European Journal of Molecular & Clinical Medicine
ISSN 2515-8260 Volume 7, Issue 4, 2020

A REAL TIME IOT BASED PATIENT HEALTH MONITORING SYSTEM USING MACHINE LEARNING ALGORITHMS

Yedla Vineetha [1], Yogesh Misra [2], K.Krishna Kishore [3]
PG scholor[1]ECE Department, GMRIT, Rajam, Affiliated to JNTUK University, AP, INDIA
Professor[2]ECE Department, GMRIT, Rajam, Affiliated to JNTUK University, AP, INDIA
Assistant professor[3]ECE Department, GMRIT, Rajam, Affiliated to JNTUK University, AP, INDIA . [1]
vineethayedla@gmail.com

ABSTRACT:
In the current's world the important factor is the nation's security. One of the essential and crucial parts is showed by the army soldiers. There are many considerations concerning the security of the soldiers. So Soldiers security purpose, more devices are set up on them to observe Soldiers health condition as well as their actual time position. This report provides ability to track the position and observes health condition of the soldiers in present time who become lost and get damaged in the battleground. It serves to reduce the time, search and recovery operation efforts of army control system. Bio-sensor systems provide various kinds of small-cost physiological sensors, communication factors and facilities and thus can provide unobtrusive, cheap wearable solutions for health monitoring. For patient health monitoring systems we use the wireless body area networks (WBAN) is a such system that implements the regular control over or inside the human body for the long time and it supports the transmission real time traffic such as the data, voice, video to look at the status of the basic organs functions. For the soldiers health monitoring k-means clustering algorithms and hierarchical clustering algorithms are used. K-means clustering method and hierarchical clustering methods is the one of the methods of the machine learning. The gathered data will be uploaded on the cloud for the analysis of the data and the estimates. By using the K-means clustering method and the hierarchical clustering algorithm.

Key words: wireless body area networks(WBAN), k-means clustering, hierarchical clustering.

1. INTRODUCTION

The soldiers must be incorporated into the automated monitoring system for health care. Real time to send and receive data from the control unit GPS(global positioning system) and data exchange. In addition to the protection of the country, the soldier must require protection, protecting himself with advanced arms and the military control unit must also monitor the solder's health status[1]. This ensures that military personnel need to connect with the wireless networks not just the control unit but also military staff side by side. To this end, bio-medical sensors and monitoring equipment are incorporated with the soldiers in this article. The devices incorporated must have a light weight and a less power consumption [2]. The soldiers are not in touch with the control room in the battlefield. To this end, the position of the soldiers should be monitored and the GPS should transmitted to the control station. In using the GPS, soldiers are correctly located and will be directed accordingly they will guide them. Smart Bio medical sensors are connected to the soldiers jacket heart beat ,ECG, temperature & humidity sensors, vibration sensors, pump detectors, etc. this device offers a wireless connection[3]. To the server at the base station. For further prediction using computer, data from the base station may be used machine learning algorithms. K-Means Clustering algorithm and hierarchical clustering algorithm.

Literature review a military health management scheme different wearable devices, thin, portable and light weight sensors developed in this study for the control of the health of the soldiers. More physiological sensors such as blood pressure sensors and humidity sensors are part of the body sensor network (BSN), which are all linked a BSN[4]. GPS based on soldiers health tracking system in this report, soldiers are monitored using GPS. For the wireless communications of a soldier to a soldier that will contribute to providing soldiers with health status and control room unit[5]. The RF module is used for the quick trans mission and short distance data. In this study "soldiers health and Lok ID system" using the GPS and GSM pressure sensors GPS and WBASN(heart beat sensors and heat sensors). Soldiers health and locational identification system this prototype was used with the microcontroller ATmega328p[6]. In this study the "IOT –based health controlling by way of LoRaWAN" suggested that collected data from a medical sensor be set up as analysis module using the LoRaWAN(long range wide area network) network via low-cost, energy safe communication. System of soldier tracking and health indicator we use a sensor vibration control heart rate GPS. The sensors are combined with the jacket of soldiers. By using GPS module, the soldiers are located and guided[7].

2. METHODOLOGY

Real-time data sensing in the war zone: data obtained from the war zone would show the health status of the soldiers. Proper sensors are proposed for deployment in order to help the control unit map the conditions around soldiers using the k-means algorithm [8]. The Data transmission: information is transmitted via Zig Bee from the soldier to the leading squadron control the squadron manager gathers information and uses LoRaWAN to move over the control device then the data are obtained and the machine learning algorithms are separated[9]. K-means clustering algorithm and hierarchical clustering algorithm are constructed by using simple conditional statements K-means algorithm. These are the unregulated learning algorithms used to visualize and combine the similar type of data.

3. K-means clustering algorithm:

The K-means clustering algorithm performs the division of the objects into the clusters which are the "similar" between them and they are "dissimilar" to the object belonging to the another cluster.

1. The K-means clustering method first define the collection of the clusters K.

2. Then load the centroids first and dragging the data set and randomly choosing the K- means data points for each centroids without the restoration.

3. Keeping the iterating process until there is no difference between centroids that is the position of the data points clusters is not changing.

The objective function is the

$$J = \sum_{i=1}^{m} \sum_{k=1}^{K} \omega_{ik} \left\| x^i - \mu_k \right\|^2 \qquad \text{---- (1)}$$

Where $\omega_{ik} = 1$ for the data point x_i if it is belonging to the cluster K; then otherwise when the w is the $\omega_{ik} = 0$ also μ_k is centroid of the x_i of clusters.

It is the minimization problem of the two parts. first minimize the J with respect to the μ_k.

$$\frac{\partial J}{\partial \omega_{ik}} = \sum_{i-1}^{m} \sum_{k=1}^{K} \left\| x^i - \mu_k \right\|^2$$

$$\Rightarrow \quad \omega_{ik} = \begin{cases} 1 if k = \arg\min_j \left\| x^i - \mu_j \right\|^2 \\ 0 otherwise. \end{cases} \qquad \text{----- (2)}$$

In the other words the assign of the data points x_i to the closest of the cluster. It is the sum of the squared distance from clusters centroid.

$$\frac{\partial J}{\partial \mu_k} = 2\sum_{i=1}^{m} \omega_{ik} \left(x^i - \mu_k\right) = 0 \Rightarrow \quad \mu_k = \frac{\sum_{i=1}^{m} \omega_{ik} x^i}{\sum_{i=1}^{m} \omega_{ik}} \qquad \text{----- (3)}$$

The k-means iterative way and irregular initialize of the centroids start of the method, for the various initializations may contribute to the various clusters[10]

$$\frac{1}{m_k} \sum_{i=1}^{m_k} \left\| x^i - \mu_{c^k} \right\|^2 \qquad \textbf{---- (4)}$$

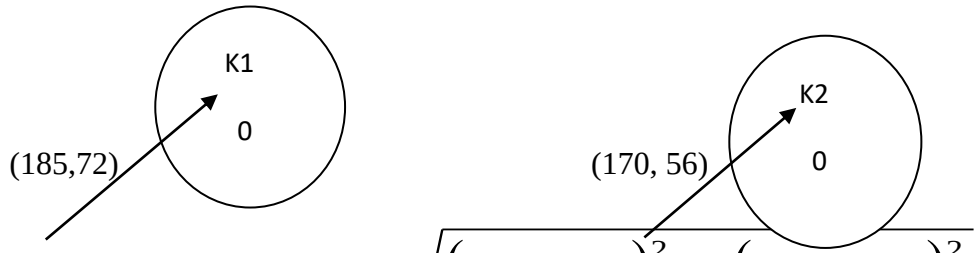
For an example we find the number of clusters. Using the K-means clustering algorithm.

Number	X1	X2
1	185	72
2	170	56
3	168	60
4	179	68
5	182	72
6	188	77
7	180	71
8	180	70
9	183	84
10	180	88
11	180	67
12	177	76

Table 1 Number of clusters.

To solve this we have to find the euclidean distance.

$$\sqrt{\left(x_o - x_c\right)^2 + \left(y_o - y_c\right)^2} \qquad \text{----- (5)}$$



From the euclidean distance (3) $\sqrt{\left(x_o - x_c\right)^2 + \left(y_o - y_c\right)^2}$

$$\text{K1} = \sqrt{(168 - 185)^2 + (60 - 72)^2}$$

K1= 20.80

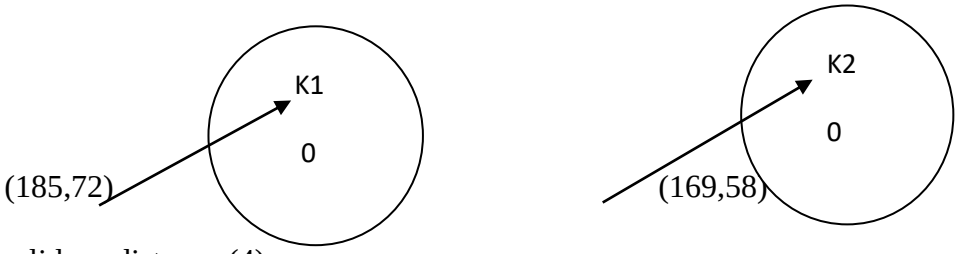
$$\text{K2} = \sqrt{(168 - 170)^2 + (60 - 56)^2}$$

K2= 4.48

New centroid calculations:

$$\text{For K2} = \left(\frac{x_o + x_c}{2}, \frac{y_o + y_c}{2} \right) \quad \text{---- (6)}$$

$$\text{K2} = \left(\frac{170+168}{2}, \frac{60 + 56}{2} \right) = (169, 58)$$



From the euclidean distance (4)

$$\text{K1} = \sqrt{(179 - 185)^2 + (68 - 72)^2}$$

K1 = 6.32

$$\text{K2} = \sqrt{(179 - 169)^2 + (68 - 58)^2}$$

K2 = 14.14

K1= {1,4,5,6,7,8,9,10,11,12}

K2 = {2,3}

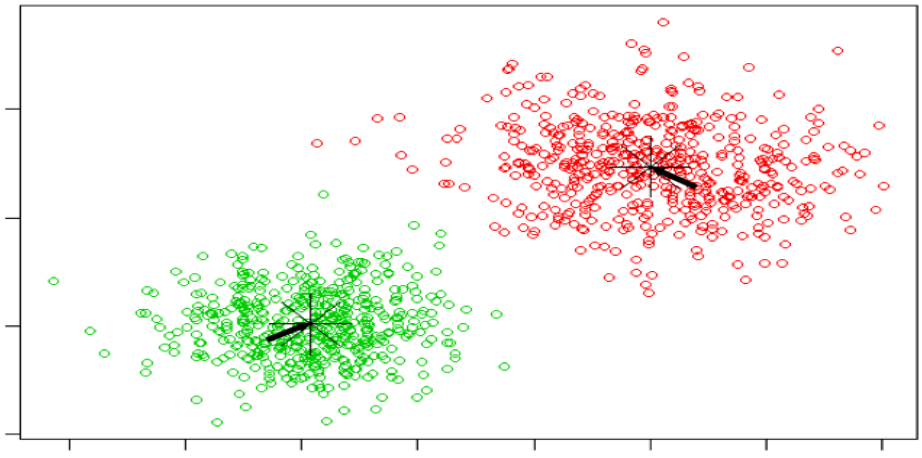


Figure 1 Centroids of the K-means clustering algorithm

4. Hierarchical clustering algorithm:

The hierarchical clustering algorithm is the one of the machine learning technique. The method is the clustering analysis two types of the clusters. They are agglomerative clusters and divisive clusters.

In the hierarchical clustering algorithm can assigning the each of the object (the data point) to a separation of the cluster. Then to find the distance (similarity) in between each of the cluster and join two most similar clusters.

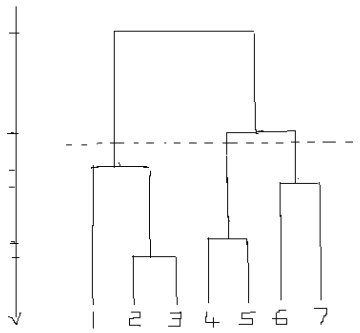
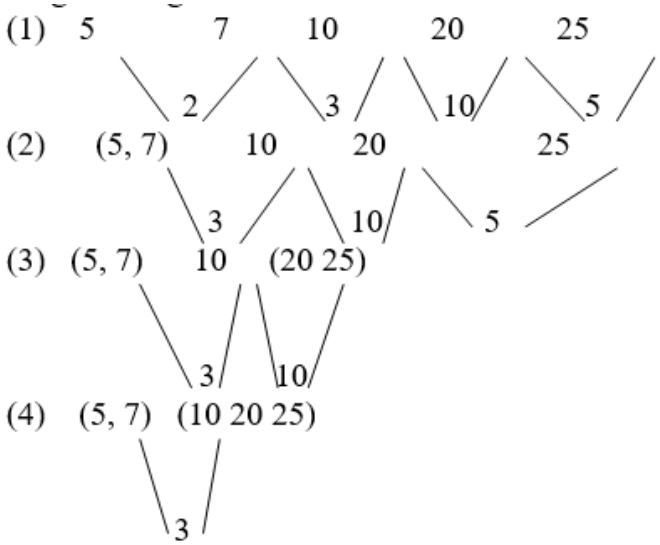


Figure 2 hierarchical clustering algorithm dendogram

For the one dimensional data set **{**5, 7, 10, 20, 25 **}**, to perform hierarchical clustering algorithm and plot dendogram to visualize it.

1. The first two points (5 and 7) are close to each other and should be in the same cluster.
2. Also the last two points (20 and 25) are close to each other and should be in the same cluster.
3. Cluster of the center point (10) is not easy to conclude.
4. The problem is to solve using the hierarchical clustering. It has two types single linkage and the complete linkage to find the clusters.

Single linkage:



By using the single linkage of the two clusters are formed.
Cluster 1 : (5 7)
Cluster 2 : (10 20 25)

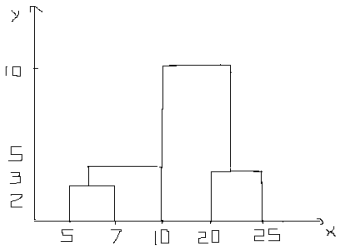
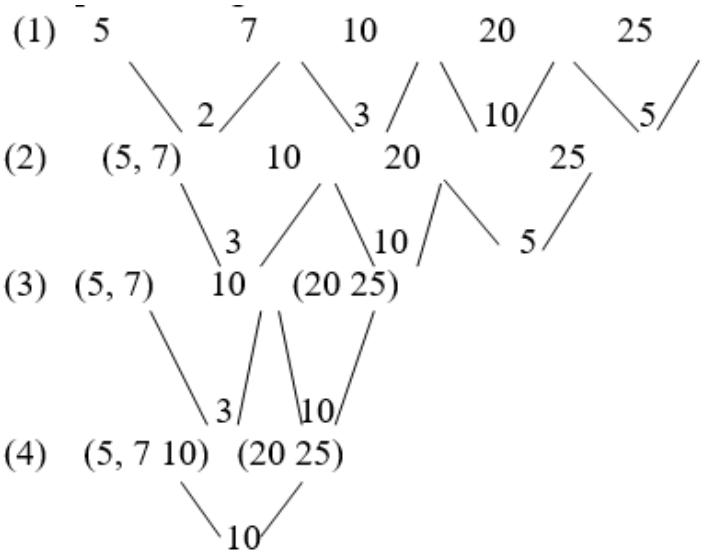


Figure 3 single linkage of the hierarchical clustering.

Complete linkage:



By using complete linkage two clusters are formed.
Cluster 1: (5 7 10)
Cluster 2: (20 25)

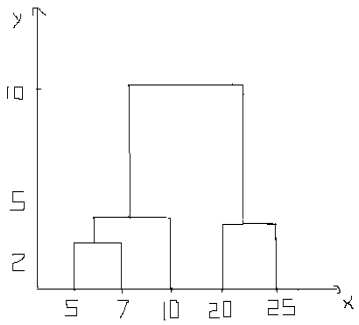


Figure 4 complete linkage of hierarchical clustering algorithm.

Comparison of K-means clustering method and hierarchical clustering method:

Properties	K-means clustering method	Hierarchical clustering method
Definition	A particular number of disjointed, flat clusters is generated by k-means clustering method.	The clustering hierarchy builds the clustering hierarchy, not just single partition of objects.
Clustering criteria	The K-means clustering method is well suited to generating globular cluster.	The hierarchical clustering to use the distance of the matrix as the clustering of the criteria. The termination condition can be used.
Performance of the system	This approach works better than the hierarchical method of clustering.	The efficiency of the k-means approach is less comparable.
The Category data	The K-means clustering algorithm used in the data category shall be first numerically transformed by assigning the category data rank.	It adopts a new approach to assigning grade value to each categorical data for due to its sophistication.
Sensitive to noise of the system	The data collection is more vulnerable to noise.	The data collection is less vulnerable to noise.
The Cluster	The task is always K.	Cluster K numbers as an input are not required.
The Execution time	K implies that the algorithm clustering improves run-time.	The Hierarchical clustering method of clustering increases its efficiency.
The Quality	It shows less quality of the system	It shows more quality of the system
The Data set	It is good for the large data set.	It is good for the small data set.

Table 2: Comparison of K-means clustering method and hierarchical clustering method

BLOCK DIAGRAM

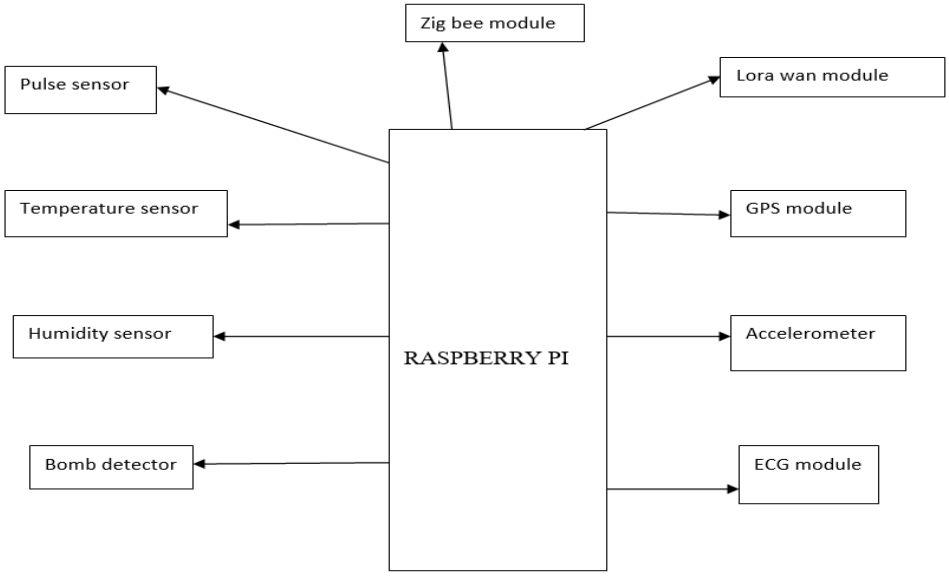


Figure 5: the block diagram of the Soliders system

The block diagram consists of the some sensors are integrated with the raspberry pi model. The sensors are the temperature sensor, humidity sensor, pulse sensor ECG module GPS module LoRa WAN module bomb detector and accelerometer and Zig Bee module. These sensors are integrated with the soldiers jacket[11]. The GPS module is used to track the location of the soldiers.

IMPLEMENTATION

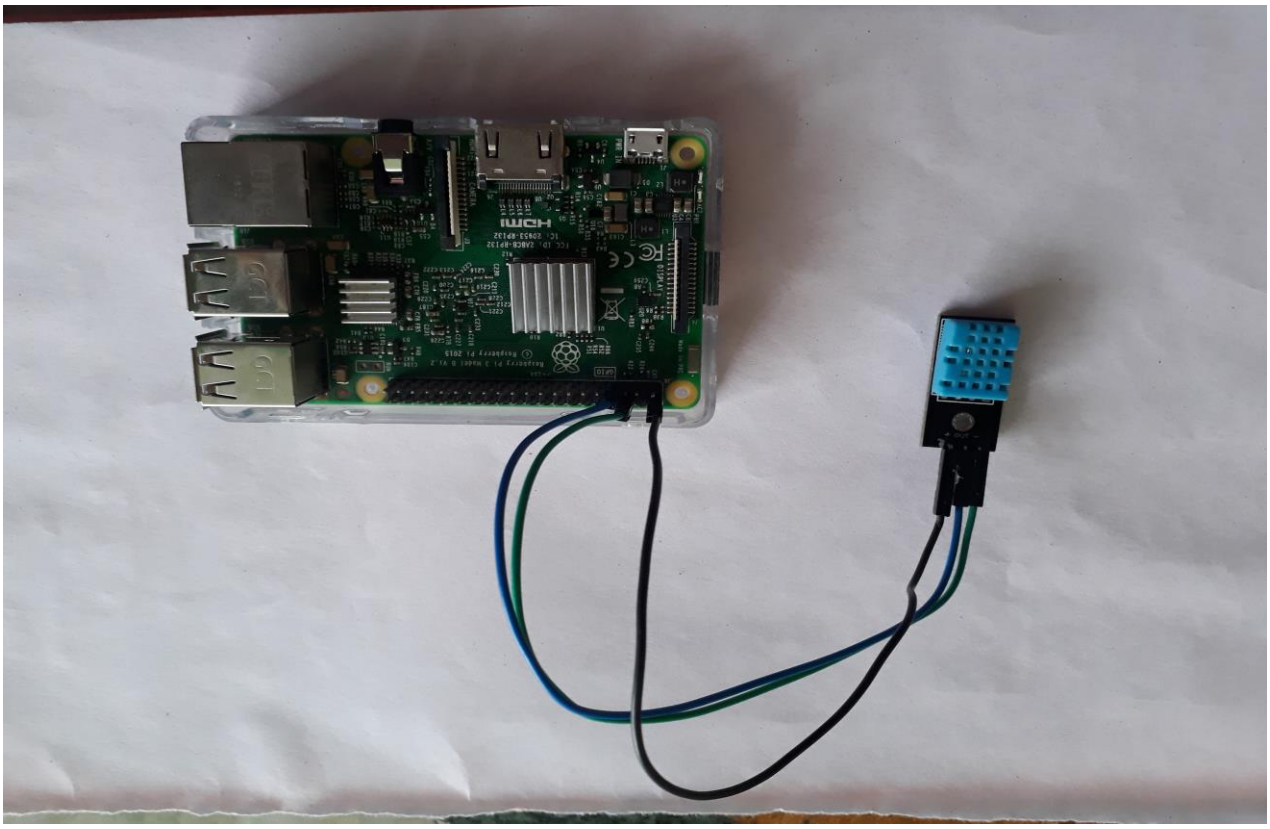


Figure 6 implementation of the temperature and humidity sensor with raspberry pi

With the raspberry pi is integrated the temperature and humidity sensor DHT11. The digital tempetature and humidity sensor is simple and ultra low-cost. By using this sensor, the temperature and humiidity of this specific area are established. It is used to measure the surrounding air using the capacitive humidity sensor and a thermistor.

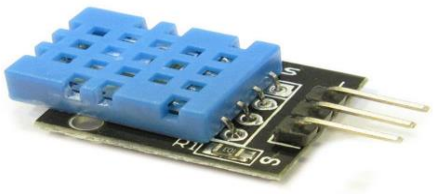


Figure 7 DHT11 sensor

The ability of this sensor 3 to 5v. and use max 2.5 mA during the conversion DHT11 has four VCC,GND and unconnected pins. It has a DHT11 sensor. For communication between the microcontroller, a pull-up resistor from 5k to 10k ohms is provided. This sensor is used in heating, ventilation and air conditioning systems to measure humidity and temperature values. These sensors are also used by weather stations to

forecast weather conditions.

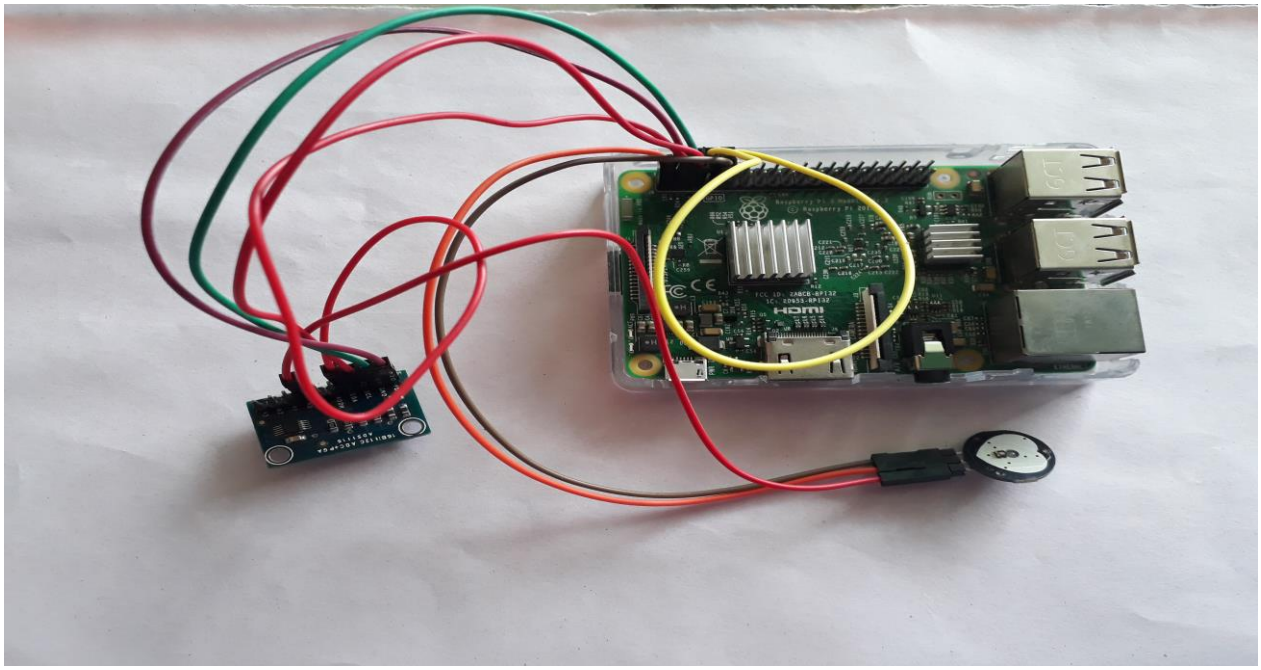


Figure 8 implementation of the pulse sensor with ADC with raspberry pi

The pulse sensor is integrated with the analog to digital converter with the raspberry pi. The Analog to digital converter is used to to convert analog data into the digital data. Pulse sensor gives the analog data by using ADC the analog data will converted into digital data. in the ADC process mainly involves two steps of conversion sampling and holding and quantizing and encoding these two are the main steps of conversion.

Figure 9 pulse sensor

The 3-pin ground VCC signal contains the pulse sensor. The sensor has two sides on the one side and the light sensor on the other, the circuit on the other. The amplification and noise cancellation work is carried out in this circuit. The sensor leads one side into our human body over a vein[12]. This may be either your fingertip or ear tips, so it should be directly located on top of your vein.

5. RESULTS

Persons	Pulse value	Temperature value	Humidity value
1	74	27	57
2	77	28	60
3	80	28	58

4	85	29	56
5	90	29	55
6	100	30	54
7	106	31	69
8	111	31	69

Table 3: different persons pulse, temperature and humidity values

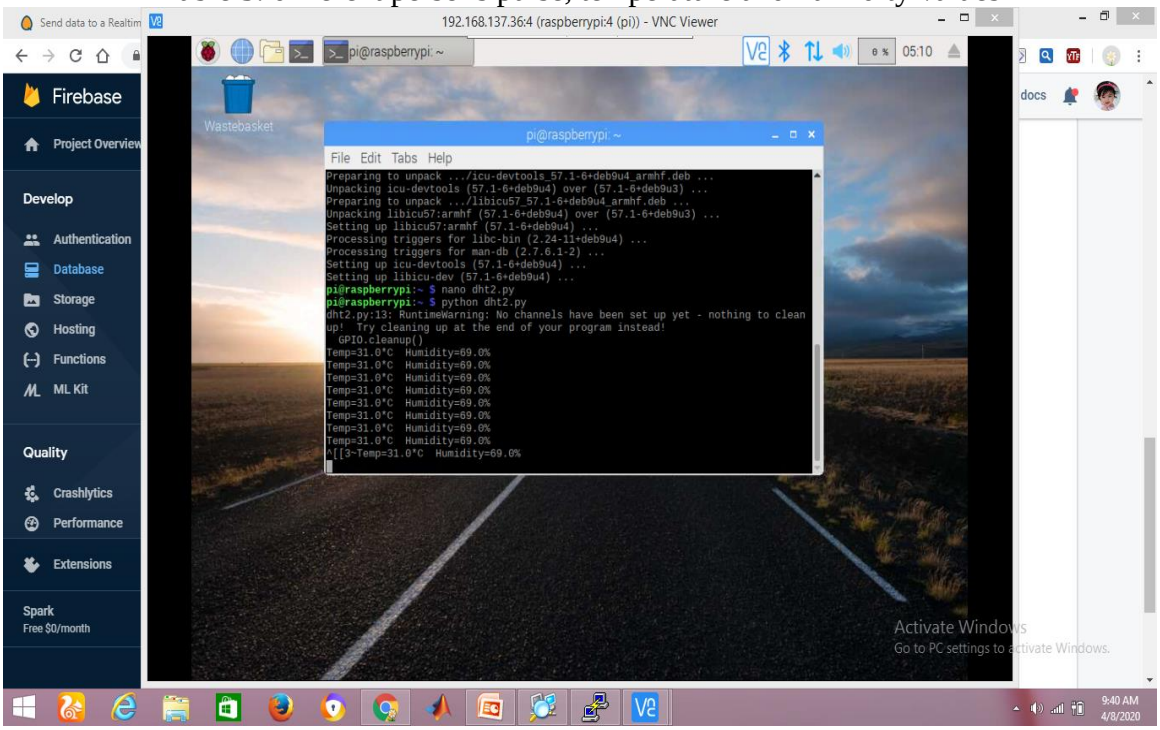


Figure 10 temperature and humidity sensor results

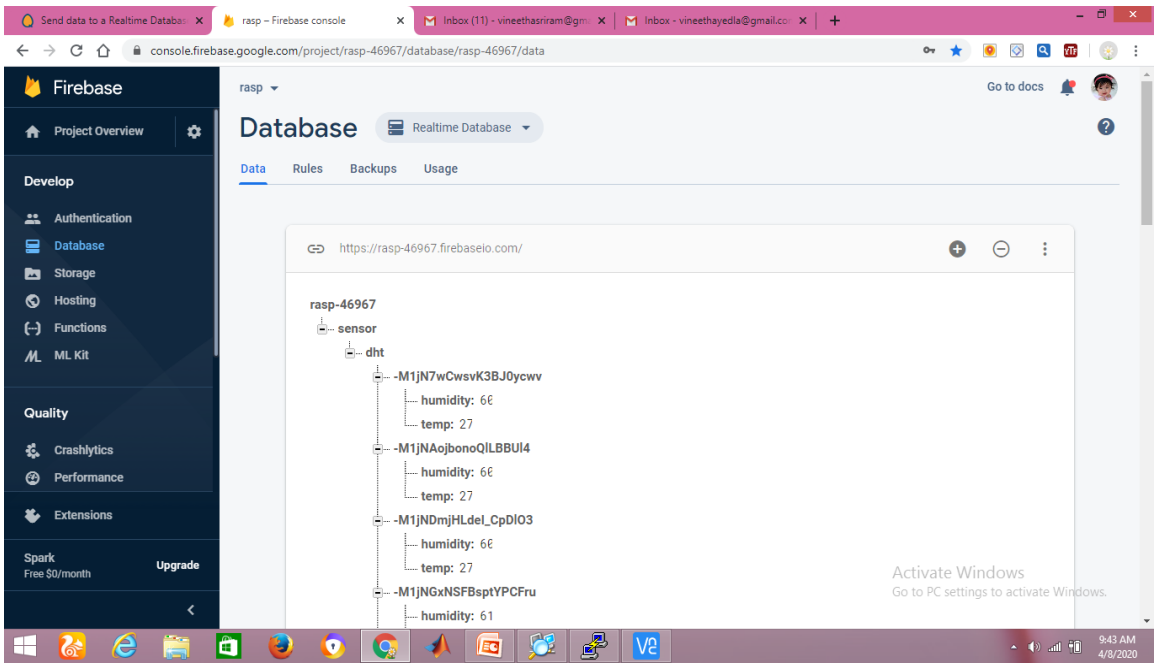


Figure 11 DHT11 sensor data send to real time firebase database

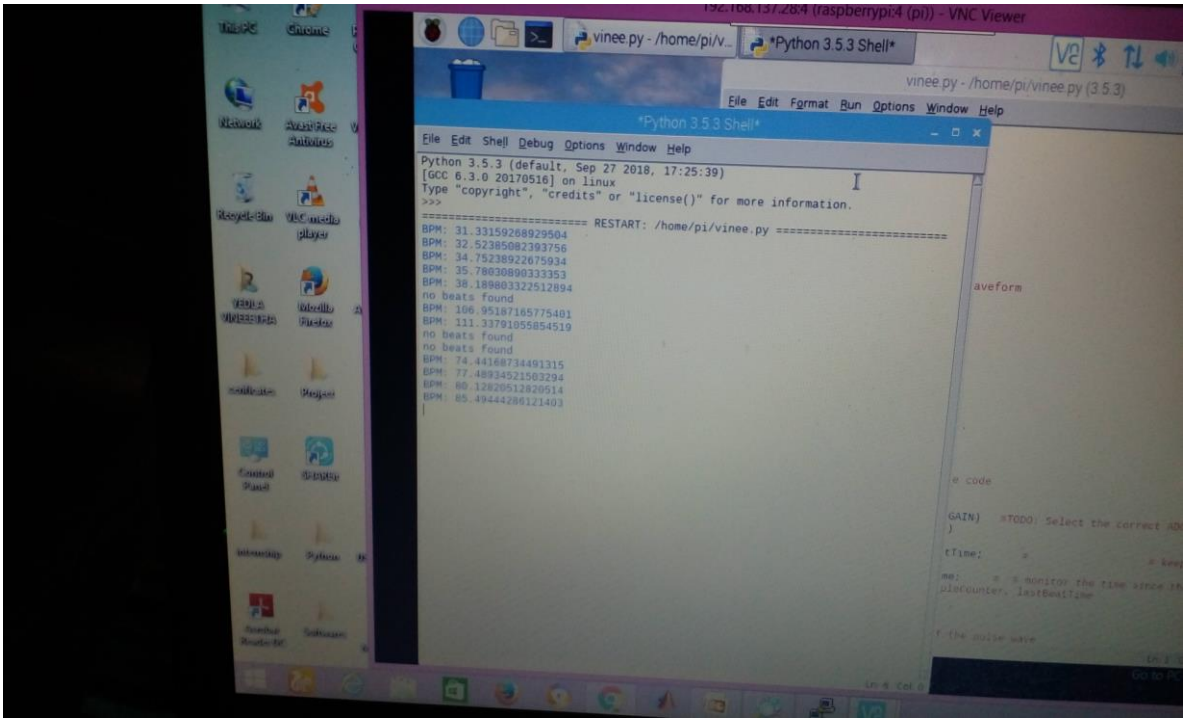


Figure 12 pulse sensor results

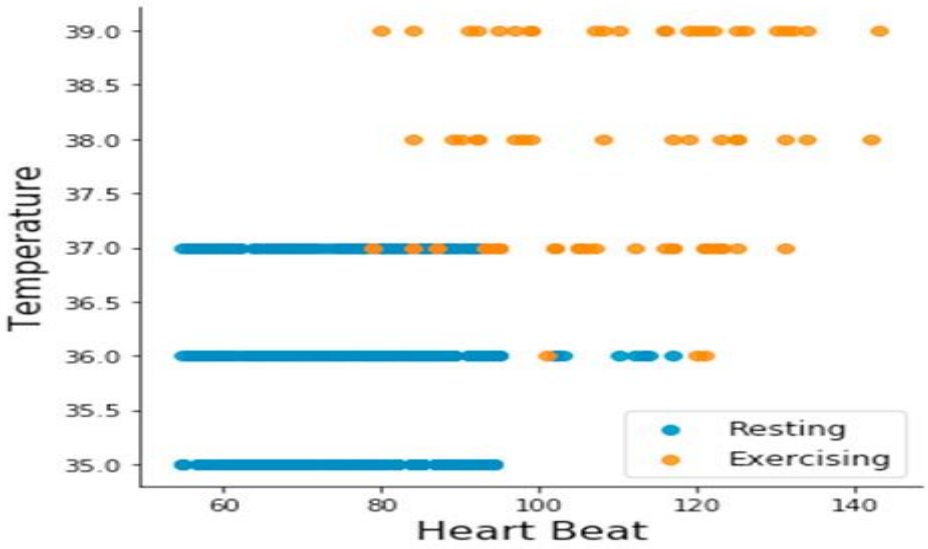


Figure 13 k-means clustering forming the temperature & heart beat

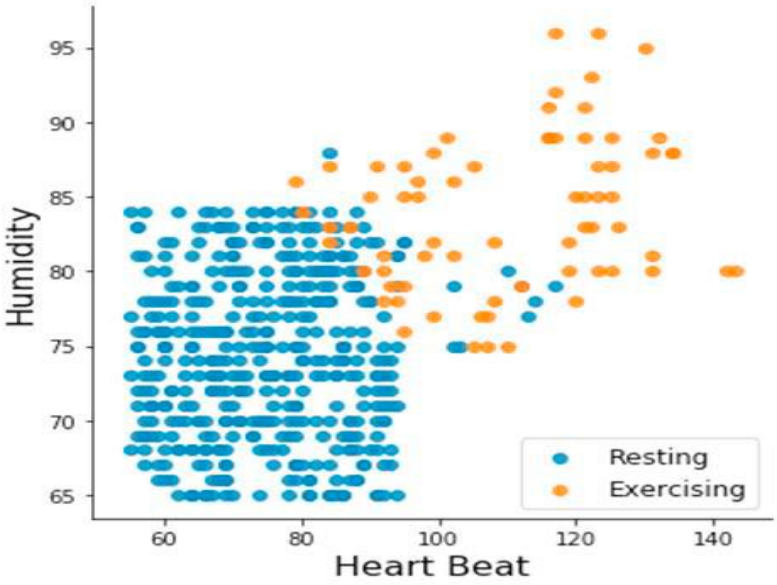


Figure 14 k-means clustering forming heart beat & humidity

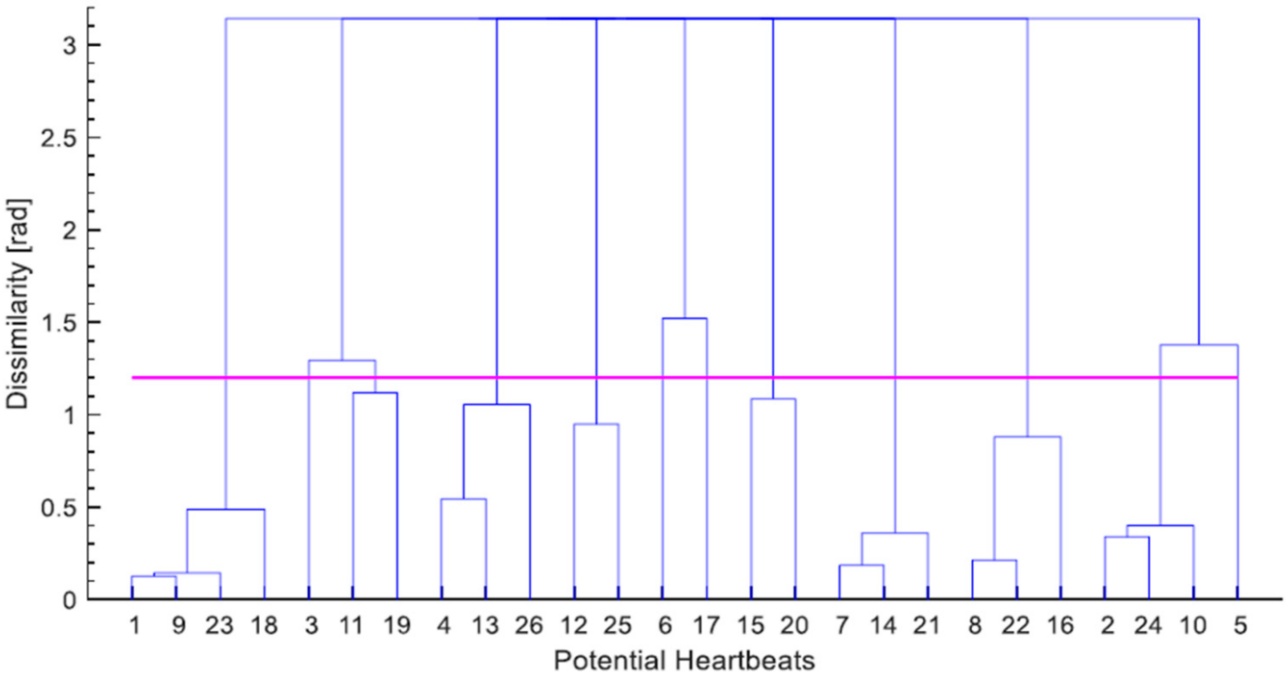


Figure 15 : Hierarchical clustering potential heart beats.

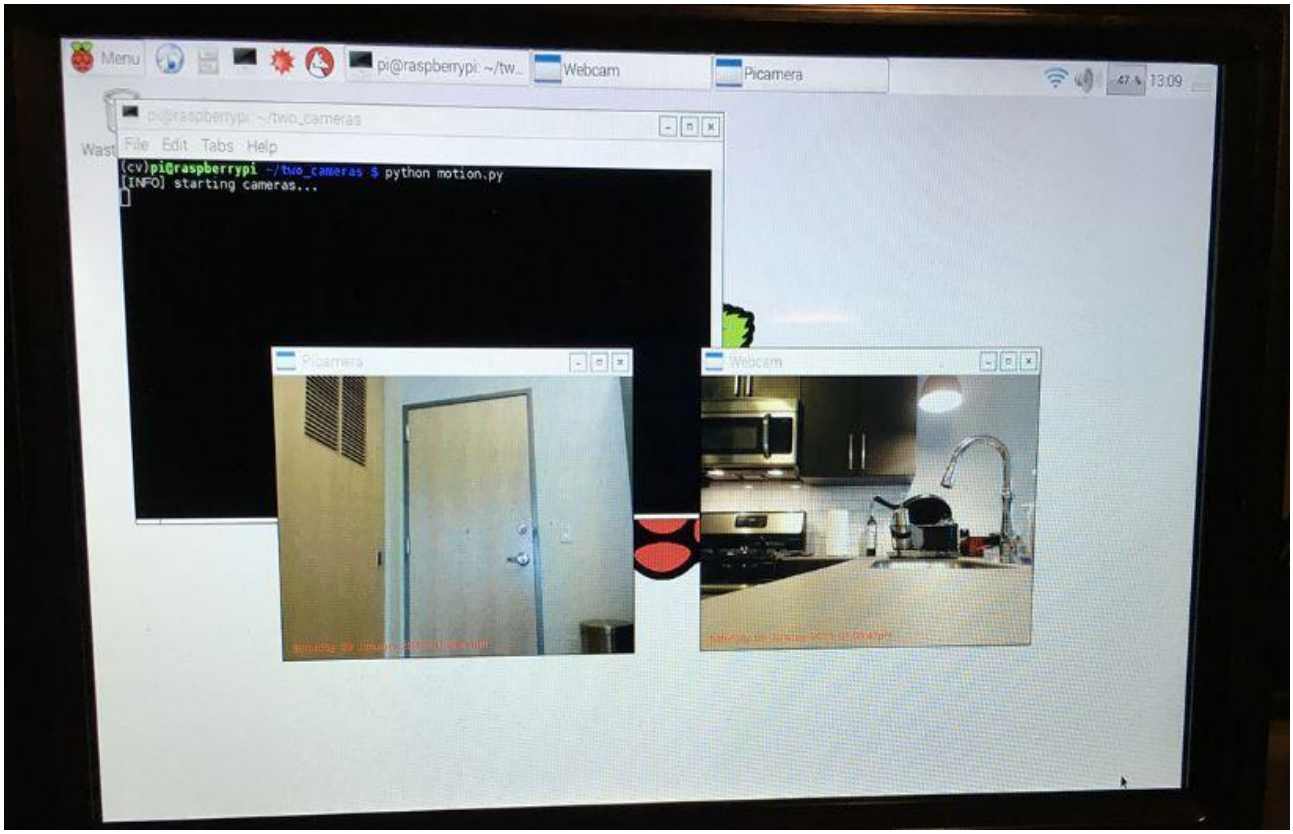


Figure 16 image capturing using raspberry pi through webcam and pi camera

6. CONCLUSION

For the soldiers health monitoring process the bio medical sensors and monitoring systems are connected with Soldiers. The work is concentrate on the tracking of the location of Soldiers which is useful for the control room unit to identify the exact position of the soldier accordingly they will guide them. The technique uses the soldiers to take support from army control room system from the another fellow soldiers in the panic condition**.** It is very useful for the military forces during the wars and rescue actions it can be applied for without the any network. The mixing and capacities of the ZigBee and LoRaWAN. The procedure will gives the security and the safety of the our Soliders.

7. REFERENCES

[1] Hock Beng Lim, Di Ma, Bang Wang, Zbigniew Kalbarczyk, Ravishankar K. Iyer, Kenneth L. Watkin (2010) “A Soldier Health Monitoring System for Military Applications” International Conference on Body Sensor Networks, pp: (246-249).

[2] William Walker, A. L. Praveen Aroul, Dinesh Bhatia (2009) “Mobile Health Monitoring Systems” 31st Annual International Conference of the IEEE EMBS, Minneapolis, Minnesota, USA, pp: (5199-5202).

[3] I. F. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci, “Wireless sensor networks: a survey,” Computer Networks, vol. 38, no. 4, pp. 393-422, 2002.

[4] G.Z. Yang, *Body Sensor Networks*, Springer-Verlag, London, 2006.

[5] M. A. Hanson, Harry C. Powell Jr., A. T. Barth, K. Ringgenberg, B. H. Calhoun, J. H. Aylor, and J. Larch, “Body Area Sensor Networks: Challenges and Opportunities,” IEEE Computer, pp. 58-65, Jan. 2009.

[6] K. Lorincz, D. J. Malan, T. R. Fulford-Jones, A. Nawoj, A. Clavel, V.Shnayder, G.Mainland, and M. Welsh, “Sensor Networks for Emergency Response: Challenges and Opportunities,IEEE Pervasive Computing, vol. 3, no. 4, pp. 16-23, 2004.

[7] A. Milenkovic, C. Otto, and E. Javanov, "Wireless Sensor Networks for Personal Health Monitoring: Issues and An Implementation," Computer Communications (Elsevier), vol. 29, no. 13/14, pp. 2521-2533, 2006.
[8] M. Pranav Sailesh, C. Vimal Kumar, B. Cecil, B. M. Mangal Deep, P. Sivraj (2014) "Smart Soldier Assistance using WSN" International Conference on Embedded Systems - (ICES 2014), IEEE, pp: (244-249).
[9] P.S. Kurhe, S.S. Agrawal (2013) "Real Time Tracking and Health Monitoring System of Remote Soldier Using ARM 7", International Journal of Engineering Trends and Technology, 4(3), pp: (311-315).
[10] 1. Baxter, G.D., Monk, A.F., Tan, K., Dear, P.R., Newell, S.J.: Using cognitive task analysis to facilitate the integration of decision support systems into the neonatal intensive care unit. k-means clustering algorithm 35, 243–257 (2005)
[11] Shruti Nikam, Supriya Patil, Prajkta Powar, V.S.Bendre (2013) "GPS based Soldier Tracking and Health Indication System" International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, **2(3)**.
[12] Akshita V. Armarkar, Deepika J. Punekar, Mrunali V. Kapse, Sweta Kumari, Jayshree A. Shelke (2017) "Soldier Health and Position Tracking System" IJESC, **7(3)**.