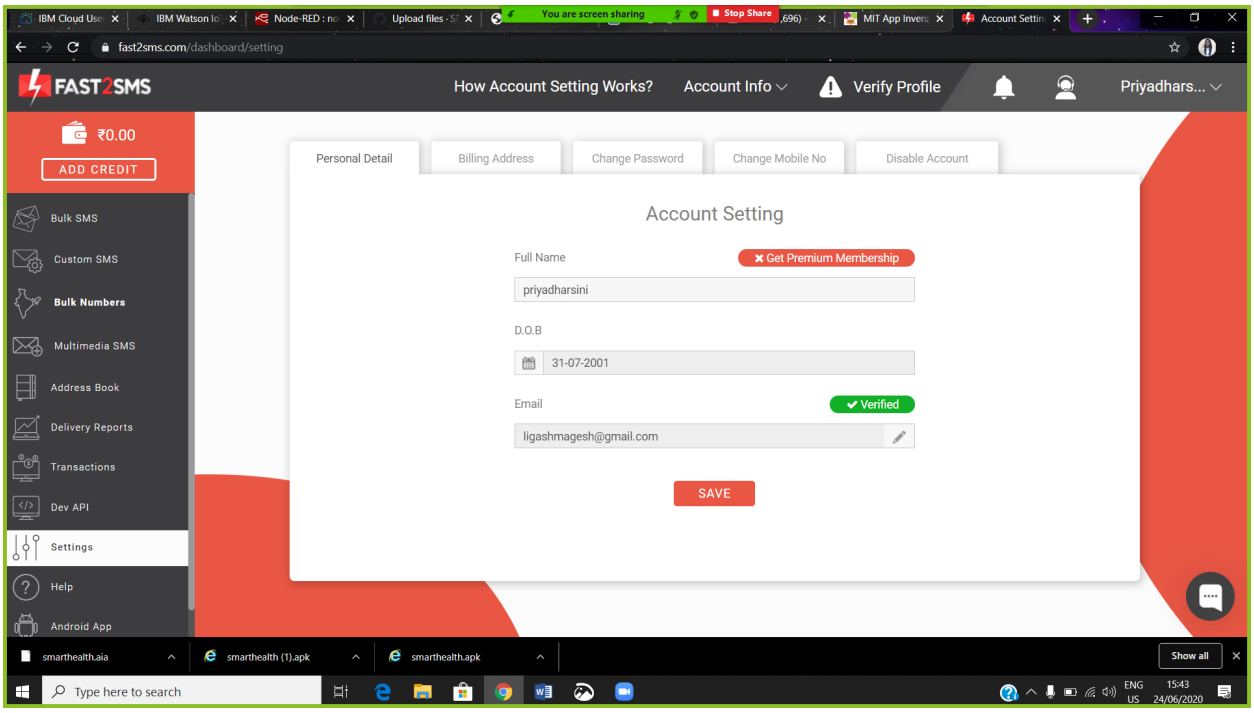
3.Using Node-Red to Connect Patient, Staff and Medical Equipment Junior Asante and Joel Olsson https://liu.diva-portal.org/smash/get/diva2:949264/FULLTEXT01.pdf

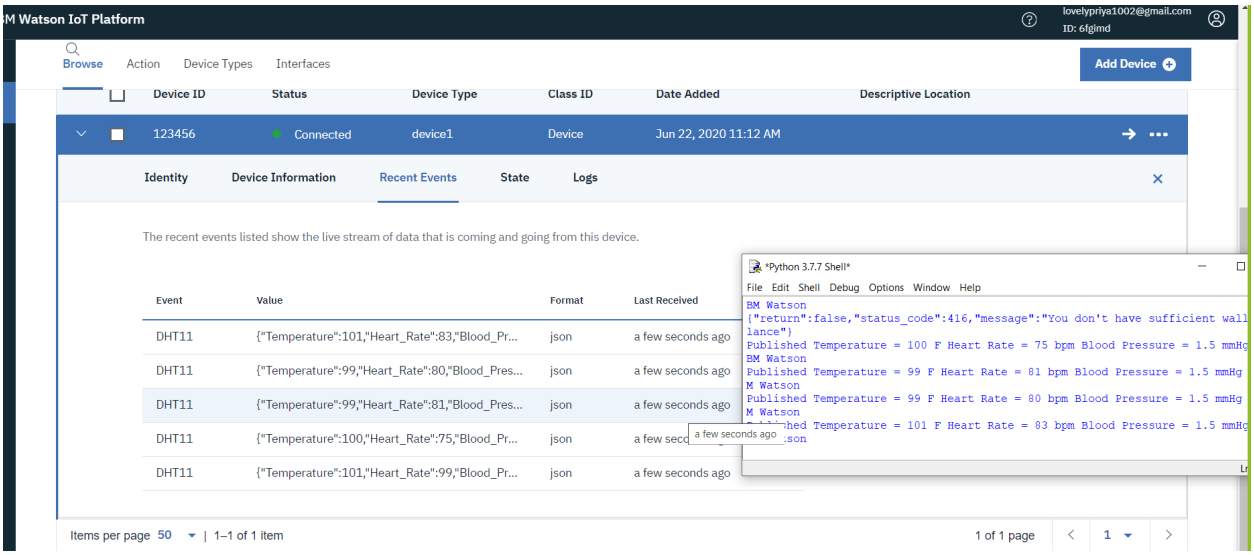
4.Design Health care system using Raspberry Pi and ESP32 https://www.ijcaonline.org/archives/volume177/number36/alsahi-2020-ijca-919863.pdf

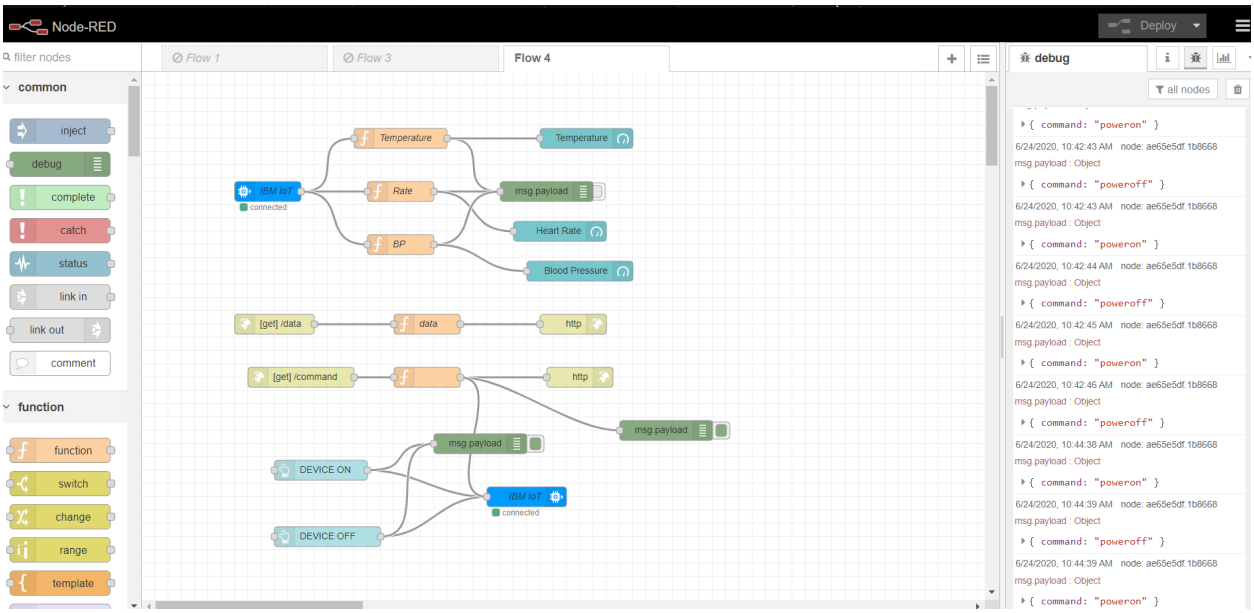
APPENDIX

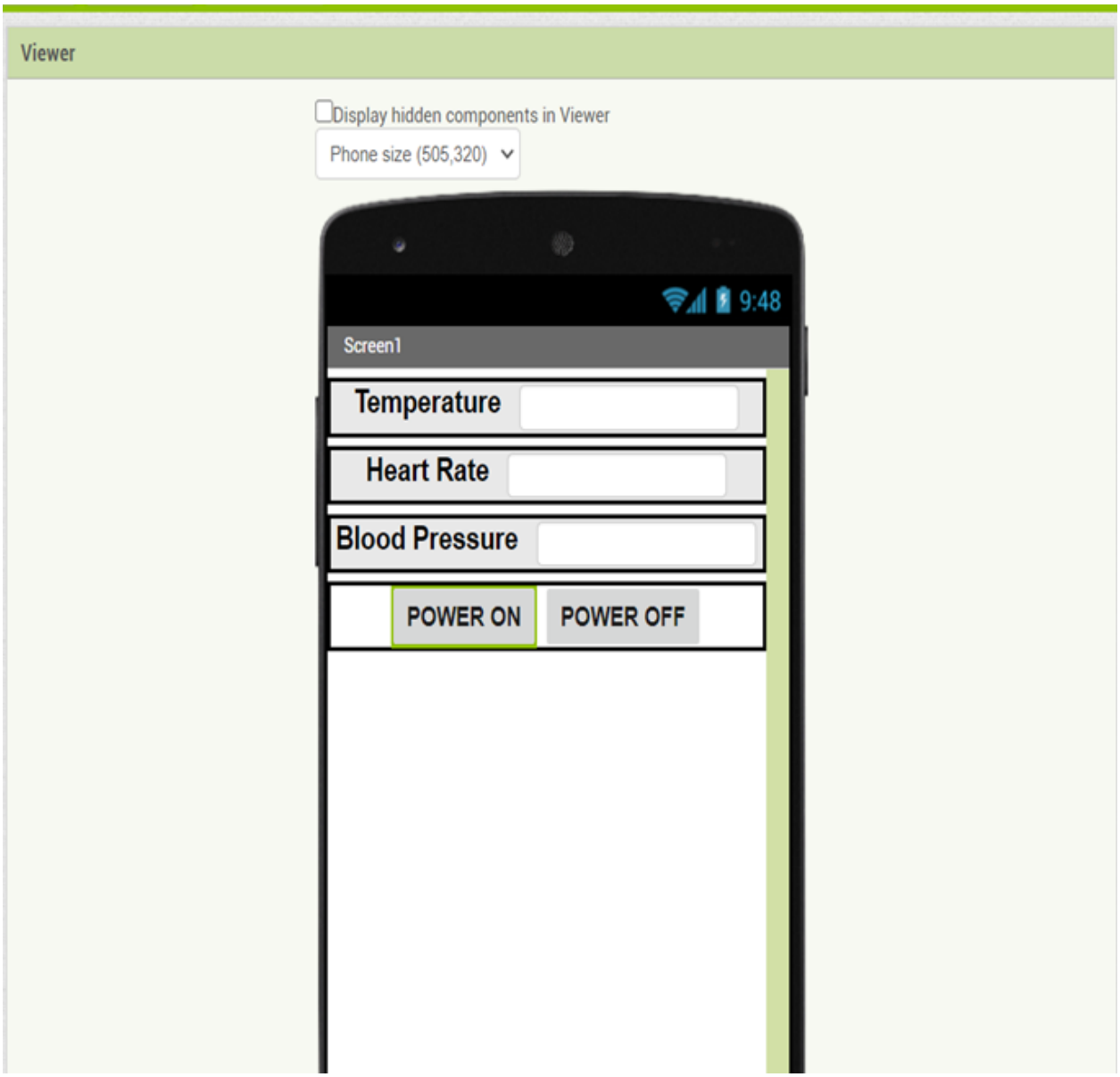
OUTPUT IMAGES:



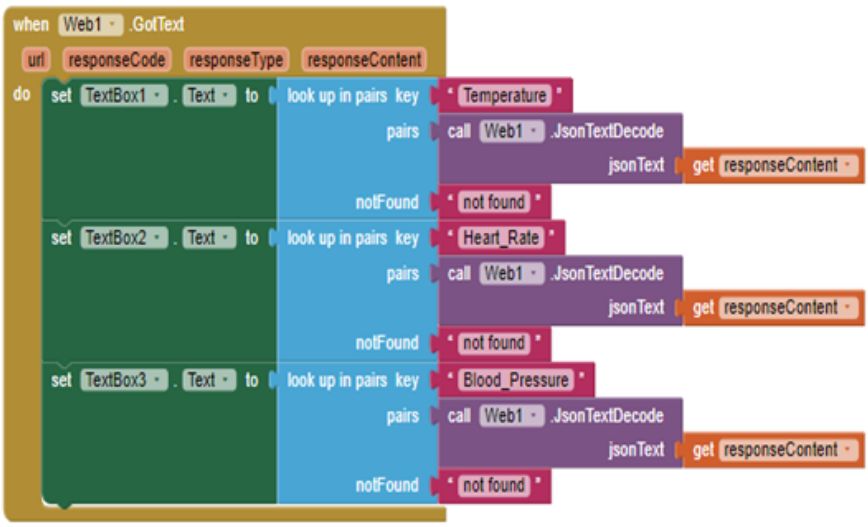



M Watson IoT Platform
lovelypriya1002@gmail.com
ID: 6fgimd
Browse
Action
Device Types
Interfaces
Add Device
Device ID
Status
Device Type
Class ID
Date Added
Descriptive Location
123456
Connected
device1
Device
Jun 22, 2020 11:12 AM
Identity
Device Information
Recent Events
State
Logs
The recent events listed show the live stream of data that is coming and going from this device.
Event
Value
Format
Last Received
DHT11
{"Temperature":101,"Heart_Rate":83,"Blood_Pr...
json
a few seconds ago
DHT11
{"Temperature":99,"Heart_Rate":80,"Blood_Pres...
json
a few seconds ago
DHT11
{"Temperature":99,"Heart_Rate":81,"Blood_Pres...
json
a few seconds ago
DHT11
{"Temperature":100,"Heart_Rate":75,"Blood_Pr...
json
DHT11
{"Temperature":101,"Heart_Rate":99,"Blood_Pr...
json
a few seconds ago
Items per page 50
1–1 of 1 item
1 of 1 page
1
Python 3.7.7 Shell
File Edit Shell Debug Options Window Help
BM Watson
{"return":false,"status_code":416,"message":"You don't have sufficient wall
lance"}
Published Temperature = 100 F Heart Rate = 75 bpm Blood Pressure = 1.5 mmHg
BM Watson
Published Temperature = 99 F Heart Rate = 81 bpm Blood Pressure = 1.5 mmHg
M Watson
Published Temperature = 99 F Heart Rate = 80 bpm Blood Pressure = 1.5 mmHg
M Watson
Published Temperature = 101 F Heart Rate = 83 bpm Blood Pressure = 1.5 mmHg
a few seconds ago


Node-RED
Deploy
filter nodes
Flow 1
Flow 3
Flow 4
common
inject
debug
complete
catch
status
link in
link out
comment
function
function
switch
change
range
template
Temperature
Temperature
IBM IoT
connected
Rate
msg.payload
BP
Heart Rate
Blood Pressure
[get] /data
data
http
[get] /command
http
msg.payload
msg.payload
DEVICE ON
IBM IoT
connected
DEVICE OFF
debug
all nodes
{ command: "poweron" }
6/24/2020, 10:42:43 AM node: ae65e5df.1b8668
msg.payload : Object
{ command: "poweroff" }
6/24/2020, 10:42:43 AM node: ae65e5df.1b8668
msg.payload : Object
{ command: "poweron" }
6/24/2020, 10:42:44 AM node: ae65e5df.1b8668
msg.payload : Object
{ command: "poweroff" }
6/24/2020, 10:42:45 AM node: ae65e5df.1b8668
msg.payload : Object
{ command: "poweron" }
6/24/2020, 10:42:46 AM node: ae65e5df.1b8668
msg.payload : Object
{ command: "poweroff" }
6/24/2020, 10:44:38 AM node: ae65e5df.1b8668
msg.payload : Object
{ command: "poweron" }
6/24/2020, 10:44:39 AM node: ae65e5df.1b8668
msg.payload : Object
{ command: "poweroff" }
6/24/2020, 10:44:39 AM node: ae65e5df.1b8668
msg.payload : Object
{ command: "poweron" }

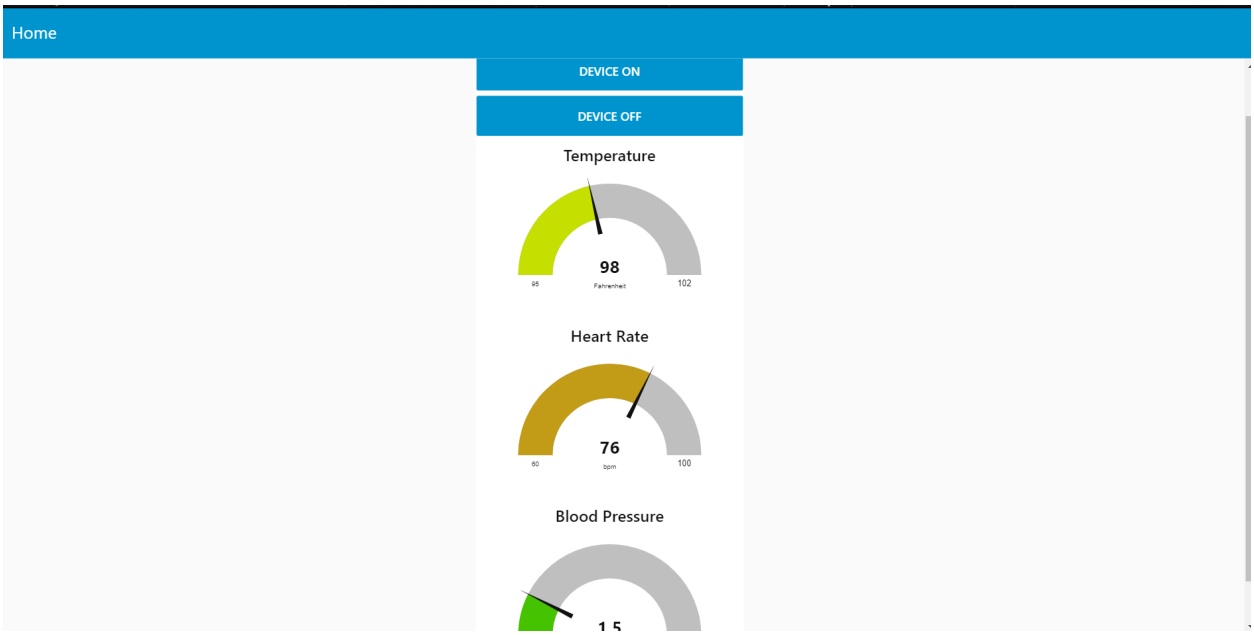

Viewer
Display hidden components in Viewer
Phone size (505,320)
9:48
Screen1
Temperature
Heart Rate
Blood Pressure
POWER ON
POWER OFF

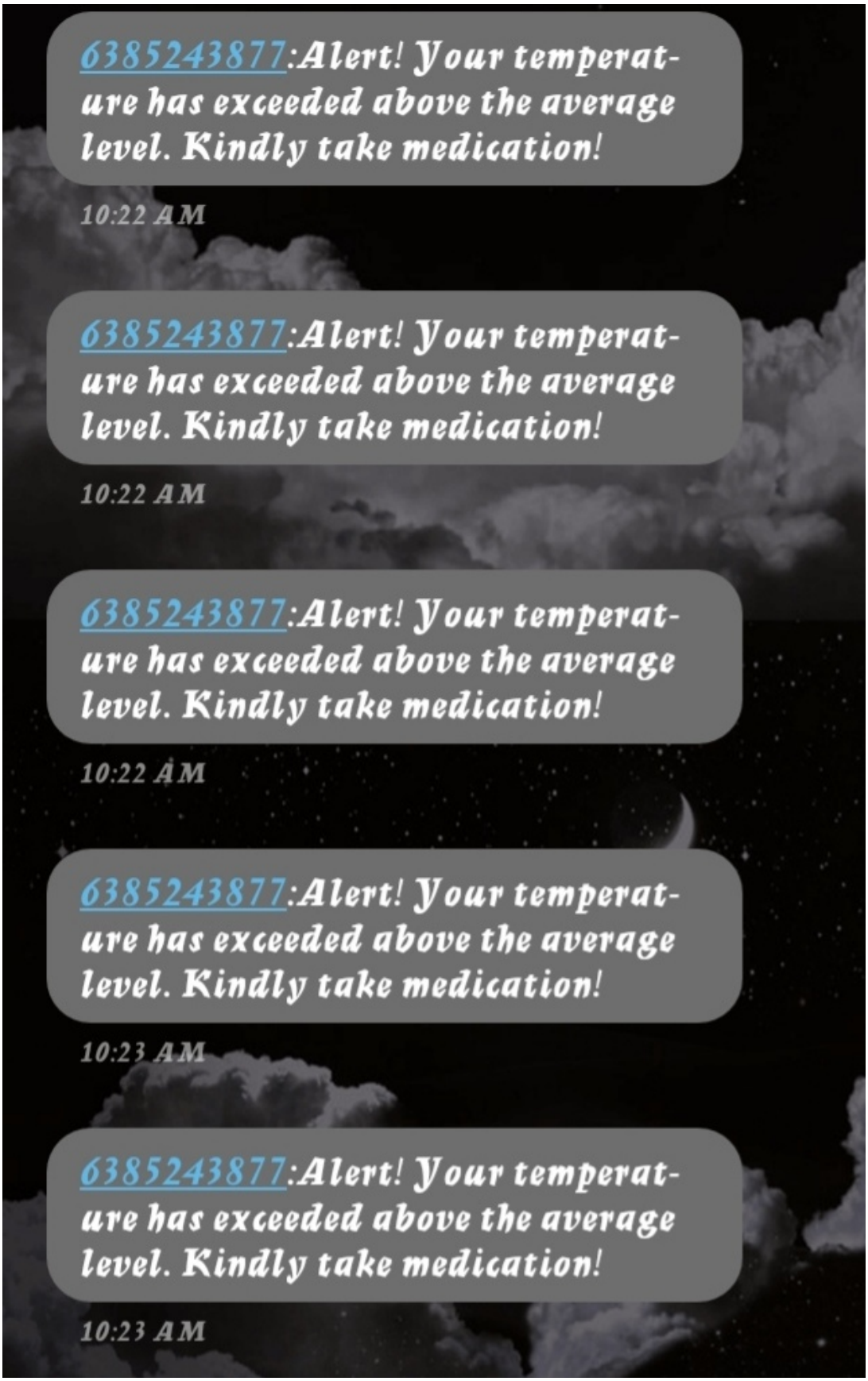

when Clock1 .Timer
do set Web1 . Url to " https://node-red-aroit.eu-gb.mybluemix.net/data "
call Web1 .Get

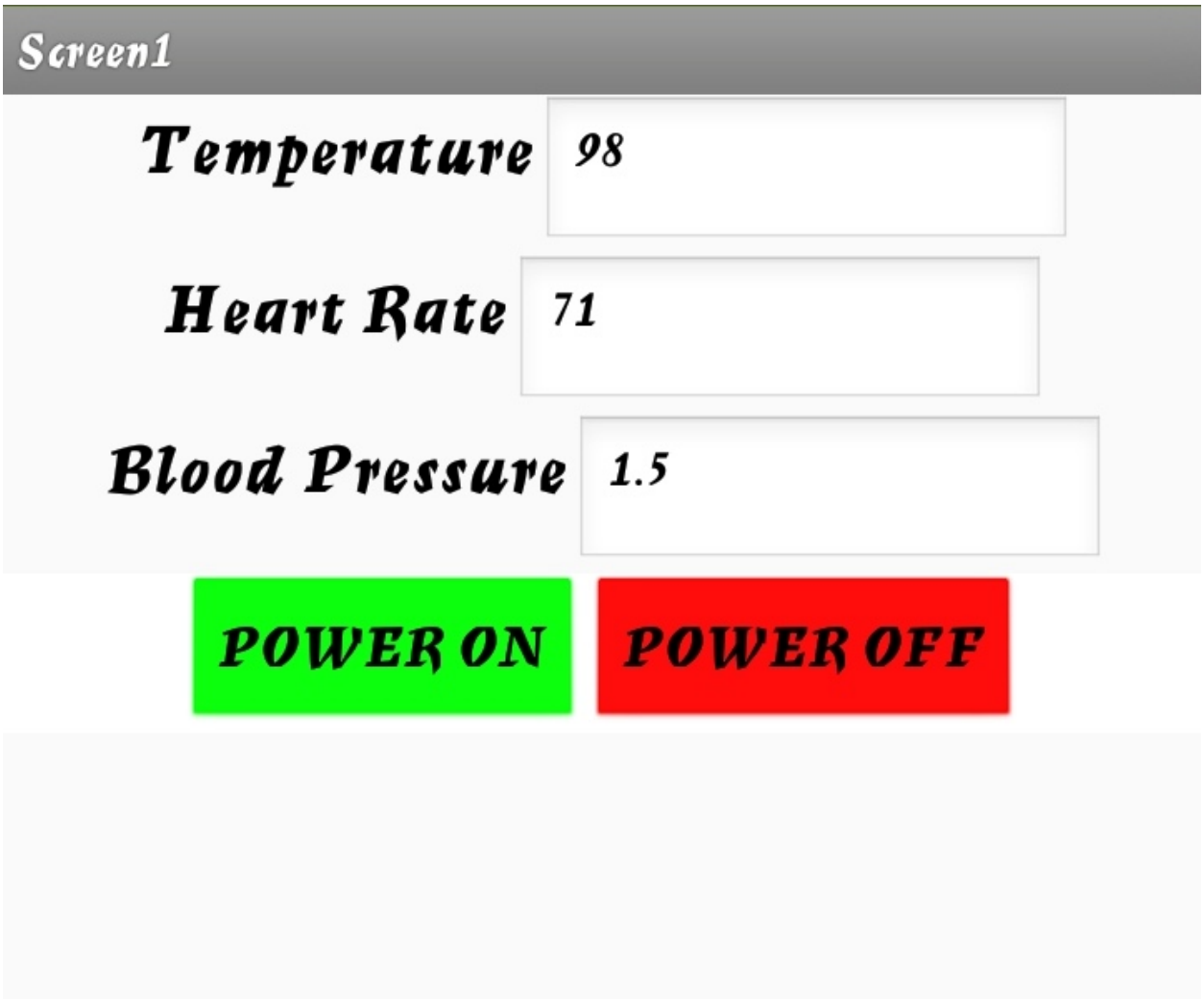

when Web1 .GotText
url responseCode responseType responseContent
do set TextBox1 . Text to look up in pairs key " Temperature "
pairs call Web1 .JsonTextDecode
jsonText get responseContent
notFound " not found "
set TextBox2 . Text to look up in pairs key " Heart_Rate "
pairs call Web1 .JsonTextDecode
jsonText get responseContent
notFound " not found "
set TextBox3 . Text to look up in pairs key " Blood_Pressure "
pairs call Web1 .JsonTextDecode
jsonText get responseContent
notFound " not found "


when Button1 .Click
do set Web2 . Url to " https://node-red-aroit.eu-gb.mybluemix.net/comma... "
call Web2 .Get
set Button1 . BackgroundColor to
set Button2 . BackgroundColor to


when Button2 .Click
do set Web2 . Url to " https://node-red-aroit.eu-gb.mybluemix.net/comma... "
call Web2 .Get
set Button2 . BackgroundColor to
set Button1 . BackgroundColor to


Home
DEVICE ON
DEVICE OFF
Temperature
98
Fahrenheit
95
102
Heart Rate
76
bpm
60
100
Blood Pressure


6385243877:Alert! Your temperature has exceeded above the average level. Kindly take medication!
10:22 AM
6385243877:Alert! Your temperature has exceeded above the average level. Kindly take medication!
10:22 AM
6385243877:Alert! Your temperature has exceeded above the average level. Kindly take medication!
10:22 AM
6385243877:Alert! Your temperature has exceeded above the average level. Kindly take medication!
10:23 AM
6385243877:Alert! Your temperature has exceeded above the average level. Kindly take medication!
10:23 AM


Screen1
Temperature
98
Heart Rate
71
Blood Pressure
1.5
POWER ON
POWER OFF