IoT Enabled Healthcare System with Machine Learning Analysis

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Introduction

The project incorporates the idea of IoT in healthcare system along with Machine Learning for detailed analysis. The sensors used for this proposed system are, heart beat sensor, blood pressure sensor and temperature sensor. KNN algorithm has then been implemented to classify if the dataset correlates to a heart disease or not.

Motivation

The current healthcare infrastructure and the lack of abundance of a proper health check-up for the elderly and the physically challenged group in the rural parts of Nepal provided as a motivation to come up with a solution project.

SCOPE of the Project

The proposed system is not limited to only a specific population group nor with the data collection sensors. Other sensors too could be implemented on the project to collect various data form the patients.

The majority of the project focuses on a target age group and people but the idea could be expanded from rural to even cities. Other algorithms could then be incorporated to get the needed analysis form the collected data. Also, similar idea could be implemented for other data collection and analysis (other sectors).

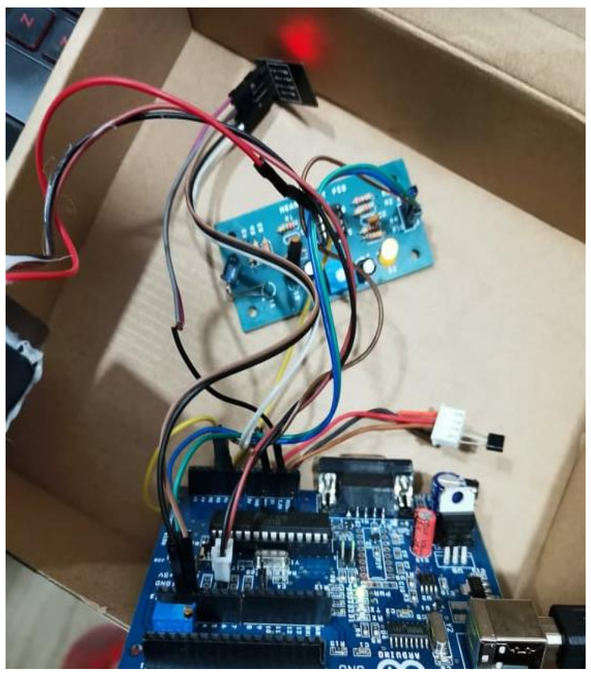
Methodology

An Arduino Uno board was used to connect the sensors. Heartbeat Sensor, Temperature Sensor and Blood Pressure Sensor modules were implemented.

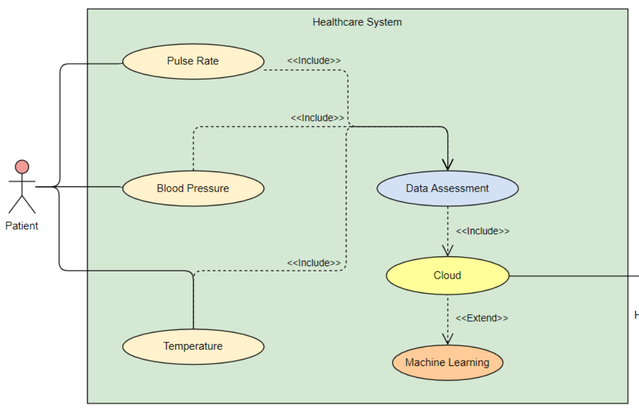
As the lingo identifies them the heart beat sensor was used to collect the heart beat of the user. Similarly with the help of temperature sensor the temperature of the patient was recorded. Blood pressure module helped to covert the analogue data into digital format.

The data then collected from these sensors were sent over to *Thingspeak* database using the help of a Wi-Fi module.

The diagram of the project is detailed below.



The figure shows the connection of the heart beat sensor, temperature sensor and the blood pressure sensor module with the Arduino Uno board along with the incorporation of the Wi-Fi Module.



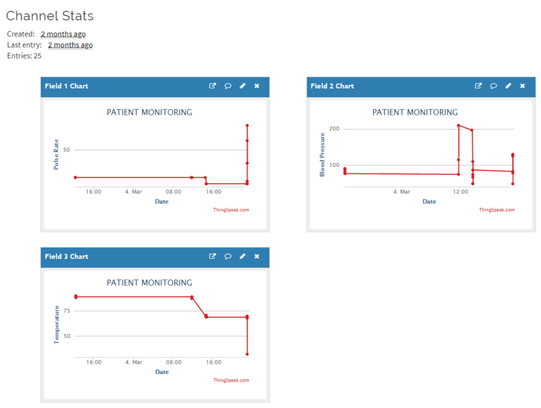
The figure shows the Use-Case Diagram (System Model) of the project. It shows how the data is collected from the patient and stored into a remote database. Now, the data could be extracted by the health post worker and Machine Learning algorithm could be implemented.

```
In [21]: knn_classifier = KNeighborsClassifier(n_neighbors = 12)
         score=cross_val_score(knn_classifier,X,y,cv=10)

In [22]: score.mean()

Out[22]: 0.8506637004078605
```

The figure shows the application of KNN algorithm on the obtained dataset to calculate the mean value.

Results

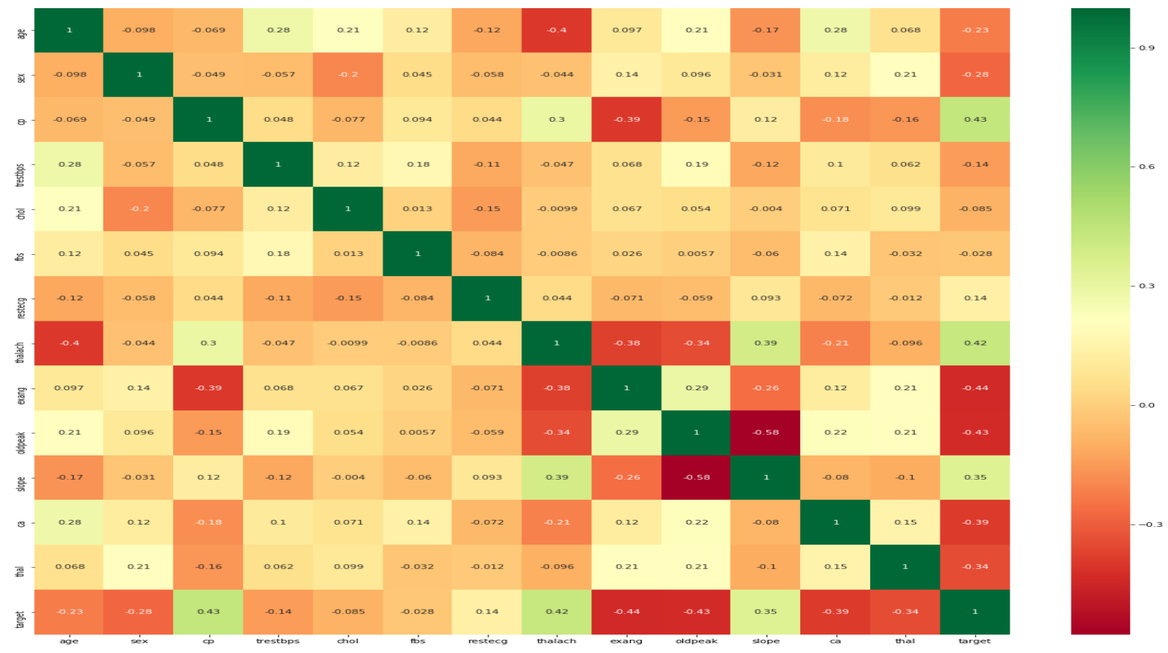
The results collected from the sensors were stored on-to the *Thingspeak* database.



The figure shows the visual representation of the data collected by the sensors on the Thingspeak webpage.

The proposed model was able to collect the data from the patient and was able to send and store it into the *Thingspeak* webpage.

Now, the data that was used to perform the machine learning algorithm was obtained from *Kaggel*. The dataset was further used to identify if the patient had heart disease or not. Similar dataset collected from the proposed device can be implemented to predict disease or to simply analyse them into groups.



The figure shows the correlation of various symptoms and heart disease.

```
In [12]: dataset = pd.get_dummies(df, columns = ['sex','cp','fbs','restecg','exang','slope','ca','thal'])

In [13]: from sklearn.model_selection import train_test_split
         from sklearn.preprocessing import StandardScaler
         standardScaler = StandardScaler()
         columns_to_scale = ['age','trestbps','chol','thalach','oldpeak']
         dataset[columns_to_scale] = standardScaler.fit_transform(dataset[columns_to_scale])

         C:\Users\omen\Anaconda3\lib\site-packages\sklearn\preprocessing\data.py:625: DataConversionWarning: Data with input dtype int64, float64 were all converted to float64 by StandardScaler.
           return self.partial_fit(X, y)
         C:\Users\omen\Anaconda3\lib\site-packages\sklearn\base.py:462: DataConversionWarning: Data with input dtype int64, float64 were all converted to float64 by StandardScaler.
           return self.fit(X, **fit_params).transform(X)

In [14]: dataset.head()

Out[14]:
```

	age	trestbps	chol	thalach	oldpeak	target	sex_0	sex_1	cp_0	cp_1	...	slope_2	ca_0	ca_1	ca_2	ca_3	ca_4	thal_0	thal_1	thal
0	0.952197	0.763956	-0.256334	0.015443	1.087338	1	0	1	0	0	...	0	1	0	0	0	0	0	1	
1	-1.915313	-0.092738	0.072199	1.633471	2.122573	1	0	1	0	0	...	0	1	0	0	0	0	0	0	
2	-1.474158	-0.092738	-0.816773	0.977514	0.310912	1	1	0	0	1	...	1	1	0	0	0	0	0	0	
3	0.180175	-0.663867	-0.198357	1.239897	-0.206705	1	0	1	0	1	...	1	1	0	0	0	0	0	0	
4	0.290464	-0.663867	2.082050	0.583939	-0.379244	1	1	0	1	0	...	1	1	0	0	0	0	0	0	

The figure shows the dataset used for analysis.

Conclusion

The project could be expanded with multiple sensors at play. Here, the proposed system was able to collect data and store it remotely on *Thingspeak* webpage. Similarly, other sensors could be used and the idea could be expanded upon.

Furthermore, a GSM module could be used if the Wi-Fi is not available in the region where the project is to be implemented.

The proposed system could provided an solution to the already crippled health sector of Nepal and moreover, the detailed analysis could be used to keep tract of the health situations in a particular area.

References

[1] D.M. Jeya Priyadharsan, K. Kabin Sanjay, S. Kathiresan, K. Kiran Karthik and K. Siva Prasath, 'Patient health monitoring using IoT with machine learning', International Research Journal of Engineering and Technology (IRJET) (Mar 2019).

[2] Kun – Hsing Yu, Andrew L. Beam and Issac S. Kohane – Artificial Intelligence in healthcare – Nature Biomedical Engineering, 2018.