Journal of Applied Technology and Innovation
Vol. 10, Issue 2, 2026, pp. 56-73
e-ISSN:2600-7304-ISSN
doi: https://doi.org/10.65136/jati.v10i2.46

Artificial Intelligence Monitor and Indicate To 108 Ambulance from Remote Area Using Deep Learning and ESP8266 Of the Patient Health -Heart Rate and ECG Signal

J. Suganthi Vinodhini[1*]
[1]St. Peter's Institute of Higher Education and Research
*Corresponding author: suganthivinodhinij.eee@sphier.ac.in
Received: 2026-01-06; Accepted: 2026-03-30; Published: 2026-07-03

Abstract

The contactless BPM and ECG signal measurement using web cameras gives greater potential for the medical team using the remote photoplethysmography technology. In research areas this contactless rPPG technology plays a major role in medical as well as industrial purpose. Many new methods were updated by using the deep learning algorithm for the remote Heart measurement of the patients. This paper shows a detailed analysis of the hybrid deep learning algorithm for capturing the remote heart measurement and ECG signal of the patient in the remote area. The computer vison technology supports detecting the face from the live video and the hybrid deep learning algorithm supports to capture the fluctuating signal as per the patient expression through their faces. Once the heart rate captured through Artificial intelligence technology the abnormal and normal BPM was converted as analog signal through the Arduino Uno. In this work the IoT plays a major part for the wireless communication between the remote area patient and the hospital (108 AMBULANCE). The Light signal was detected by a light sensor and an ESP8266 Wi-Fi module combines with the BLYNK cloud to give the alert emergency message to the nearer hospital from the remote area about the patient health. The alert message was given to the hospital through E-mail as well as through the mobile phone message with the help of Wi-Fi device ESP8266. This work gives accurate measurement of the heart rate and ECG signal and monitor as well as indicate to nearer hospital from the remote area.

Keywords: *Artificial Intelligence, Deep Learning Algorithm, ESP8266, IoT, rPPG.*

1. Introduction

The heart rate and BPM measurement is the primary detection for the abnormal patient. Two types of measurement are there in medical field: Contact type Heart rate measurement and non-contact type heart rate measurement. Contact Type Heart rate measurement: To assess our health it is essential to monitor our heart rate to make our overall fitness level normal and healthy. There are several different heart rate categories for human beings. For reference, Table 1 displays the estimated maximum heart rate for human beings.

Table 1. Estimated max heart rate (BPM) for Men and Women.

Age	Maximum heart rate	Target heart rate (60–85 percent of max)
20	200	120–170
25	195	117–166
30	190	114–162
35	185	111–157
40	180	108–153
45	175	105–149
50	170	102–145
55	165	99–140
60	160	96–136
65	155	93–132
70	150	90–123

Note. The maximum heart rate in BPM is (220-Age) and (226-Age) for men and women respectively.

Bradycardia is where the heart rate was below 60 BPM which is slower than the normal BPM. It was not always the serious problem, but it has to face the consequences for some patients. This heart rate is very slow and cannot be able to pump the oxygen rich to the blood in body. ECG can detect this Bradycardia and this one of the contact types of measuring the heart rate.

Tachycardia is where the heart rate over 100 BPM and it was an irregular heart rhythm which is called arrythmias. This occurs in the body when the electric signal in the body was faster and this was happening by the sinus node. This process happens by the stimulus of the external features like injecting drugs, stress and pain.

Radia pulse contact type: Just below the thumb finger on the opposite wrist place the middle and pointer fingers and once if the pulse was felled then start to count the pulse for 15 seconds and multiple the count into 4 and thus the heart rate in terms of beats per minute can be calculated. The thumb finger should not use for this to check because the artery is present in the thumb and this make harder to count the beats accurately.

Caotid Pulse contact type: Below the jawbone which is on the side of the windpipe place the middle and pointer fingers and once if the pulse was felled then start to count the pulse for 15 seconds and multiple the count into 4 and thus the heart rate in terms of beats per minute can be calculated.

Pedal pulse contact type: The highest point where the bone runs along the top of the foot place the middle and index fingers and once if the pulse was felled then start to count the pulse for 15 seconds and multiple the count into 4 and thus the heart rate in terms of beats per minute can be calculated.

Stethoscope contact type: For physical examination the stethoscope is used, and it is directly placed on the skin in the chest for a period of 15 seconds and multiple the count into 4 and thus the heart rate in terms of beats per minute can be calculated.

Non- contact Heart rate measurement: The heart rate was monitored using the Impulse radio with ultra-wide band using the radar technology which is contactless heart monitoring system. The single processing algorithm was used to get the perfect capturing of the BPM. The other monitoring systems were used to measure the contactless heart rate are Electromagnetic based heart monitoring system, Laser based heart monitoring system and Image based heart monitoring system.

In 2008 the rPPG which offers contactless approach as well as low-cost but still this approach faces many complicated sequences which includes the different persons of the head movement, skin tone and facial expression changes. PPG SIGNAL: Infrared light plays a major part in this photoplethysmography where it measures the volumetric variations in the body in blood circulation. The measure waveform from the PPG signal can be used to measures the SpO2, respiratory rate and heart rate. Photoplethysmography is an optimal measurement by using a single photodiode by measuring the arterial volume in the body (Vinodhini, 2024)

PPG Ear plug PPG Pulse meter PPG Smart care PPG Smart watch

Figure 1. contact PPG signal devices for health monitoring.

Mainly in PPG signals one can easily affordable with non-invasive medical care applications. In serval diseases like neurological, respiratory and cardiovascular this PPG signal plays a major role to monitor the patient healthcare. This PPG technology gives the way for artificial intelligence and deep learning algorithm for further development in contactless heart rate measurement.

rPPG SIGNAL: Remote photoplethysmography access the emotional expressions from the face of the human and provides the necessary details like normal or abnormal signal by the help of the Artificial Intelligence technology. Mainly the rPPG work with the contactless measurement with different facial expressions and the dimension takes place by the flow of blood in the cells by photosensitive means and involving in the dimension of changes in the communication of light created by blood flow in a part of the human body. This rPPG offers a non-invasive means of measuring the heart rate remotely and the computer vision technology helps to create more development in the contactless patient monitoring system by their physiological conditions by extracting the information from the facial expressions with the absorption of the light source (Soderland & Lehnert, 1994). The computer vision technology provides a best healthcare by identifying the physiological conditions of the patients like respiratory rate, heart rate and other statistics regarding the medical condition of the humans. For researches and clinical providers this rPPG data provides an effective scope.

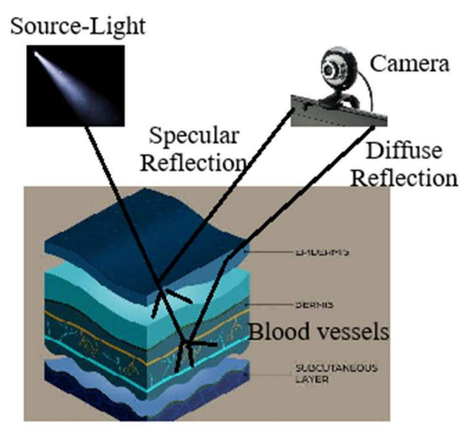


Figure 2. Pulsation Information from skin using the light source and camera.

2. Background of rPPG signal

In 1937, Spealman and Hertzman discovered a new change while reflecting the light OFF and ON the body such that the heartbeat changes as per the flow of blood in the body. In 1938, the PPG was introduced by Hertzman that measure the heart rate of the individual over a time period. In 2005, Critchely provided much information regarding the PPG signal where it not only shows the parameters of the human body, but it also provides information about the stress level and the emotional response of the body. In 2007, Allen detected abnormalities in the body of human using the PPG technology, especially measuring the respiratory rate and the heart rate during the person's physiological state. In 2008, Nelson gave the proper solution for the rPPG technology where the accurate heart rate was measured by the contactless devices like webcam with the normal ambient light conditions which flow through into the patient face. In 2015, Poh showed that by using the rPPG technology with the tracking of the face in many regions like chin, check and forehead the heart rate was measured with multiple number of people at the same time. **The Uses of rPPG in Artificial Intelligence include c**ontactless (Telehealth) Monitoring and measurement (such as measuring Blood Pressure, SpO2 Measurement, Respiratory rate measurement and Body Temperature Measurement), Pet Health Monitoring and Health screening.

3. Proposed Network Architecture

Figure 3 displays the proposed network architecture.

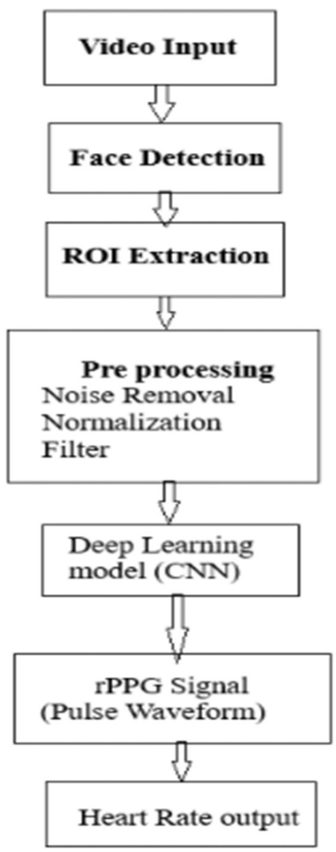


Figure 3. Proposed Network Architecture.

4. Steps Involved on measuring the rPPG signal to find heart rate

Computer vision tools are used in Image classification, Object segmentation, Tracking, pose estimation and objet detection. The object detection tool in computer vison technology helps and supports the medical field to estimate the heart rate of the patient using the remote photoplethysmography signals

(Wray & Laird, 2003). This paper deals with the computer vision technology powered by the deep learning algorithm which provides the true value of output and especially it has two kinds 1. End-to-end deep learning methods and 2. Hybrid deep learning methods.

5. Preprocessing in rPPG

Pre-processing is exceptionally vital in rPPG since the it is exceptionally frail and can be effortlessly influenced by lighting changes and movement. These steps help in progressing the quality of the flag sometime recently analysis (Zhou et. al., 2007; Verkruysse, Svaasand & Nelson, 2008):

1. Discovery and tracking: This step distinguishes the confront in each outline of the video and keeps track of it ceaselessly. It guarantees that the framework centers as it were on the facial locale where the beat flag is display. Following makes a difference keep up consistency indeed if the individual moves slightly.

2. ROI extraction: After identifying the confront, particular zones like the temple and cheeks are chosen. These locales are chosen since they contain solid blood stream signals and are less influenced by developments or obstructions.

3. Color space conversion: The video outlines are changed over from RGB to other color spaces like YUV or HSV. This makes a difference partitioned brightness from color data, making it less demanding to identify little color changes caused by blood flow.

4. Outline Alignment: This step rectifies little developments of the confront between outlines. It guarantees that the same facial locale is analyzed all through the video, progressing the precision of the extricated flag.

5.1. End-to-End Deep Learning Algorithm

The raw input was directly used by the machine learning algorithm where the trainer trains the single neural network for every complex responsibility without any physical feature extraction of the data. This is displayed in Figure 4. The steps are: Collecting the raw data (30sec patients facial expression Videos), using a Neural Network (Deep Nets) to process the data, then generate Predictions (ECG signal and Heart rate Prediction).

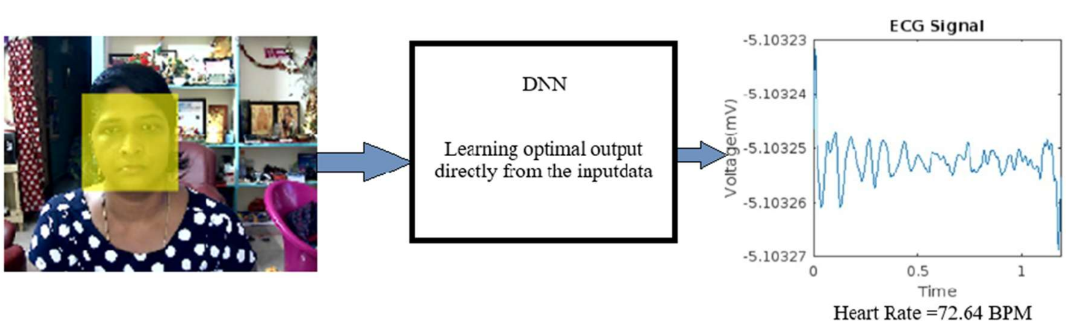


Figure 4 . End-to-End Deep learning Algorithm.

5.2. Hybrid Deep learning method.

The hybrid deep learning in the rPPG technology is mainly used to approach that it first trains the data with the deep train network and it extracts all the features for the deep network and again to perform the final arrangement it uses the structures to re-express the data for input to a non-deep learning method. This is demonstrated in Figure 5.

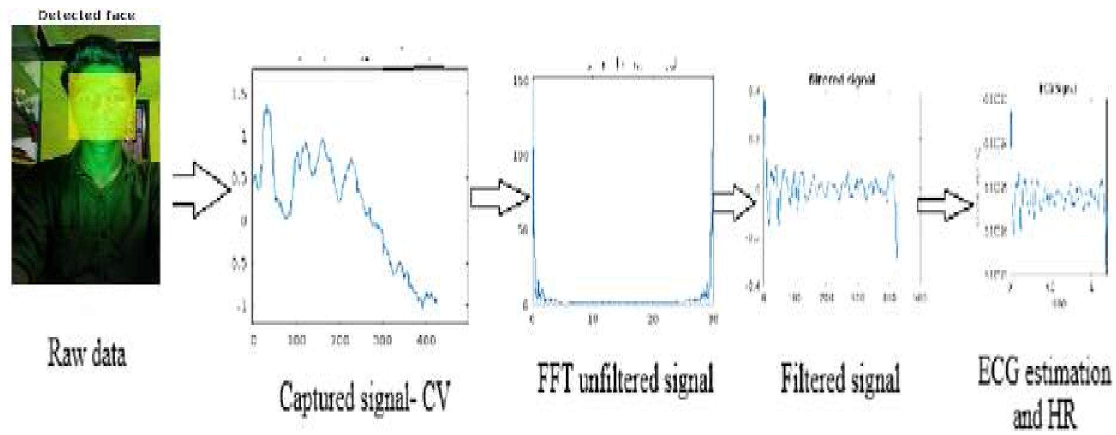


Figure 5. Hybrid deep learning algorithm.

As shown in Figure 5, the steps for ECG estimation are:

1. Collecting the raw data (30sec patients facial expression Videos)
2. Signal extraction using the computer vision algorithm
3. Capturing the normal and abnormal signal from the facial expressions
4. FFT process
5. Filtering the signal to attain the predicted output
6. Estimation of ECG signal and Heart rate of the detected face

In ECG machines the patients feel uncomfortable and have limited mobility while taking the bio- medical output because more than 8 electrodes are used on the body patient. Nowadays PPG plays a vital role by measuring blood pressure per minute and beat counts. This PPG signal gives a more reliable measurement of the patient as well as normal body measurements and this technique was commonly used in smartphones and smart watches.

The remote measurement and health monitoring system is more useful for the public and it was the most medical support which does not contact the body especially it was most inevitable during the pandemic conditions “COVID”. During these conditions the whole world expected a contactless monitoring of the patients like Heart rate, SpO2 and ECG. The new terms called rPPG bloom technology as contactless monitoring of the patient’s health in various parameters.

6. Simulation and Experimental results for the proposed work

6.1. Flow chart for the proposed work

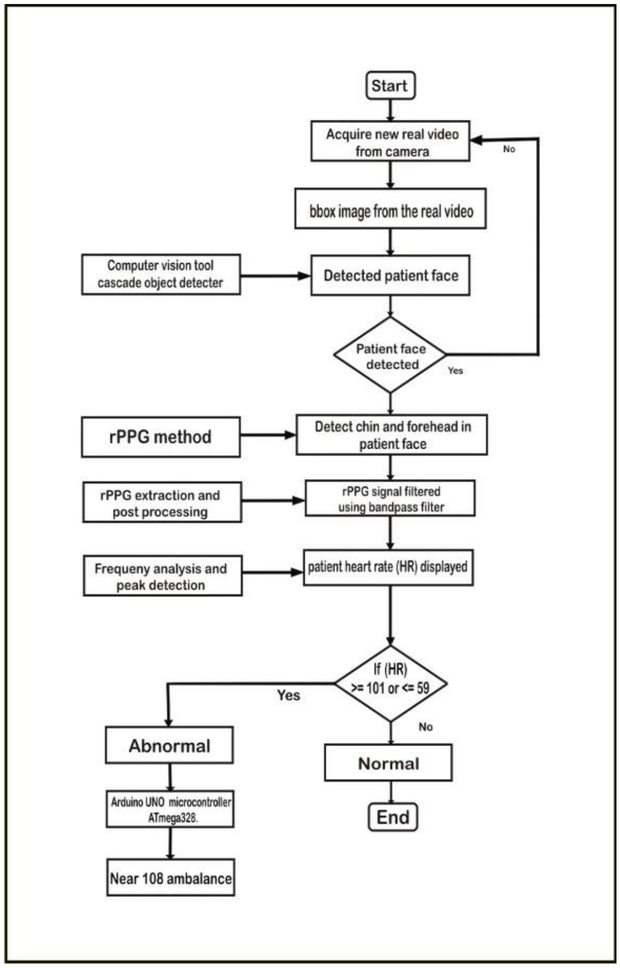


Figure 6. Flow chart for the proposed work.

6.2. Use case diagram for the proposed work

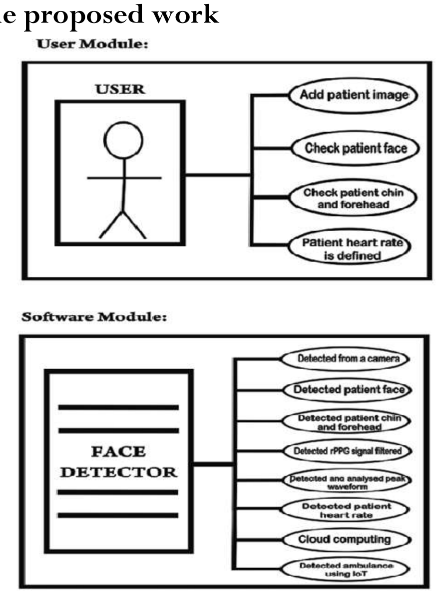


Figure 7. User case for the proposed work.

6.3. Technology stack for the proposed work

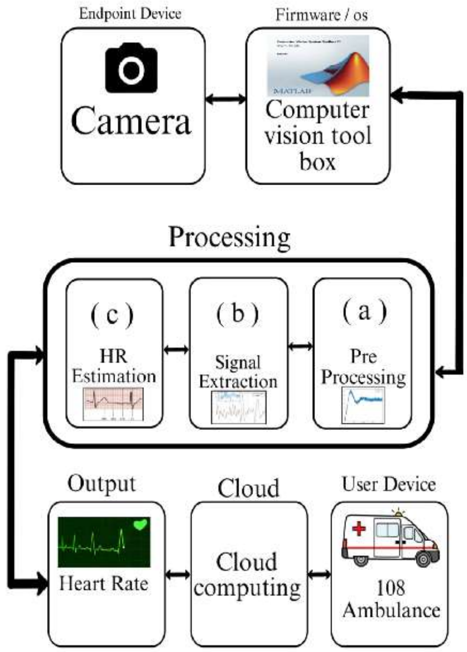


Figure 8. Technology stack for the prosed work.

6.4. Live video analysis using Computer vison and Hybrid deep learning algorithm

This proposed work results shows for the various sample live videos of the (patients) with different ages captures the abnormal and normal signal using the computer vision and deep learning algorithm the heart rate and ECG signal was captured accurately and this signal is transfer to the Arduino Uno to give the signal to the nearer 108 ambulance regarding Emergency about the abnormal signal predicated for the person through this prosed Artificial intelligence work (Kwon et. al., 2015; Ding, Nassehi & Larson, 2018).

Videos of each patient face for 30 seconds was captured using the standard camera present in the village without flash and by this with the support of computer vision technology the face was detected and the fluctuating signal carried out and by this signal the hybrid deep learning algorithm carried out for the two sample videos where it shows the abnormal signal and it needs an emergency medical support. Figures 9 and 10 display the first sample of video captured signal analysis for someone 39 years old. Figure 11 displays the second Sample of video captured signal analysis for a 20-year-old. Figures 12 and 13 display the third Sample of video captured signal analysis for a 19-year-old and Figures 14 and 15 display the Fourth Sample of video captured signal analysis for a 42-year-old.

Figure 9. Detected the face- Calm reaction stage.

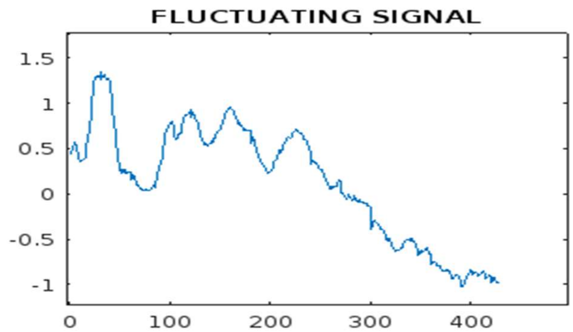
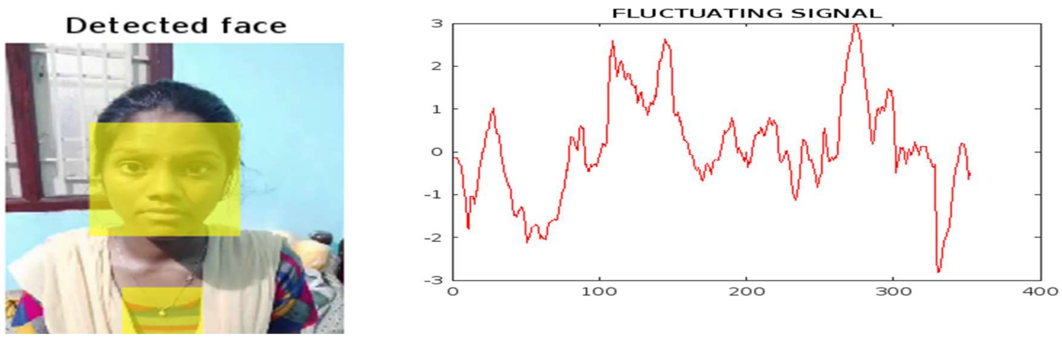


Figure 10. Captured fluctuating signal using frame square means -Normal signal.



(a) *(b)*

Figure 11. (a) Detected the face- Depressed reaction stage and (b) Captured fluctuating signal using frame square means - Abnormal signal.

Figure 12. Detected the face- Happy reaction stage.

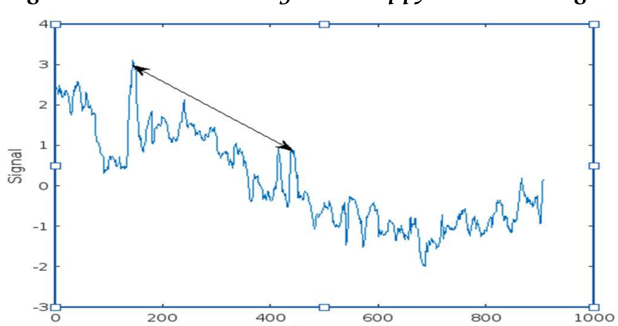


Figure 13. Captured fluctuating signal using frame square means - Normal signal.

Figure 14. Detected the face- Tired reaction stage

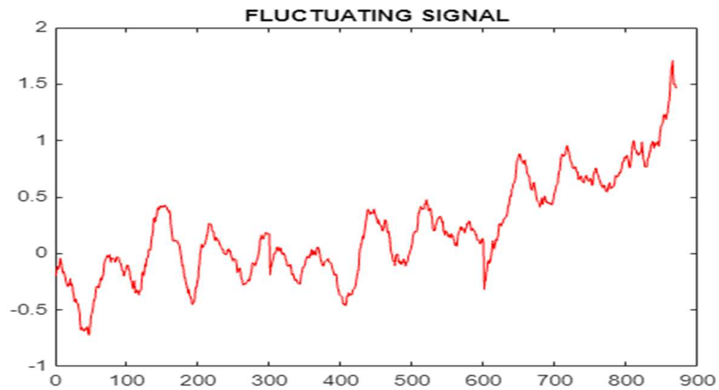


Figure 15. Captured fluctuating signal using frame square means - Abnormal signal.

Table 2 shows the overall medical parameters of the normal to abnormal conditions of the person with respect to the Heart rate, SpO2 and Temperature of the body. In this proposed work mainly two major level taken from the sample person 1. Home monitoring where the pulse rate above 101BPM and 2. Urgent medical support above 131 BPM, so by the analysis of the two sample live videos taken with different emotional reaction (Depressed Age :20 and Tired Age: 42) and that analysis is carried out using the Computer vision-based hybrid deep learning algorithm using MATLAB of artificial intelligence technology.

Table 2. Medical parameters for all stages in human.

Parameters	Normal	Home Monitoring	Seek Advice	Urgent medical support
Oxygen Saturation (SpO2)	96% more	95%	93%	92%
Pulse Rate (bpm)	40-100	101-109	110-130	131 more
Temperature(centigrade)	37.5	38	39	39 more

As per the flow chart shown in Figure 7 and as per Table 1, if the value of BPM is within 101 BPM to 131BPM above the signal will goes high where the flashlight will turn ON and this process is connected with MATLAB Simulink program with the Arduino mega 2560. Figure 16 demonstrates the flesh light turning on in this scenario.

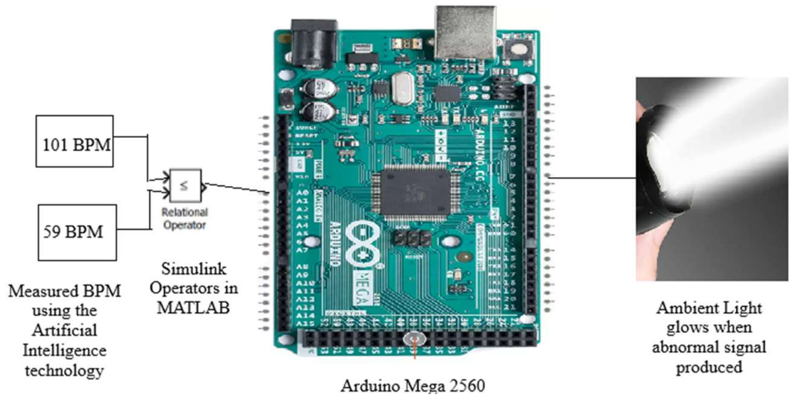


Figure 16. Block diagram to produce light signal using the MATLAB Simulink and Arduino Mega 2560.

6.5 Process for fetching MATLAB program with Arduino Mega 2560

The process for fetching MATLAB program with Arduino Mega 2560 is as follows. Firstly, we ensure that the Arduino mega 2560 is connected to the system. Then, we ensure the Board is connected to the system by checking in the MATLAB command window a = "Arduino". After running step 2, the command window shows the Arduino properties which was connected to the system. Next, in the workspace the data should be cleared then only the further step can be proceed in the Simulink. Then, we programed the Arduino to open the Simulink library, once it opens then open the new model and Simulink library for Arduino to program.

To blink the flashlight digital output is taken and the pin 3 it was connected in the proposed hardware and for the source the operators where used. Next, to run the program in the Arduino board the tools should get selected in the MATLAB/Simulink and the n to run the installed targeted hardware selected the Install/update support package and prepare to run and clicking the hardware enable specification like Arduino mega 2560. Finally, while clicking the run button in the MATLAB the code run in the hardware and the ambient light will turn ON when the BPM is abnormal condition or otherwise the flashlight will get OFF when the normal signal obtains in this proposed work.

7. Software results using Hybrid Deep learning Algorithm for two sample live videos

Figure 17. Detected the face- Depressed reaction stage.

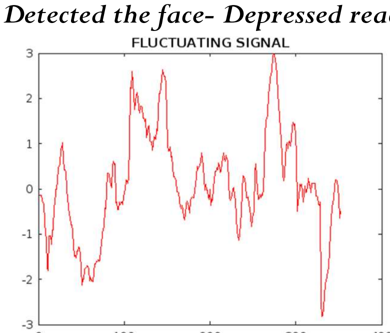


Figure 18. Captured fluctuating signal using frame square means - Abnormal signal.

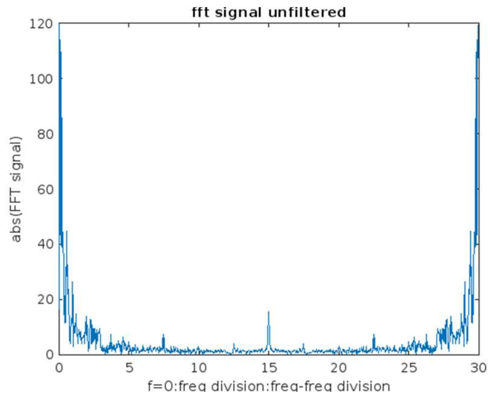


Figure 19. Captured FFT unfiltered signal - Abnormal signal.

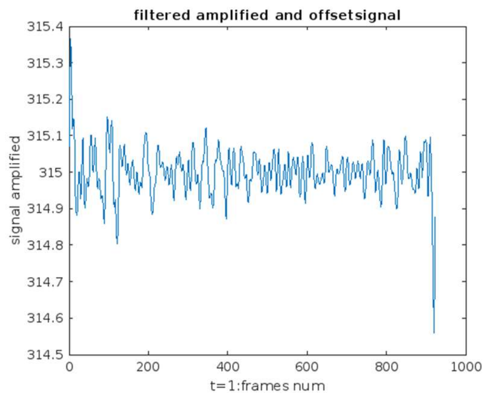


Figure 20. Captured filtered signal - Abnormal signal.

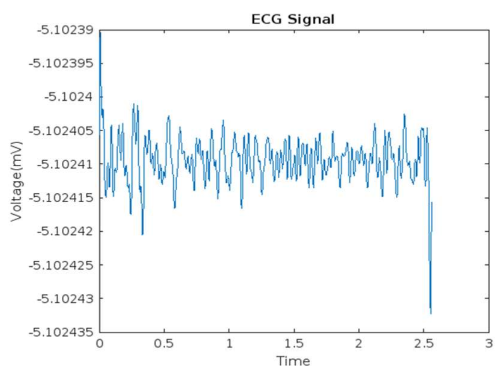


Figure 21. Captured ECG signal - Abnormal signal.

7.1 Output parameters of the first sample: Age 20 Depressed stage

Table 3. Output parameters of the first sample: Age 20 Depressed stage.

Output Parameters	Rate
Sampling Frequency	100 Hz
Heart rate	102.34BPM
SpO2	96.33
Beat count	100
Time Average square, i.e. mean (frame square means)	131
Frame Square	1×870 double
Frame numbers	870
Location of the face	[378,81,174,174]
Pixels	378
Video width	848

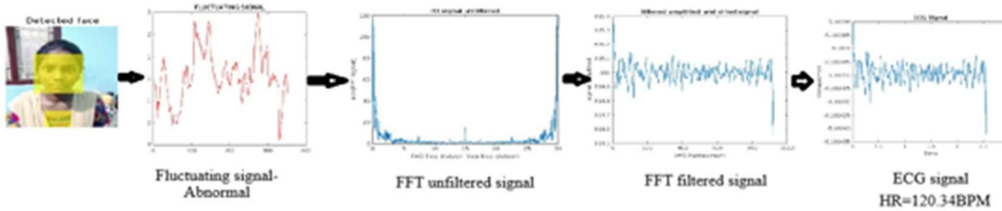


Figure 22. HR analysis from live video using Hybrid deep learning algorithm.

Figure 23. Detected the face- Calm reaction stage.

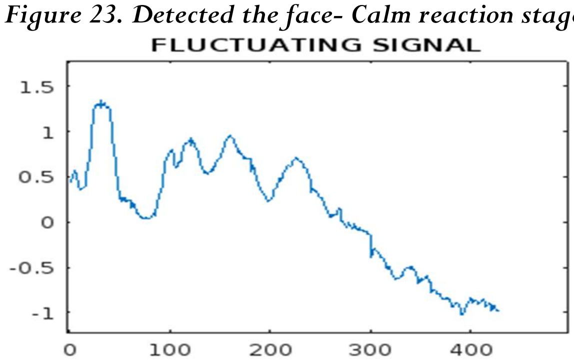


Figure 24. Captured fluctuating signal using frame square means - Normal signal.

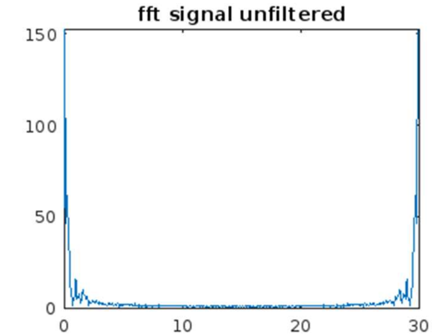


Figure 25. Captured FFT unfiltered signal - Normal signal.

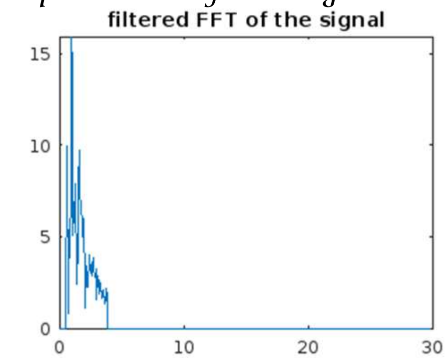


Figure 26. Captured FFT filtered signal - Normal signal.

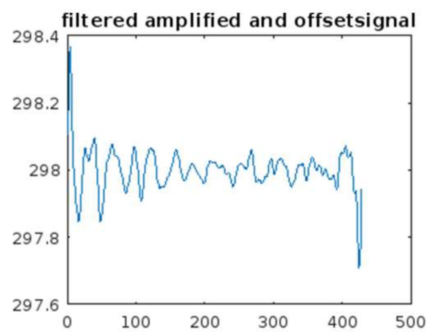


Figure 27. Captured FFT filtered and offset signal - Normal signal.

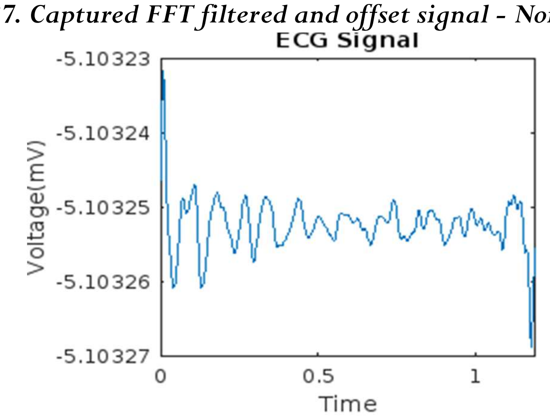


Figure 28. Captured ECG signal - Normal signal.

7.2 Output parameters of the second sample: Age 39 Calm stage

Table 4. Output parameters of the first sample: Age 39 Calm stage.

Output parameters	Rate
Sampling Frequency	100 Hz
Heart rate	72.64 bpm
SpO2	101.9951
Beat count	73
Face Detector	Vision Cascade Object Detector
ECG Signal	1×907
Face box	[61,13,190,190]
Video Frame	240×320×3

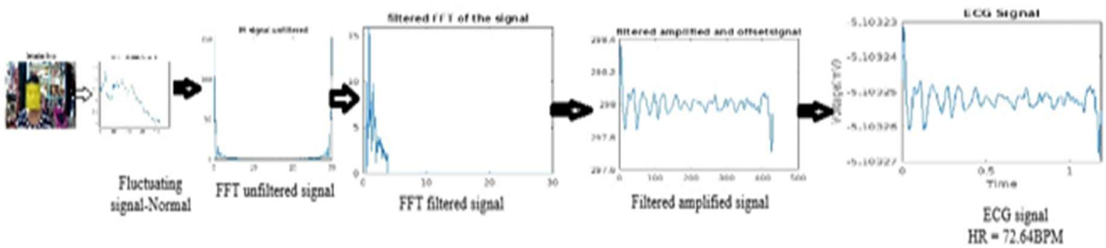


Figure 29. HR analysis from live video using Hybrid deep learning algorithm.

7.3 Wireless communication to the nearer hospital (108 Ambulance) from, the remote area

BlynkSoftware: Software which supports for the Arduino, ST microelectronics, Raspberry Pi and this software enables the remote management, the prototyping with the connected electronics devices to control the things automatically. It sends the array from the widgets and sends the data from the application to the hardware. Blynk application which interfaces 3.0 where the Arduino uses the programming language C and C++. It was user-friendly software especially for the Internet of Things.

Arduino Uno ESP8266: Arduino is mainly used for IOT purposes with sensors. ESP8266 Wi-Fi module uses the 32-bit microprocessor with the 16-bit instructions where it is low cost and it helps in many home applications like controlling the electronic equipment through the internet. It was more reliable and flexible, and is available in automation products. ESP8266 gives quick response to the input signals with low power consumption, scalability and it was wireless connection which more convenient for the patients.

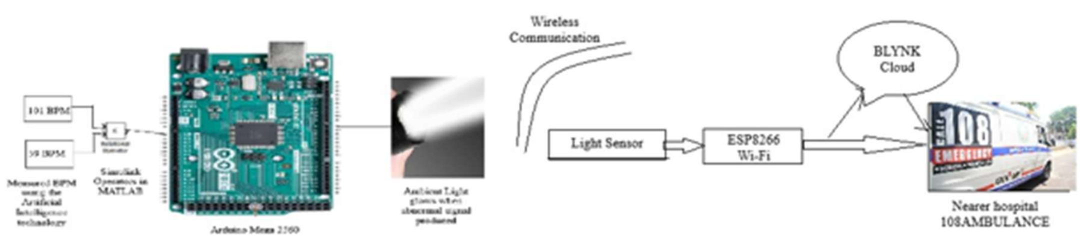


Figure 30. Overall Block diagram for the proposed work.

This proposed work shows the best results for the remote area people where they can easily access the nearer hospital who in need of emergency medical support. This rPPG with deep learning algorithm supports wireless communication to give a medical support for the villages. Figure.29 shows the Artificial Intelligence technology supports a lot for the remote are people (Gumpnipet village) who can get quick medical support. Internet of Things which supports to give the alert message the nearer hospital and 108 AMBULANCES to save the remote are people from the emergency situation. ESP8266 plays a major part as wireless communication through the BLYNK cloud and connects with the hospital by giving the alert emergency message through mobile phone and E-mail.Figure.30 shows the hardware results where both Artificial Intelligence and IOT combine together and supports for the emergency medical services using wireless communication.

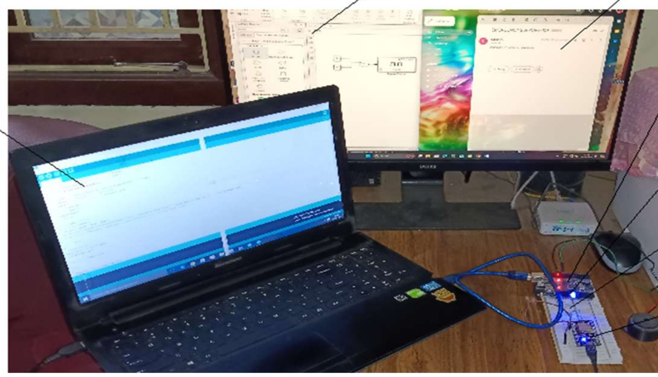


Figure 31: Hardware results for the Proposed work

8. Conclusion

Artificial Intelligence is a powerful technology where the deep learning algorithm majorly used for the emotion recognition, handwriting recognition and speech recognition. In this work the software and hardware analysis were carried out for four sample live videos with different emotions and captured the fluctuating signals where it gives the normal and abnormal signals. Hybrid deep learning algorithm carried out to get the accurate heart rate, SpO2, Beat count and ECG signal of the samples. The Internet of Things process is carried out to give complete alert message to the nearer hospital/108 AMBULANCE from the remote area by the Wi-Fi devices ESP8266. Especially this work is carried out for remote area people where they can access easily in the emergency of their health care situation.so, this artificial intelligence monitor and indicate to 108 ambulance from remote area using deep learning and ESP8266 of the patient health research work take a step forward towards a better society and also access easily for medical support.

References

Soderland, S., & Lehnert, W. (1994). *Wrap-up: A trainable discourse module for information extraction*. Journal of Artificial Intelligence Research, 2, 131–158. https://doi.org/10.1613/jair.68

Wray, R. E., & Laird, J. E. (2003). *An architectural approach to ensuring consistency in hierarchical execution*. Journal of Artificial Intelligence Research, 19, 355–398. https://doi.org/10.1613/jair.1142

Zhou, X., Liu, B., Wu, Z., & Feng, Y. (2007). *Integrative mining of traditional Chinese medicine literature and MEDLINE for functional gene networks*. Artificial Intelligence in Medicine, 41(2), 87–104. https://doi.org/10.1016/j.artmed.2007.07.007

Verkruysse, W., Svaasand, L. O., & Nelson, J. S. (2008). *Remote plethysmographic imaging using ambient light*. Optics Express, 16(26), 21434–21445. https://doi.org/10.1364/OE.16.021434

Pedregosa, F., et al. (2011). *Scikit-learn: Machine learning in Python*. Journal of Machine Learning Research, 12, 2825–2830. https://doi.org/10.48550/arXiv.1201.0490

Kwon, S., Kim, J., Lee, D., & Park, K. (2015). *ROI analysis for remote photoplethysmography on facial video*. 2015 37th Annual International Conference of the IEEE EMBC, 4938–4941. https://doi.org/10.1109/EMBC.2015.7319499

Ding, X., Nassehi, D., & Larson, E. C. (2018/2019). *Measuring oxygen saturation with smartphone cameras using convolutional neural networks*. IEEE Journal of Biomedical and Health Informatics, 23(6), 2603–2610. https://doi.org/10.1109/JBHI.2018.2887209

Yue, Z., Shi, M., & Ding, S. (2023). *Facial video-based remote physiological measurement via self-supervised learning*. IEEE Transactions on Pattern Analysis and Machine Intelligence, 45(11), 13844–13859. https://doi.org/10.1109/TPAMI.2023.3298650

Gupta, K., Sinhal, R., & Badhiye, S. S. (2024). *Remote photoplethysmography-based human vital sign prediction using cyclical algorithm*. Journal of Biophotonics, 17, e202300286. https://doi.org/10.1002/jbio.202300286

Vinodhini, J. S. (2024). *An overview review of artificial intelligence with real-time face detection application*. International Journal of Computer Applications Technology and Research, 13(6), 1–7. https://doi.org/10.7753/IJCATR1306.1001