Remote Health Monitoring System with Analytics Dashboard

1 INTRODUCTION

1.1 Overview

This project is an application of machine learning and IOT to the medical field. The Remote Health Monitoring System with Analytics Dashboard is actually about predicting the health status of the user through some vital metrics that are measured in real time by an iot device.
These metrics are the heart pulse, temperature, and blood pressure. They are calculated then sent to an ML model trained on the adequate dataset to eventually predict the health status which will be Normal, Critical or another status indicating a specific health issue (Hertension, Hypotension, Hypothermia…). A mobile app is developed to be the user interface of this project.

1.2 Purpose

Our application can be used both at home and in hospitals. It helps doctors and nurses control their patients status. Since our application is connected to vital signs measurement devices, medical care staff can be notified with emergency cases immediately. Thus they're able to provide help quickly.

2 LITERATURE SURVEY

2.1 Existing problem

Remote patient management has been tackled by a lot of projects. Some companies offer several applications that help monitor vital signs by nurses while patients are home at hospitals.
As an example we can mention Napier Healthcare, having an interactive dashboard that offers tele consultation, assessments and panic alerts.

2.2 Proposed solution

Our application's added value compared previously mentioned existing solutions is the health status prediction, that is updated continuously thanks to our iot measurement devices and machine learning classifier.

3 THEORETICAL ANALYSIS

3.1 Block diagram

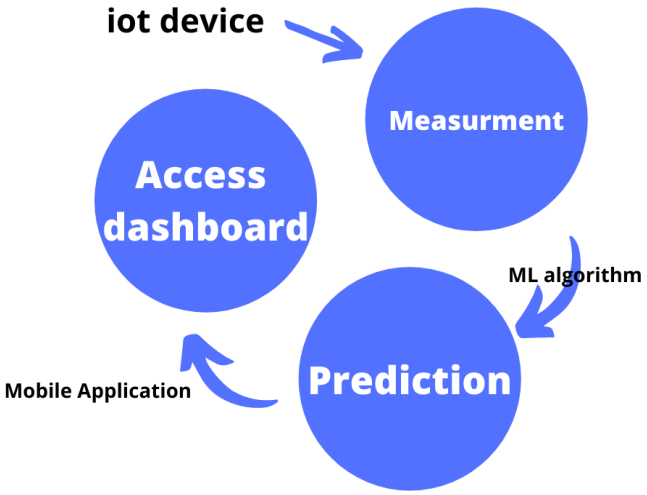

Fig1

3.2 Hardware / Software designing

- Hardware requirements

Thermometer	temperature measurement
Blood pressure monitor	blood pressure measurement
Pulse rate monitor	heart pulse rate measurement

- Software requirements

IBM Watson IOT Platform	Uploading vital signs data to the cloud
Python	data preprocessing
IBM Watson Machine Learning Platform	Predict the health status
Mobile Application	access the dashboard

4 EXPERIMENTAL INVESTIGATIONS
4.1 IOT sensors simulation:

Blood Pressure Category	Systolic mm Hg (upper #)		Diastolic mm Hg (lower #)
Normal	less than **120**	and	less than **80**
Prehypertension	**120 – 139**	or	**80 – 89**
High Blood Pressure (Hypertension) **Stage 1**	**140 – 159**	or	**90 – 99**
High Blood Pressure (Hypertension) **Stage 2**	**160** or higher	or	**100** or higher
Hypertensive Crisis (Emergency care needed)	Higher than **180**	or	Higher than **110**

Fig2

Based on the figure above[1], this data was generated on the Watson IOT Platform to play the role of the informations sent continuously from the iot measurement tools.

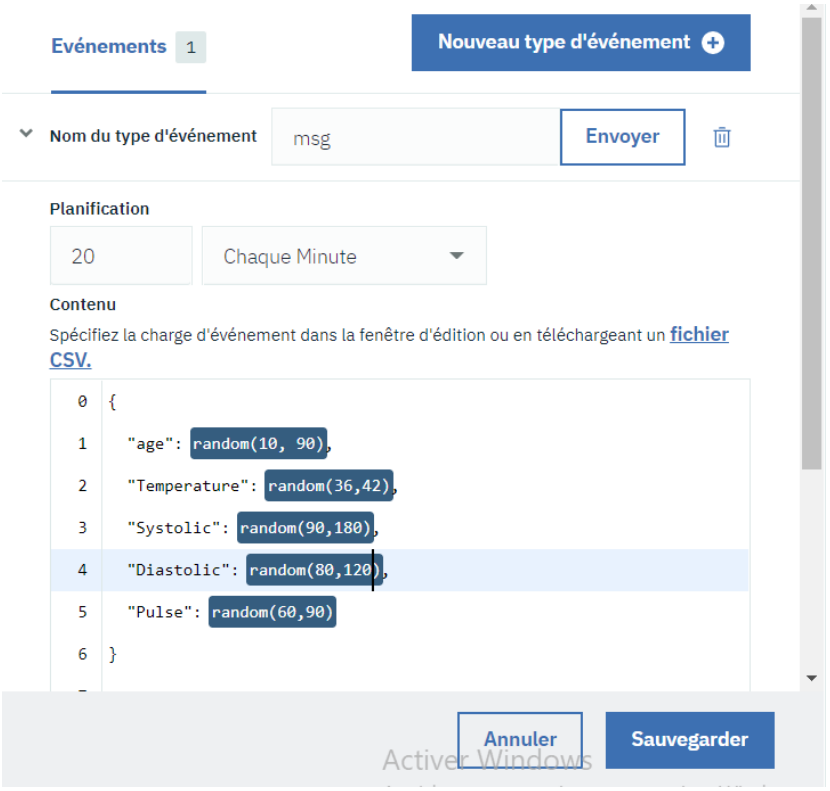

Fig 3

4.2 Data collection:

For the classifier model training, I had to use this dataset [2].
Dataset description (visualization and preprocessing):
Our dataset contains 985 rows and 7 columns (age, temperature, blood pressure: systolic and diastolic, pulse and status: our target).

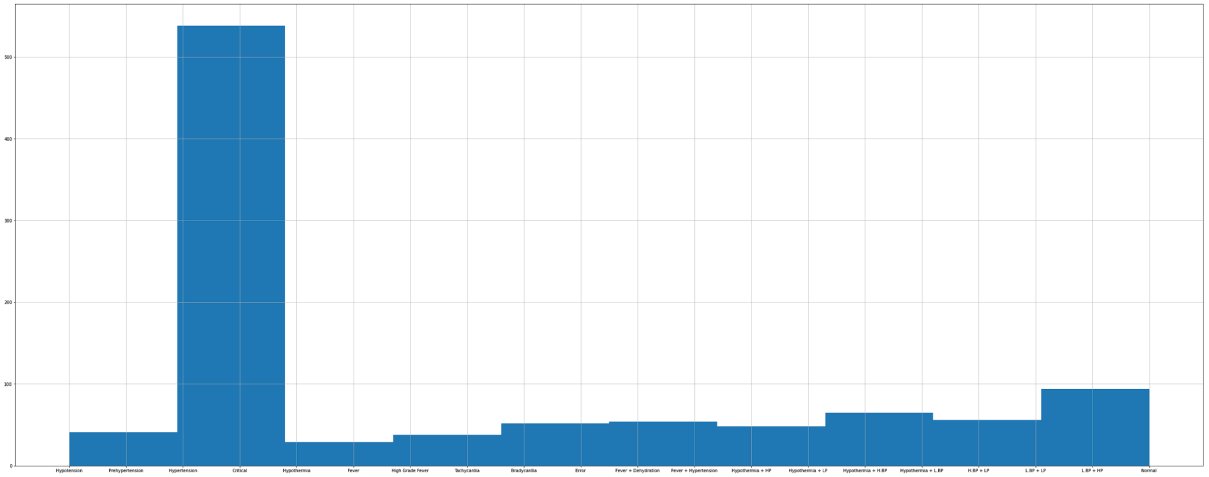

Fig4

Fig 4 indicates the distribution of the health status.

As we can see, some of the rows have Error as the health status. To prevent these rows from misleading our model, they have been dropped.

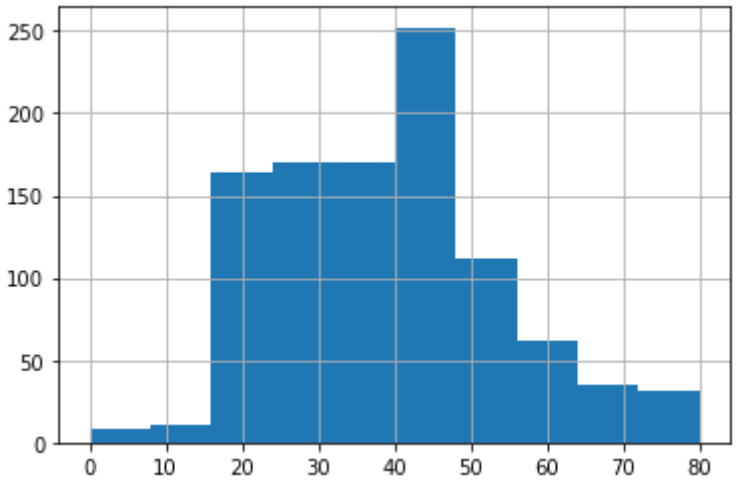

Fig 5

Fig 5 indicates the distribution of age.

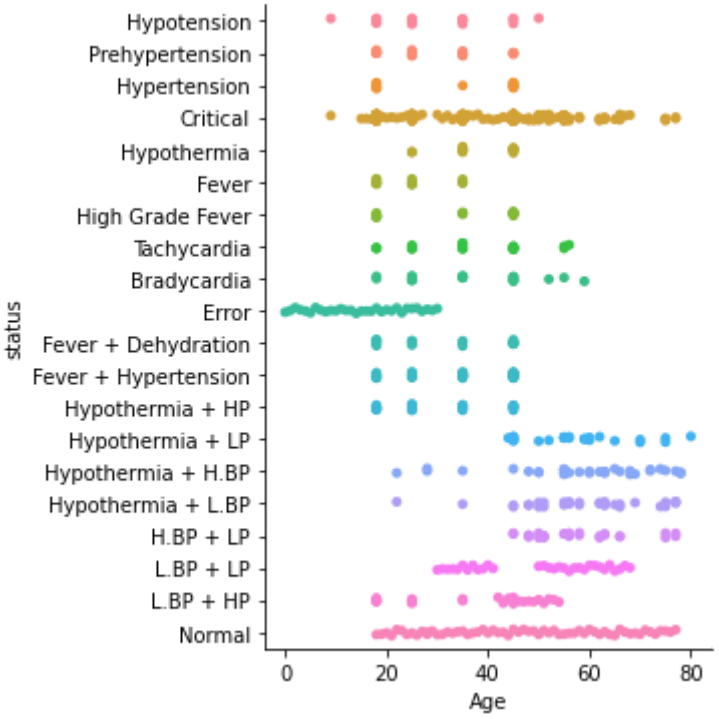

Fig 6

Fig 6 indicates the distribution of the health status by age.

4.3 Model implementation:
Since our target is not binary, we chose to use multiple classifier algorithms. On the IBM Watson machine learning platform we trained several models on our dataset. The most performing one: decriminalizing decision tree was deployed eventually.

Rang ↑	Nom	Algorithme	Précision (optimisé)	Améliorations	Heure de création
★ 1	Pipeline 3	Discriminant d'arbre de décisions	0.953	HPO-1 FE	00:0 Sauvegarder sous
2	Pipeline 4	Discriminant d'arbre de décisions	0.953	HPO-1 FE HPO-2	00:00:08
3	Pipeline 1	Discriminant d'arbre de décisions	0.948	*Aucun*	00:00:01
4	Pipeline 2	Discriminant d'arbre de décisions	0.948	HPO-1	00:00:03

Fig 7

4.4 Mobile Application:

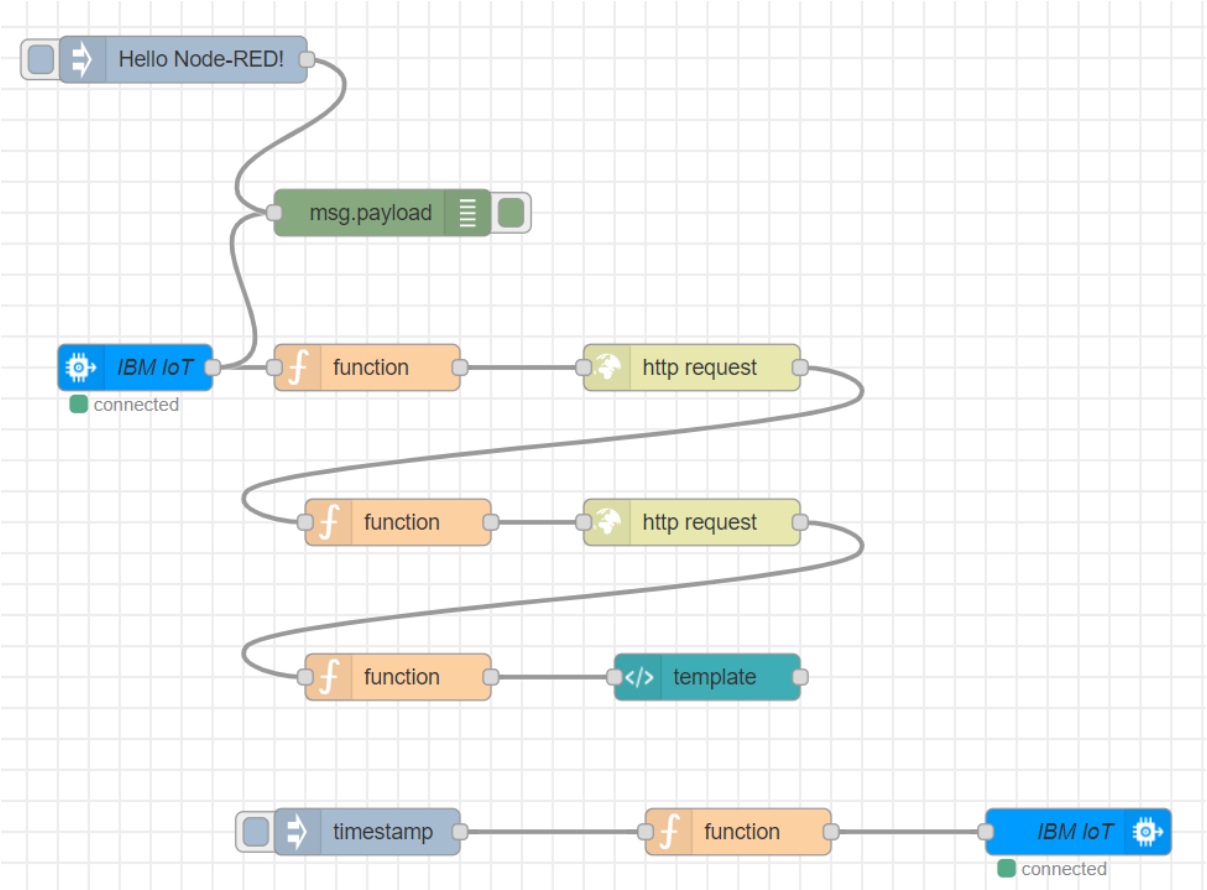

Fig8

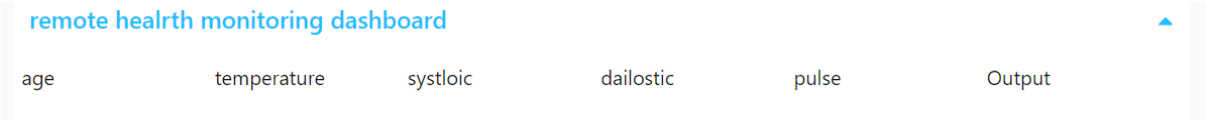

Fig 9

Node Red was used to connect both the iot devices and the ml model with our application.

5 FLOWCHART

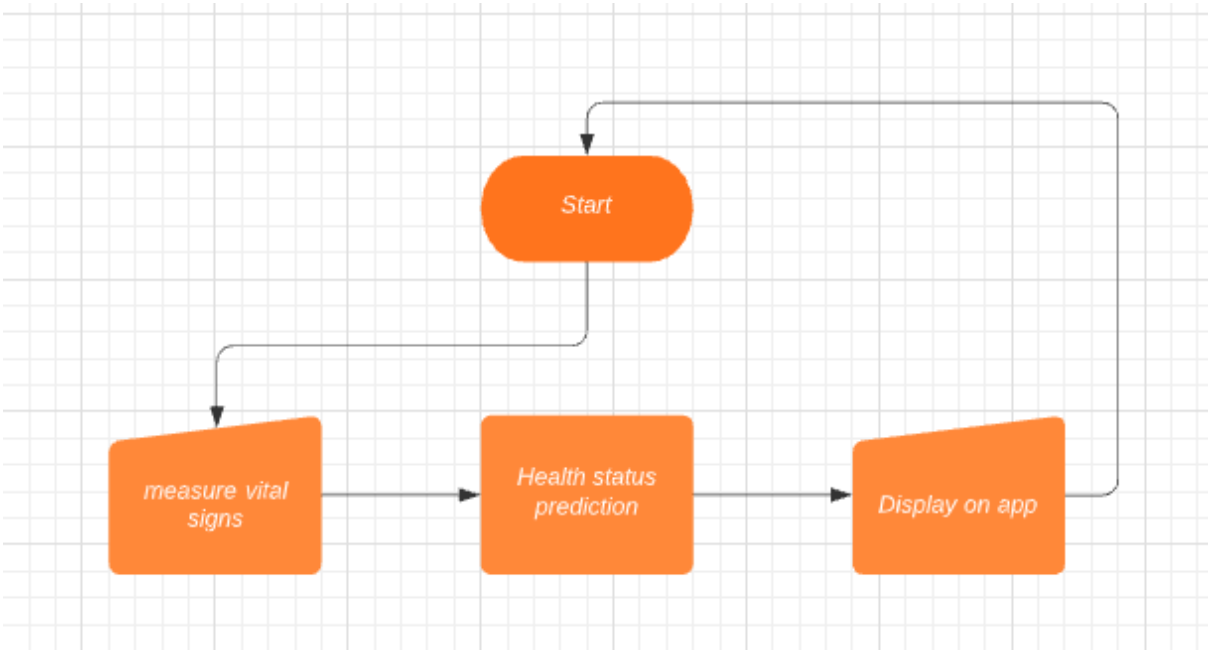

Fig 10

6 RESULT

Our model predicts the health status 0.953 precision rate. Unfortunately it could not be deployed because of the limited Capacity Unit Hours. During the build-a-thon challenge, I worked on more than one project and deployed a lot of models. Thus, I chose to continue the UI part and submit what I managed to accomplish.

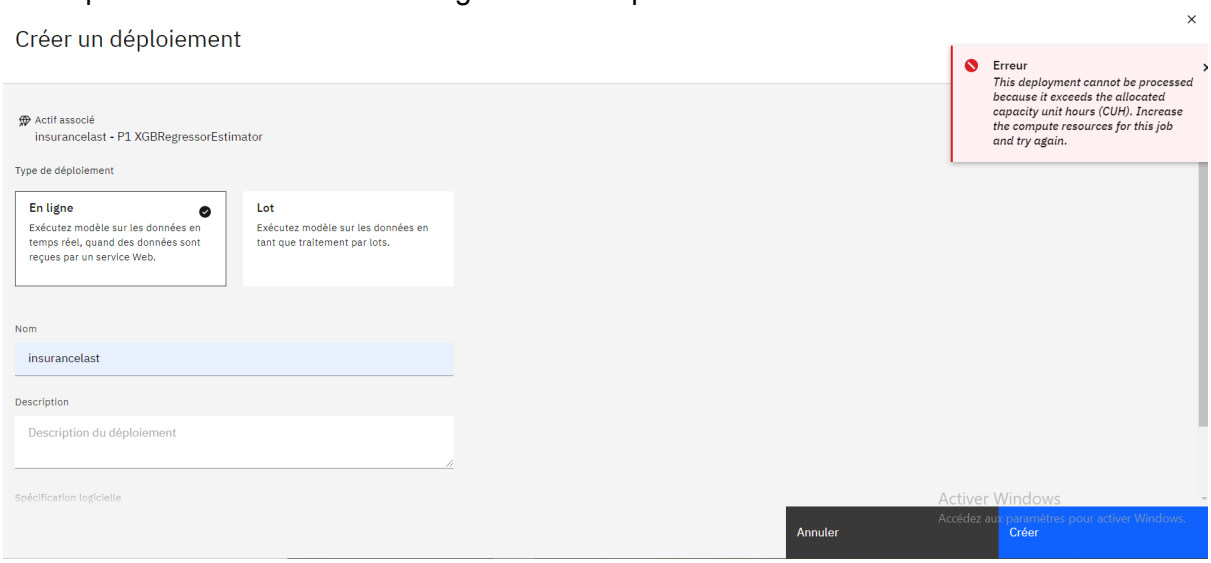

Fig 11

7 ADVANTAGES & DISADVANTAGES

List of advantages and disadvantages of the proposed solution

- advantages:
    - Very good prediction accuracy.
    - Continuous monitoring thanks to the use of IOT technologies.

- disadvantages:
    - Limited to one feature.

8 APPLICATIONS

This solution can be applied in clinics, hospitals and at home. It can be used by medical care staff or by people who are taking care of someone at home.

9 CONCLUSION

In this project, I managed to explore the IBM Watson IOT, IBM Watson Machine Learning and Node Red platforms to finally build a pipeline of connected components. First, thanks to the IOT platform I simulated vital signs measurement sensors. Then, trained a classifier on the ML platform to predict the health status of our user. Finally a dashboard was implemented using Node Red to access our solution.

10 FUTURE SCOPE

At this phase, my project can be enhanced in two ways:

- Programming real iot devices to measure the vital signs.
- Adding additional useful features to make the application complete.