Remote Health Monitoring System with Analytics Dashboard

Aim: To deploy a machine learning algorithm in Watson studio and predict the output by sending the sensor data from the IOT Device using IOT Platform and node-red Service.

Requirements:

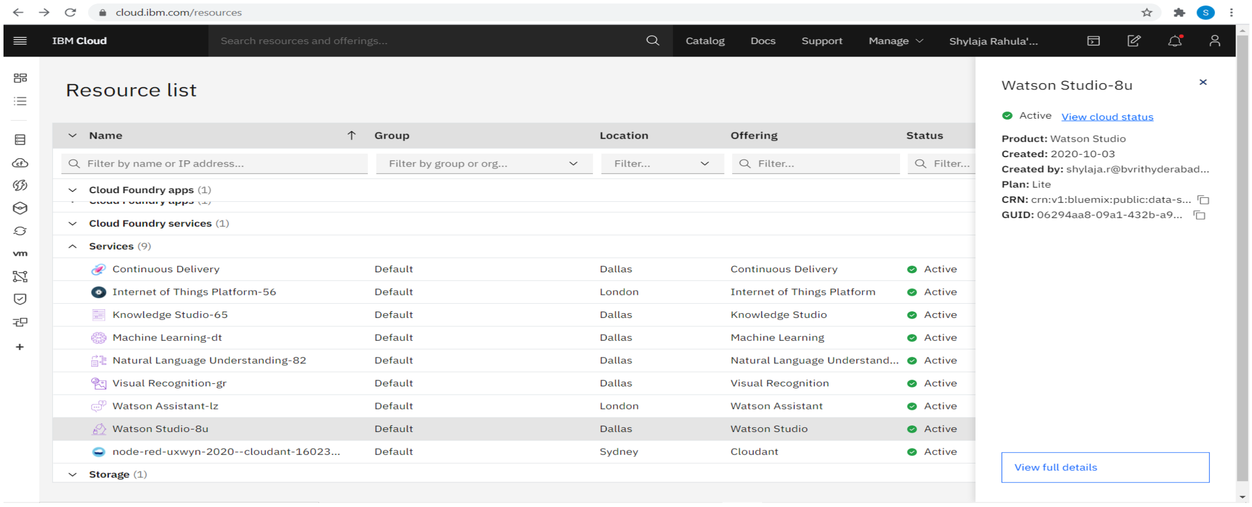
- Data Set for Project
- IBM cloud account

IBM cloud services used:

- Watson Studio service
- Machine learning instance
- Training the machine learning model with data set in Auto AI experiment
- IBM IOT WATSON PLATFORM
- Node-red application

Implementation:

Watson studio service instance is created in IBM cloud.



Resource list

Name	Group	Location	Offering	Status
Filter by name or IP address...	Filter by group or org...	Filter...	Filter...	Filter...
Cloud Foundry apps (1)				
Cloud Foundry services (1)				
Services (9)				
Continuous Delivery	Default	Dallas	Continuous Delivery	Active
Internet of Things Platform-56	Default	London	Internet of Things Platform	Active
Knowledge Studio-65	Default	Dallas	Knowledge Studio	Active
Machine Learning-dt	Default	Dallas	Machine Learning	Active
Natural Language Understanding-82	Default	Dallas	Natural Language Understand...	Active
Visual Recognition-gr	Default	Dallas	Visual Recognition	Active
Watson Assistant-lz	Default	London	Watson Assistant	Active
Watson Studio-8u	Default	Dallas	Watson Studio	Active
node-red-uxwyn-2020--cloudant-16023...	Default	Sydney	Cloudant	Active
Storage (1)				

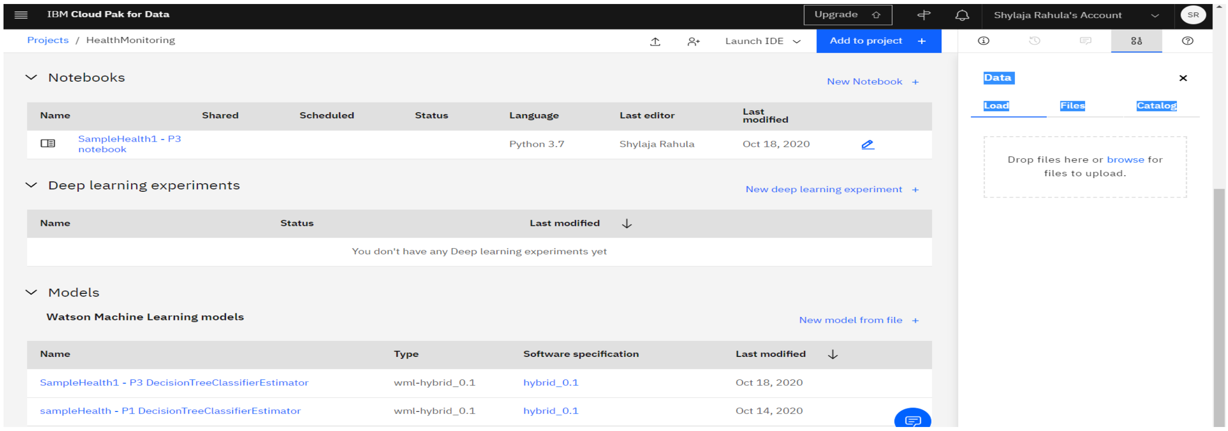
Watson Studio-8u

Active View cloud status

Product: Watson Studio
Created: 2020-10-03
Created by: shylaja.r@bvrithyderabad...
Plan: Lite
CRN: crn:v1:bluemix:public:data-s...
GUID: 06294aa8-09a1-432b-a9...

Remote Health Monitoring System with Analytics Dashboard

HealthMonitoring project is created in watson studio.



Notebooks

New Notebook +

Name	Shared	Scheduled	Status	Language	Last editor	Last modified
SampleHealth1 - P3 notebook				Python 3.7	Shylaja Rahula	Oct 18, 2020

Deep learning experiments

New deep learning experiment +

Name	Status	Last modified
You don't have any Deep learning experiments yet		

Models

Watson Machine Learning models

New model from file +

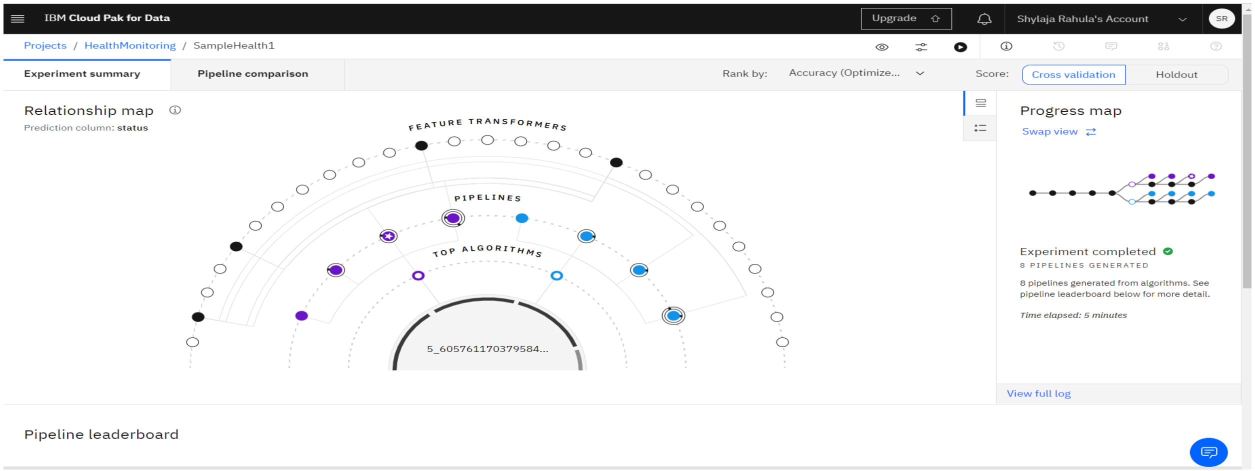
Name	Type	Software specification	Last modified
SampleHealth1 - P3 DecisionTreeClassifierEstimator	wml-hybrid_0.1	hybrid_0.1	Oct 18, 2020
sampleHealth - P1 DecisionTreeClassifierEstimator	wml-hybrid_0.1	hybrid_0.1	Oct 14, 2020

Data

Load Files Catalog

Drop files here or browse for files to upload.

A project in Watson studio is created and added an auto AI experiment as an asset to that project and linked a machine learning instance to the project. After successfully creating AutoAI Experiment health monitoring data set as .csv file is uploaded. By selecting the prediction column from the data set Experiment is run.After clicking on Run Experiment it loaded the page with Progress map and it started training the model. Selected the decision tree classifier algorithm of pipeline 3 and the model is saved.



Projects / HealthMonitoring / SampleHealth1

Experiment summary | Pipeline comparison

Rank by: Accuracy (Optimize...

Score: Cross validation | Holdout

Relationship map

Prediction column: status

Progress map

Experiment completed ✓

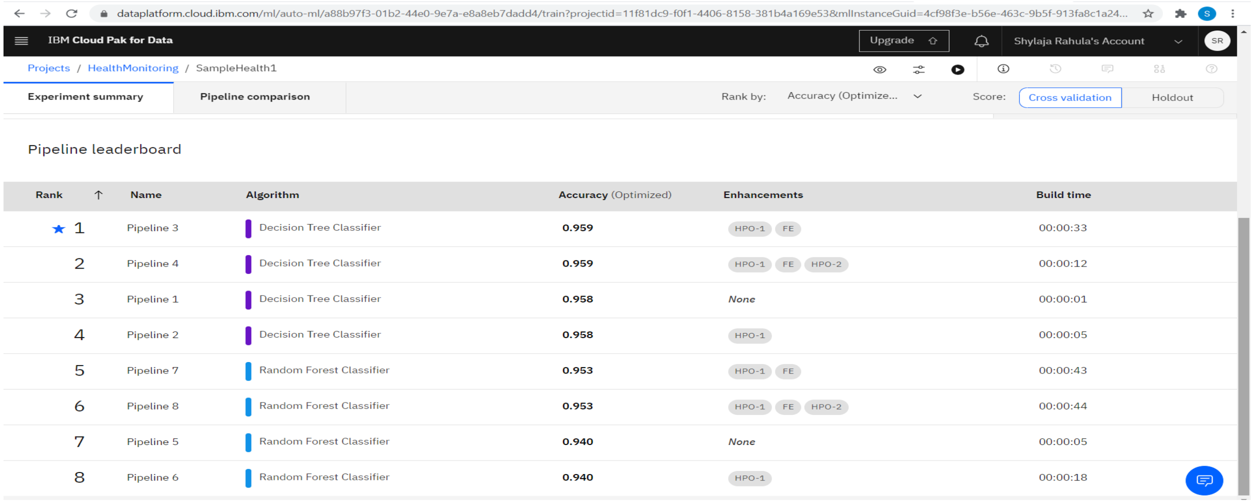
8 PIPELINES GENERATED

8 pipelines generated from algorithms. See pipeline leaderboard below for more detail.

Time elapsed: 5 minutes

Pipeline leaderboard

Remote Health Monitoring System with Analytics Dashboard

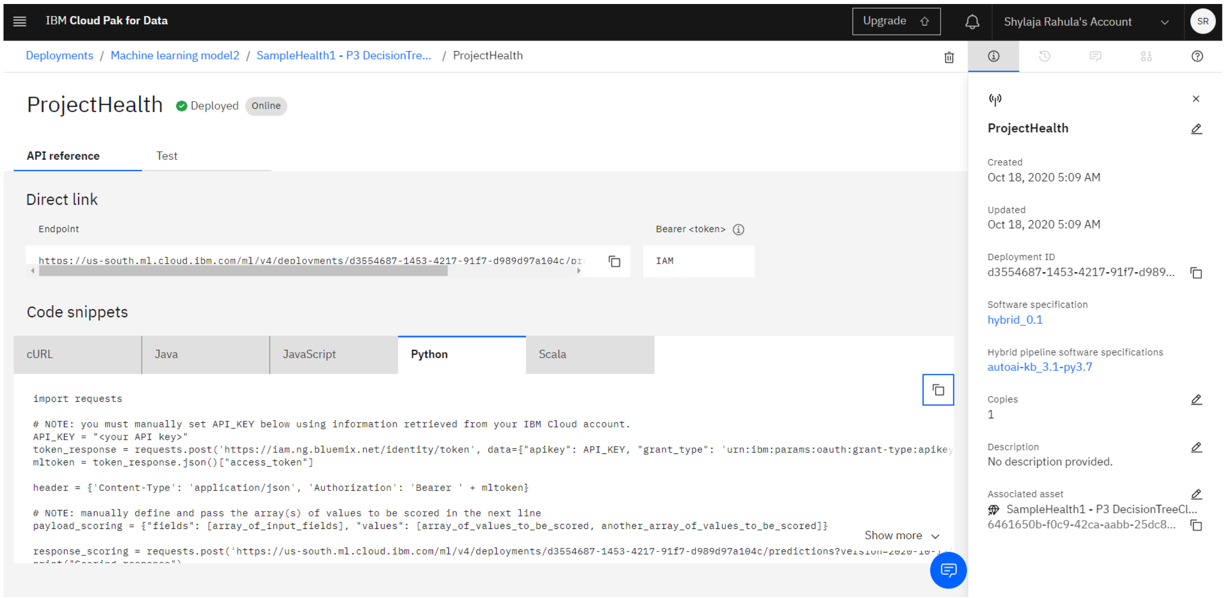


dataplatform.cloud.ibm.com/ml/auto-ml/a88b97f3-01b2-44e0-9e7a-e8a8eb7dadd4/train?projectid=11f81dc9-f0f1-4406-8158-381b4a169e53&mlInstanceGuid=4cf98f3e-b56e-463c-9b5f-913fa8c1a24...

Pipeline leaderboard

Rank	Name	Algorithm	Accuracy (Optimized)	Enhancements	Build time
★ 1	Pipeline 3	Decision Tree Classifier	0.959	HPO-1 FE	00:00:33
2	Pipeline 4	Decision Tree Classifier	0.959	HPO-1 FE HPO-2	00:00:12
3	Pipeline 1	Decision Tree Classifier	0.958	*None*	00:00:01
4	Pipeline 2	Decision Tree Classifier	0.958	HPO-1	00:00:05
5	Pipeline 7	Random Forest Classifier	0.953	HPO-1 FE	00:00:43
6	Pipeline 8	Random Forest Classifier	0.953	HPO-1 FE HPO-2	00:00:44
7	Pipeline 5	Random Forest Classifier	0.940	*None*	00:00:05
8	Pipeline 6	Random Forest Classifier	0.940	HPO-1	00:00:18

After successfully saving , the model is deployed .



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Shylaja Rahula's Account
SR
Deployments / Machine learning model2 / SampleHealth1 - P3 DecisionTre... / ProjectHealth

ProjectHealth ✓ Deployed Online

Direct link

Endpoint

https://us-south.ml.cloud.ibm.com/ml/v4/deployments/d3554687-1453-4217-91f7-d989d97a104c/pr

Bearer <token>

IAM

Code snippets

```
import requests

# NOTE: you must manually set API_KEY below using information retrieved from your IBM Cloud account.
API_KEY = "<your API key>"
token_response = requests.post('https://iam.ng.bluemix.net/identity/token', data={"apikey": API_KEY, "grant_type": 'urn:ibm:params:oauth:grant-type:apikey
mltoken = token_response.json()["access_token"]

header = {'Content-Type': 'application/json', 'Authorization': 'Bearer ' + mltoken}

# NOTE: manually define and pass the array(s) of values to be scored in the next line
payload_scoring = {"fields": [array_of_input_fields], "values": [array_of_values_to_be_scored, another_array_of_values_to_be_scored]}

response_scoring = requests.post('https://us-south.ml.cloud.ibm.com/ml/v4/deployments/d3554687-1453-4217-91f7-d989d97a104c/predictions?version=2020-10-1
```

ProjectHealth

Created: Oct 18, 2020 5:09 AM

Updated: Oct 18, 2020 5:09 AM

Deployment ID: d3554687-1453-4217-91f7-d989...

Software specification: hybrid_0.1

Hybrid pipeline software specifications: autoai-kb_3.1-py3.7

Copies: 1

Description: No description provided.

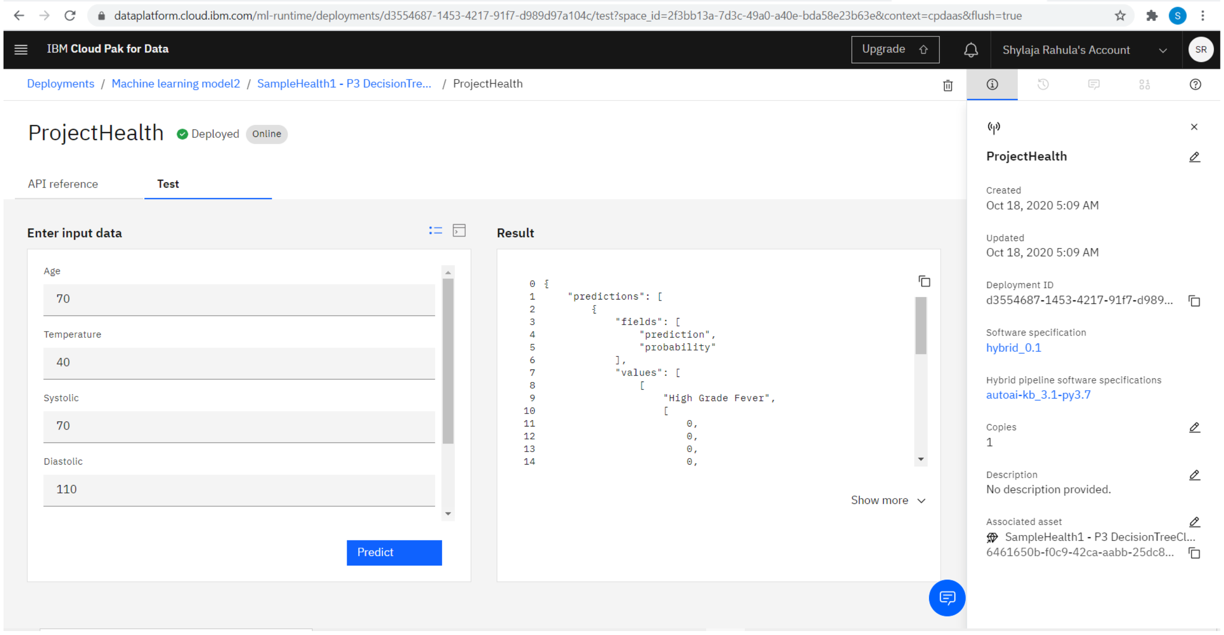
Associated asset: SampleHealth1 - P3 DecisionTreeCl... 6461650b-f0c9-42ca-aabb-25dc8...

Remote Health Monitoring System with Analytics Dashboard

```
import requests

# NOTE: you must manually set API_KEY below using information retrieved from your IBM Cloud account.
API_KEY = "<your API key>"
token_response = requests.post('https://iam.ng.bluemix.net/identity/token', data={"apikey": API_KEY, "grant_type": 'urn:ibm:params:oauth:grant-type:apikey'})
mltoken = token_response.json()["access_token"]

header = {'Content-Type': 'application/json', 'Authorization': 'Bearer ' + mltoken}

# NOTE: manually define and pass the array(s) of values to be scored in the next line
payload_scoring = {"fields": [array_of_input_fields], "values": [array_of_values_to_be_scored, another_array_of_values_to_be_scored]}

response_scoring = requests.post('https://us-south.ml.cloud.ibm.com/ml/v4/deployments/d3554687-1453-4217-91f7-d989d97a104c/predictions?version=2020-10-17', json=payload_scoring, headers={'Authorization': 'Bearer ' + mltoken})
print("Scoring response")
print(response_scoring.json())
```

After deploying successfully the modele is tested by applying input from data set and predicting the output that is health status.The output is predicted correctly.

Remote Health Monitoring System with Analytics Dashboard



dataplatform.cloud.ibm.com/ml-runtime/deployments/d3554687-1453-4217-91f7-d989d97a104c/test?space_id=2f3bb13a-7d3c-49a0-a40e-bda58e23b63e&context=cpdaas&flush=true

IBM Cloud Pak for Data | Upgrade | Shylaja Rahula's Account | SR

Deployments / Machine learning model2 / SampleHealth1 - P3 DecisionTre... / ProjectHealth

ProjectHealth ● Deployed Online

API reference | Test

Enter input data

Age: 70

Temperature: 40

Systolic: 70

Diastolic: 110

Predict

Result

```
{
    "predictions": [
        {
            "fields": [
                "prediction",
                "probability"
            ],
            "values": [
                [
                    "High Grade Fever",
                    [
                        0,
                        0,
                        0,
                        0,
```

Show more

ProjectHealth

Created: Oct 18, 2020 5:09 AM

Updated: Oct 18, 2020 5:09 AM

Deployment ID: d3554687-1453-4217-91f7-d989...

Software specification: hybrid_0.1

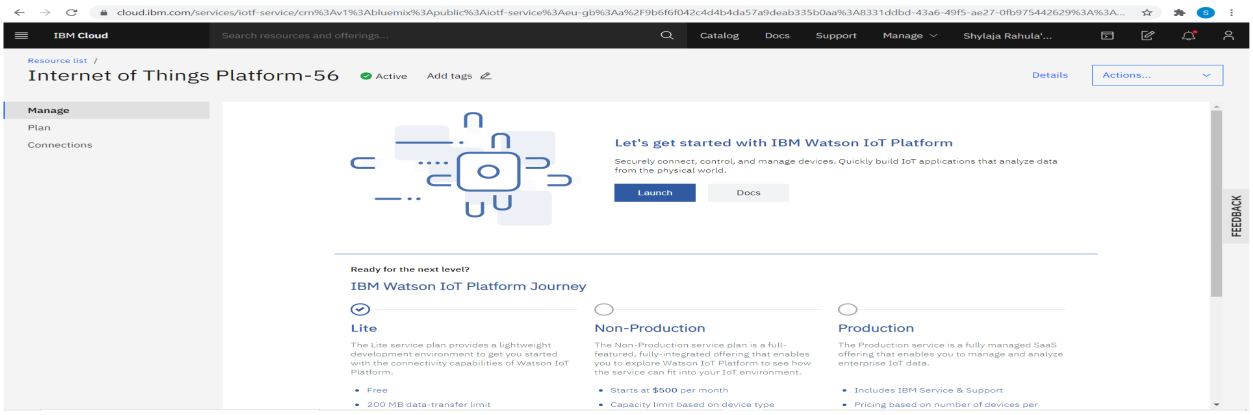
Hybrid pipeline software specifications: autoai-kb_3.1-py3.7

Copies: 1

Description: No description provided.

Associated asset: SampleHealth1 - P3 DecisionTreeCl... 6461650b-f0c9-42ca-aabb-25dc8...

The machine learning Model to predict health status is implemented and tested.The model is integrated with IOT Platform through which sensor data is sent.Watson Internet of Things platform instance is created in IBM cloud and an Iot device instance is created in it. Used built in sensor simulator to get sensor data from the device.



cloud.ibm.com/services/iotf-service/crn%3Av1%3Abluemix%3Apublic%3Aiotf-service%3Aeu-gb%3Aa%2F9b6f6f042c4d4b4da57a9deab335b0aa%3A8331ddbd-43a6-49f5-ae27-0fb975442629%3A%3A...

IBM Cloud | Search resources and offerings... | Catalog | Docs | Support | Manage | Shylaja Rahula'...

Resource list /

Internet of Things Platform-56 ● Active Add tags

Details | Actions...

Manage
Plan
Connections

Let's get started with IBM Watson IoT Platform

Securely connect, control, and manage devices. Quickly build IoT applications that analyze data from the physical world.

Launch | Docs

Ready for the next level?

IBM Watson IoT Platform Journey

Lite

The Lite service plan provides a lightweight development environment to get you started with the connectivity capabilities of Watson IoT Platform.

- Free
- 200 MB data-transfer limit

Non-Production

The Non-Production service plan is a full-featured, fully-integrated offering that enables you to explore Watson IoT Platform to see how the service can fit into your IoT environment.

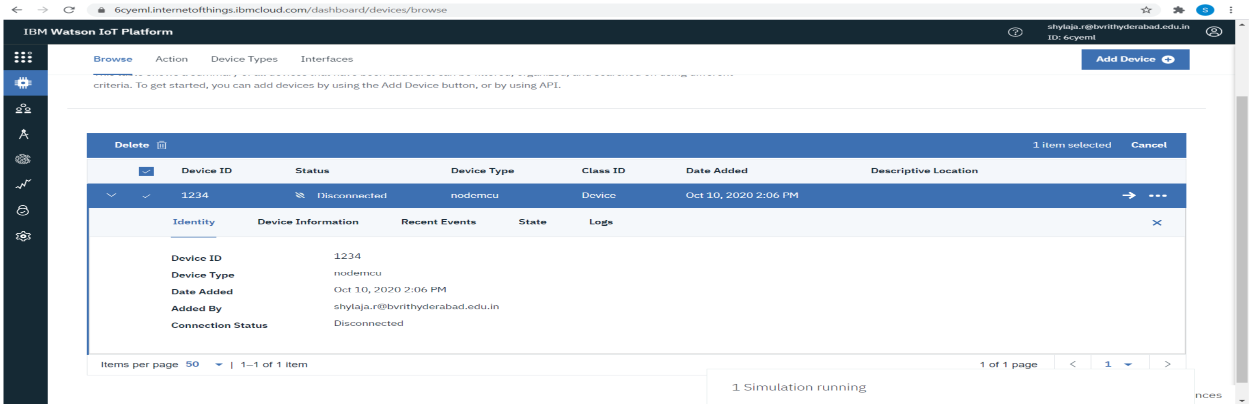
- Starts at $500 per month
- Capacity limit based on device type

Production

The Production service is a fully managed SaaS offering that enables you to manage and analyze enterprise IoT data.

- Includes IBM Service & Support
- Pricing based on number of devices per

Remote Health Monitoring System with Analytics Dashboard



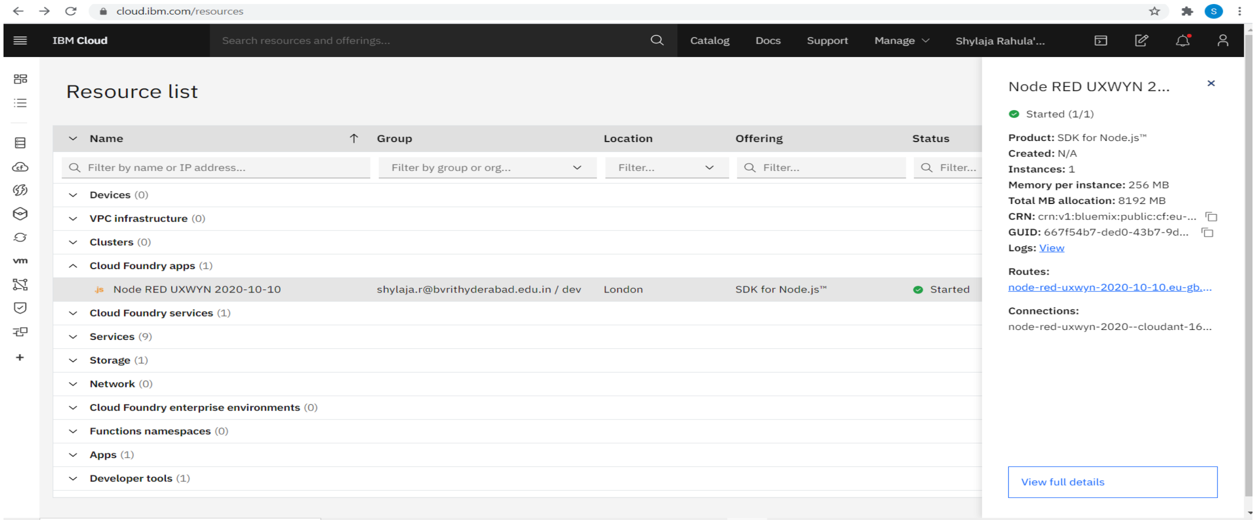
criteria. To get started, you can add devices by using the Add Device button, or by using API.

Device ID	Status	Device Type	Class ID	Date Added	Descriptive Location
1234	Disconnected	nodemcu	Device	Oct 10, 2020 2:06 PM	

Device ID	1234
Device Type	nodemcu
Date Added	Oct 10, 2020 2:06 PM
Added By	shylaja.r@bvrithyderabad.edu.in
Connection Status	Disconnected

Items per page 50 | 1–1 of 1 item   1 of 1 page

NODERED application is launched and node-red-scx-ibmiotapp is intalled for installing the ibm iot app nodes used to interface with IBM IoT Watson Platform along with dashboard nodes.



Resource list

Name	Group	Location	Offering	Status
Devices (0)				
VPC infrastructure (0)				
Clusters (0)				
Cloud Foundry apps (1)				
Node RED UXWYN 2020-10-10	shylaja.r@bvrithyderabad.edu.in / dev	London	SDK for Node.js™	Started
Cloud Foundry services (1)				
Services (9)				
Storage (1)				
Network (0)				
Cloud Foundry enterprise environments (0)				
Functions namespaces (0)				
Apps (1)				
Developer tools (1)				

Node RED UXWYN 2...

Started (1/1)

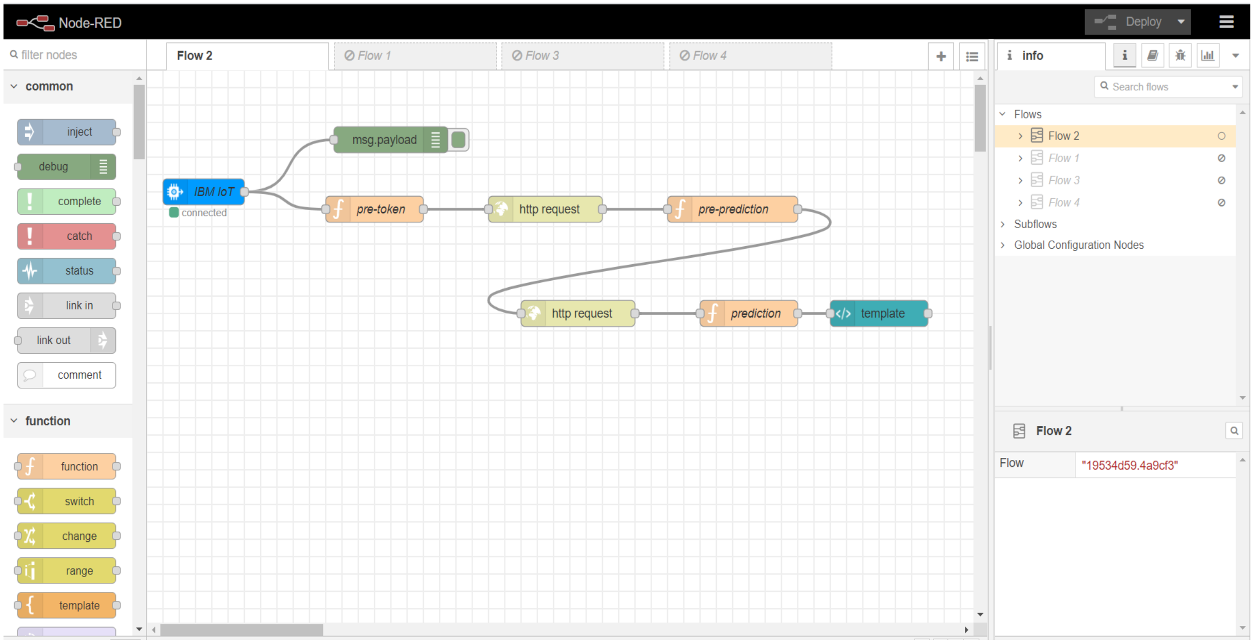
Product: SDK for Node.js™
Created: N/A
Instances: 1
Memory per instance: 256 MB
Total MB allocation: 8192 MB
CRN: crn:v1:bluemix:public:cf:eu-...
GUID: 667f54b7-ded0-43b7-9d...
Logs: View

Routes:
node-red-uxwyn-2020-10-10.eu-gb....

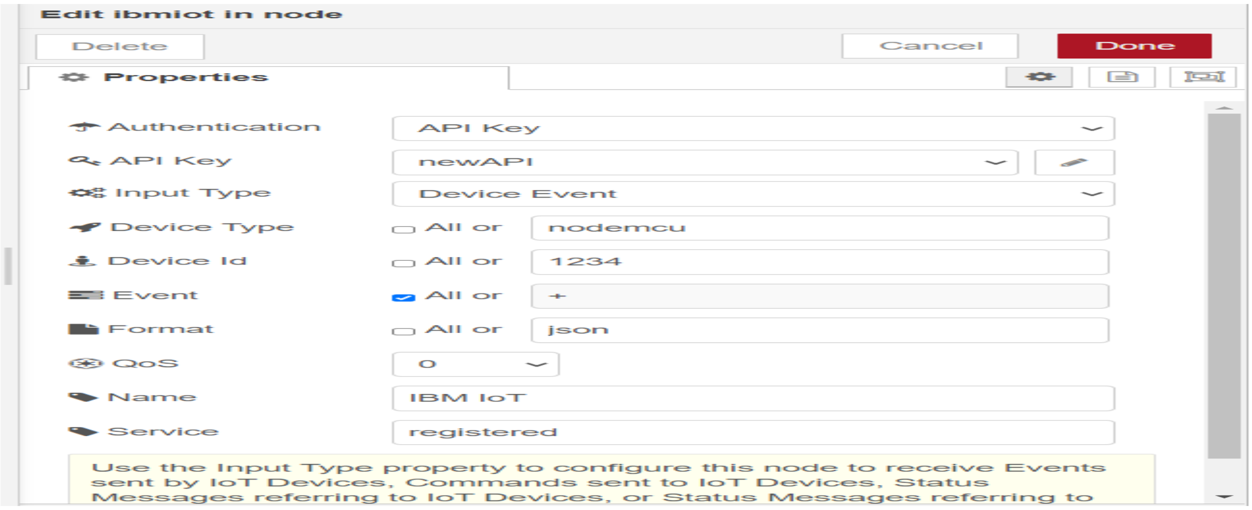
Connections:
node-red-uxwyn-2020--cloudant-16...

Remote Health Monitoring System with Analytics Dashboard

Nodered flow is created integrating IoT platform,machine learning model and dash board is cofigured for user interface.



All the nodes are configured as shown below



Edit ibmiot in node

Delete | Cancel | Done

Properties

Authentication: API Key

API Key: newAPI

Input Type: Device Event

Device Type: □ All or nodemcu

Device Id: □ All or 1234

Event: ☑ All or +

Format: □ All or json

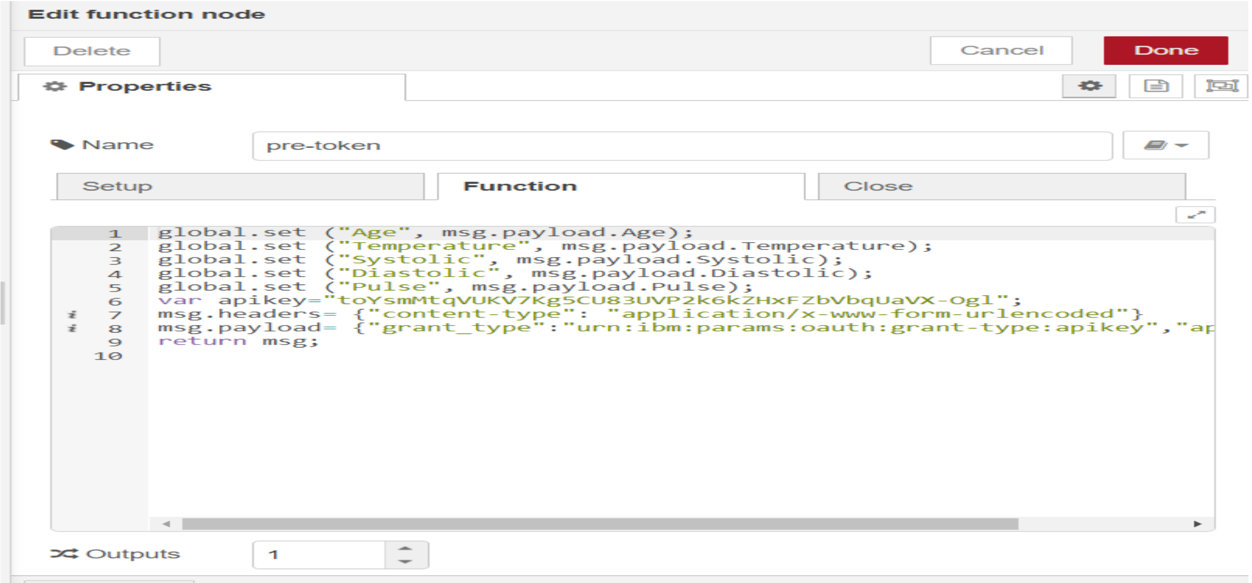
QoS: 0

Name: IBM IoT

Service: registered

Use the Input Type property to configure this node to receive Events sent by IoT Devices, Commands sent to IoT Devices, Status Messages referring to IoT Devices, or Status Messages referring to

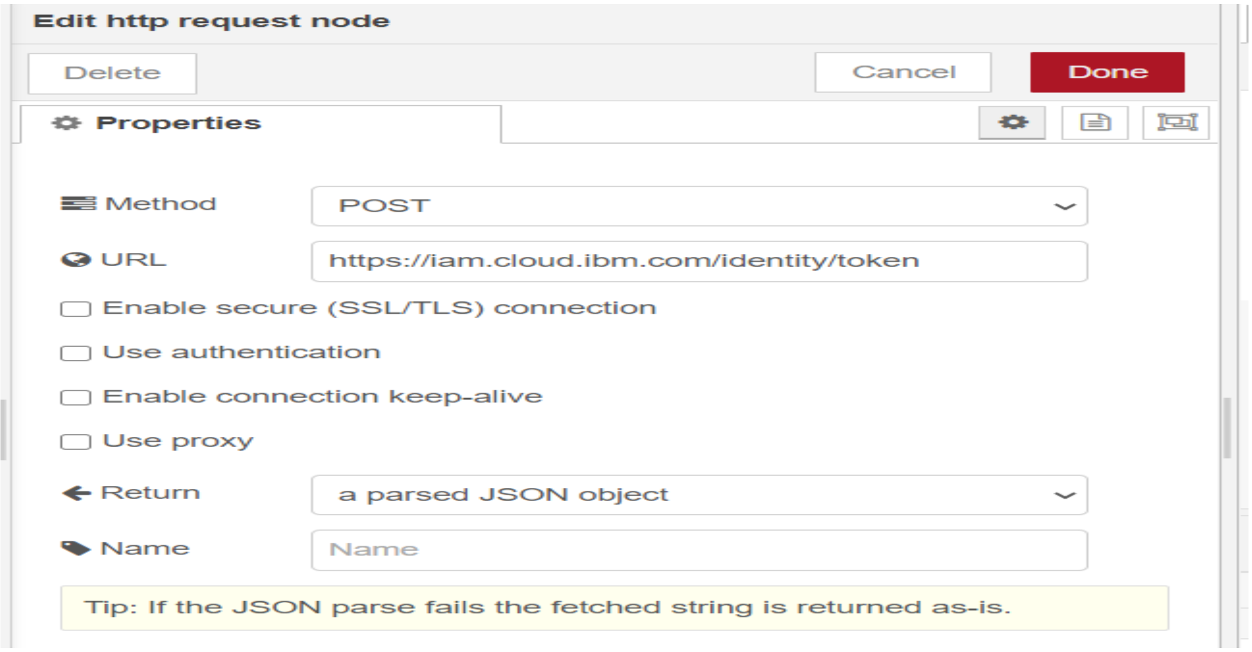
Remote Health Monitoring System with Analytics Dashboard



Name: pre-token

```
global.set ("Age", msg.payload.Age);
global.set ("Temperature", msg.payload.Temperature);
global.set ("Systolic", msg.payload.Systolic);
global.set ("Diastolic", msg.payload.Diastolic);
global.set ("Pulse", msg.payload.Pulse);
var apikey="toYsmMtqVUKV7Kg5CU83UVP2k6kZHxFZbVbqUaVX-Ogl";
msg.headers= {"content-type": "application/x-www-form-urlencoded"}
msg.payload= {"grant_type":"urn:ibm:params:oauth:grant-type:apikey","ap
return msg;
```

Outputs: 1



Method: POST

URL: https://iam.cloud.ibm.com/identity/token

□ Enable secure (SSL/TLS) connection

□ Use authentication

□ Enable connection keep-alive

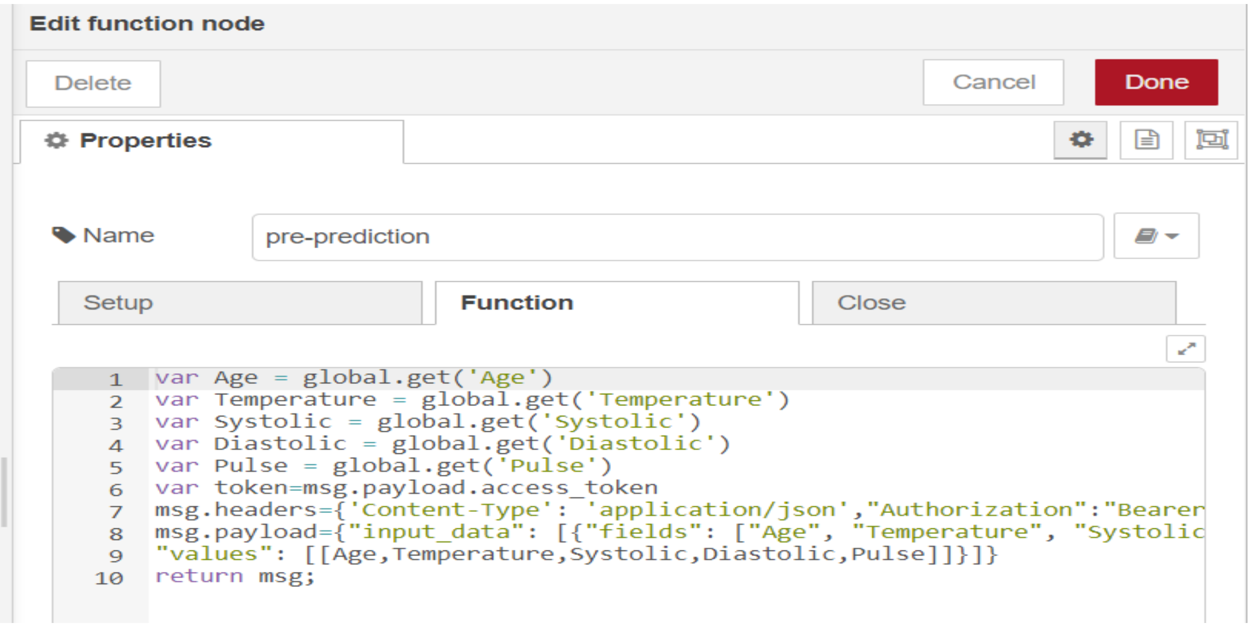
□ Use proxy

Return: a parsed JSON object

Name: Name

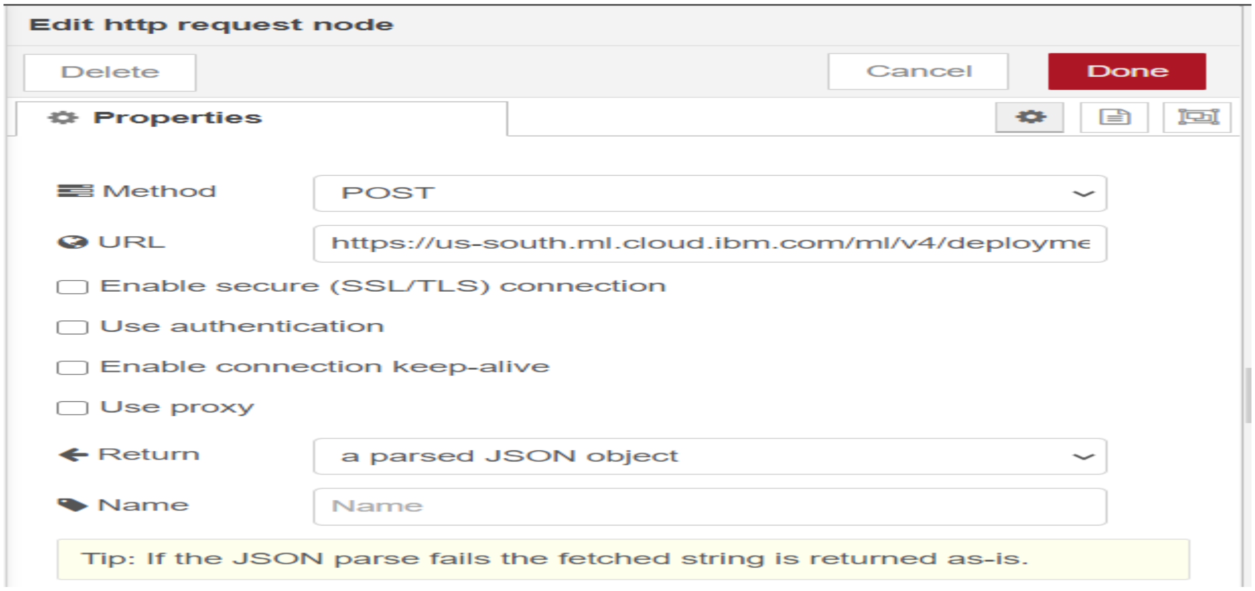
Tip: If the JSON parse fails the fetched string is returned as-is.

Remote Health Monitoring System with Analytics Dashboard



Name: pre-prediction

```
var Age = global.get('Age')
var Temperature = global.get('Temperature')
var Systolic = global.get('Systolic')
var Diastolic = global.get('Diastolic')
var Pulse = global.get('Pulse')
var token=msg.payload.access_token
msg.headers={'Content-Type': 'application/json',"Authorization":"Bearer
msg.payload={"input_data": [{"fields": ["Age", "Temperature", "Systolic
"values": [[Age,Temperature,Systolic,Diastolic,Pulse]]}]}
return msg;
```



Method: POST

URL: https://us-south.ml.cloud.ibm.com/ml/v4/deployme

□ Enable secure (SSL/TLS) connection

□ Use authentication

□ Enable connection keep-alive

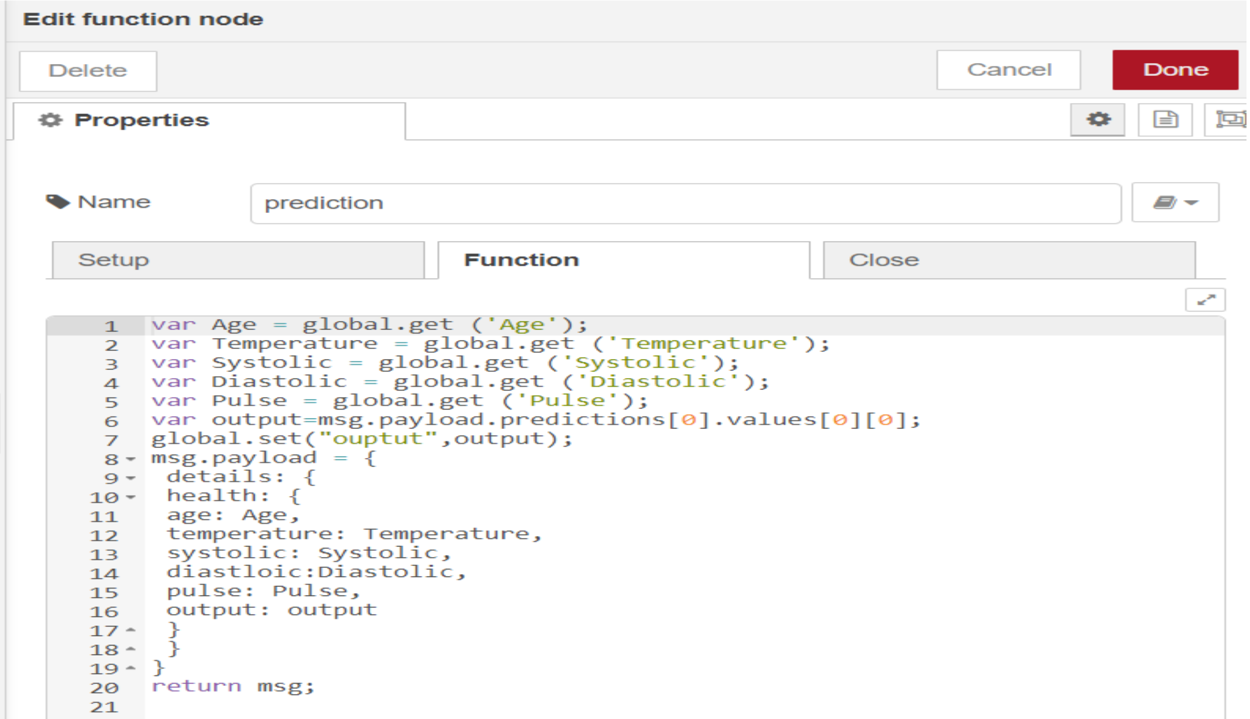
□ Use proxy

Return: a parsed JSON object

Name: Name

Tip: If the JSON parse fails the fetched string is returned as-is.

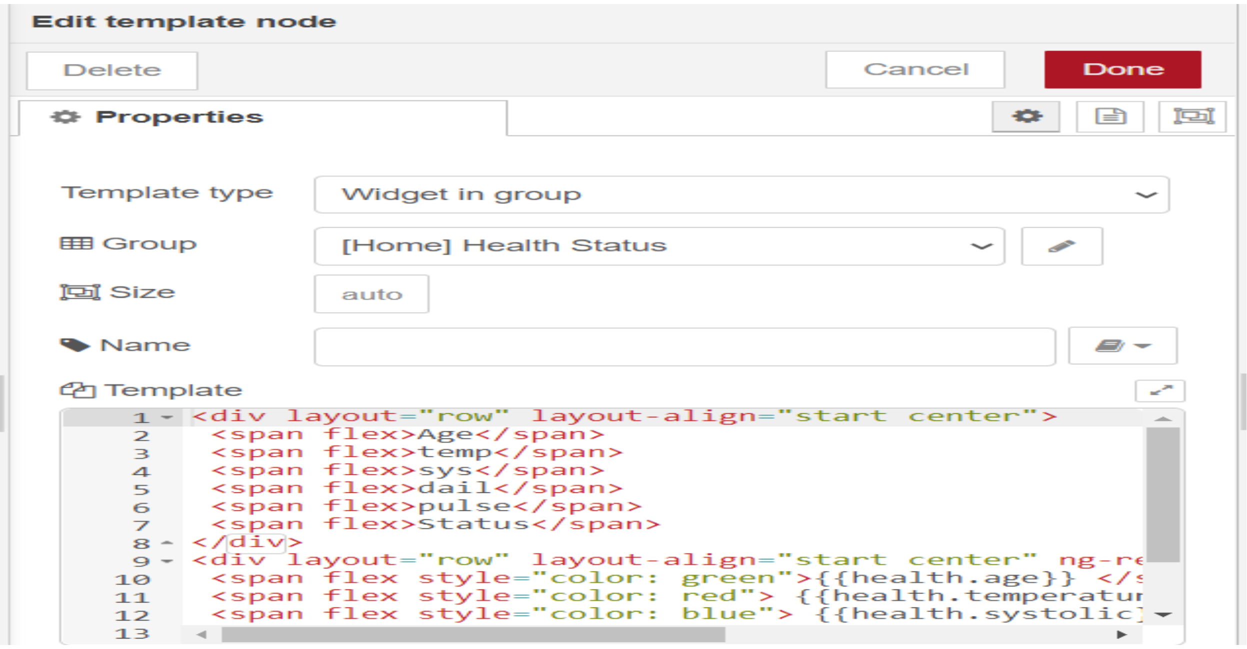
Remote Health Monitoring System with Analytics Dashboard



Edit function node

Name: prediction

```
var Age = global.get ('Age');
var Temperature = global.get ('Temperature');
var Systolic = global.get ('Systolic');
var Diastolic = global.get ('Diastolic');
var Pulse = global.get ('Pulse');
var output=msg.payload.predictions[0].values[0][0];
global.set("ouptut",output);
msg.payload = {
 details: {
 health: {
 age: Age,
 temperature: Temperature,
 systolic: Systolic,
 diastloic:Diastolic,
 pulse: Pulse,
 output: output
 }
 }
}
return msg;

```



Edit template node

Template type: Widget in group

Group: [Home] Health Status

Size: auto

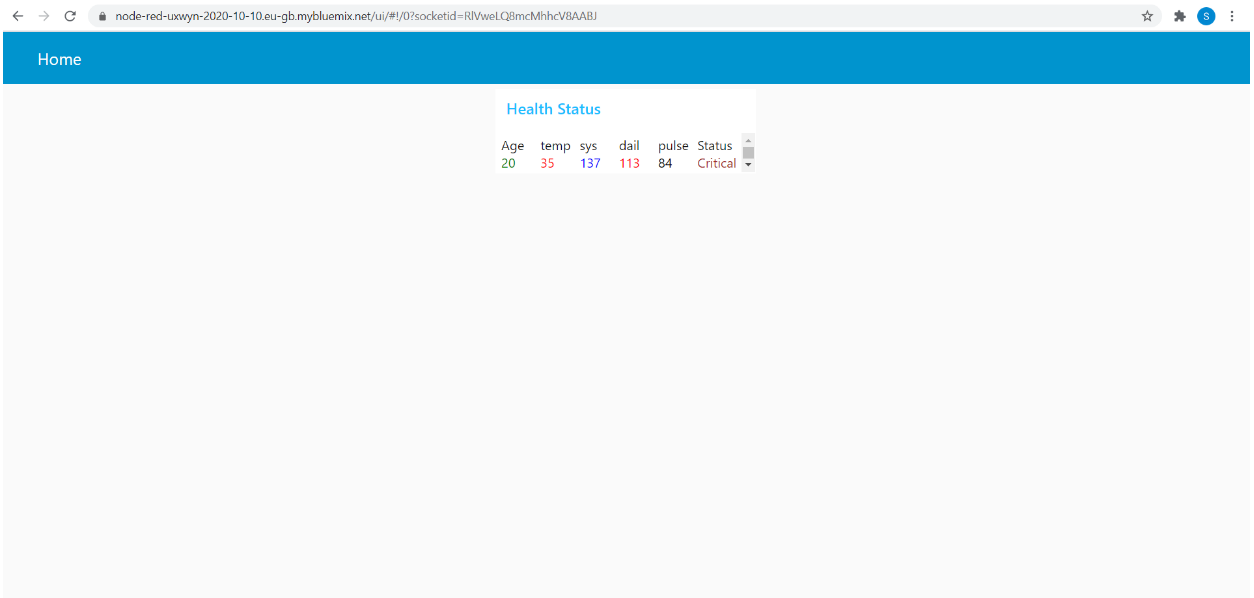
Name:

Template

```
<div layout="row" layout-align="start center">
 <span flex>Age</span>
 <span flex>temp</span>
 <span flex>sys</span>
 <span flex>dail</span>
 <span flex>pulse</span>
 <span flex>Status</span>
</div>
<div layout="row" layout-align="start center" ng-re
 <span flex style="color: green">{{health.age}} </s
 <span flex style="color: red"> {{health.temperatur
 <span flex style="color: blue"> {{health.systolic]

```

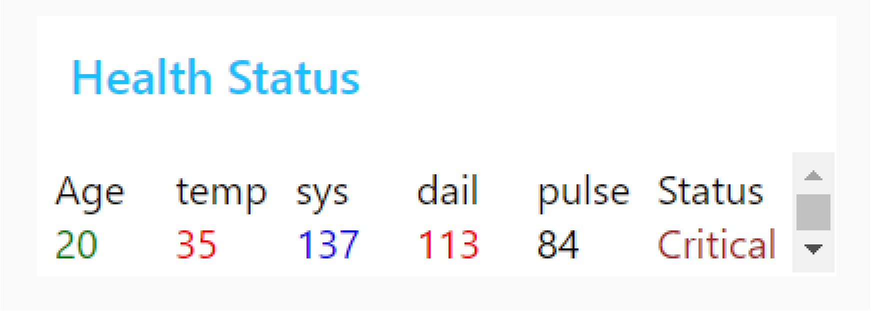
Remote Health Monitoring System with Analytics Dashboard

OUTPUT:


node-red-uxwyn-2020-10-10.eu-gb.mybluemix.net/ui/#!/0?socketid=RlVweLQ8mcMhhcV8AABJ
Home

Health Status

Age	temp	sys	dail	pulse	Status
20	35	137	113	84	Critical



Health Status

Age	temp	sys	dail	pulse	Status
20	35	137	113	84	Critical

Result:
A machine learning algorithm is deployed in Watson studio and predicted the output by sending the sensor data from the IOT Device using IOT Platform and node-red Service.