Review of Remote ECG signal Monitoring, Preprocessing and Arrhythmia Detection

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Abstract:
ECG signal is one of the most significant biomedical signals, which is used to reflect the activity of human heart, and it is considered as one of better understood signals, that can provide basic information to diagnosis of heart disease. Therefore, different study and intensive research are developed in recent years, also different effective techniques and methods are proposed for analysis and processing in order to discover essential and new diagnostic information. In this paper, we are introduced literature review of significant study, techniques and algorithms, which are applied to ECG signal, some of these method are used to pre-process the ECG signal in order to increase the accuracy of diagnosis of heart problem, while other techniques are used to classify the signal automatically. The study is explained the methods that are applied to extract the ECG signal with different monitoring system either directly or by using remote monitoring system depending on some technique, also the ECG signal algorithms and methods are described in some details. Because QRS complex part of the ECG signal is considered the most significant information of the signal, different algorithm to detect this peak are explained in our study, finally, the classification algorithm of the ECG signal is described, classification is used to determine the statue of the heart activity and according it, classify the problem.

Key word: ECG, ANN, Raspberry Pi and QRS.

1-Introduction:

In recent years, different smart systems have been researched by using internet of things and intelligent algorithm, some of these research are devoted for monitoring purpose, and the others is proposed for prediction or classification for controlling purpose based on intelligent deep learning algorithms. The studies and researches of the previous works will be presented according to devoted research efforts and method used. Cardiovascular disease is considered largest threat to human health fin last decades, and millions of people is died because of treatment is delayed ,so (ECG) signal can be used to analysis the patients statue because it provide high indication about heart activity, ECG analysis is become key point of analysis patient condition , and this make it very important signal, ECG has different characteristics, the As the most important information of ECG is QRS complex .different research and study are introduced to deal with this signal some of it are used extract it, other are used to preprocessing it in different method such as de-noising and enhancement and other techniques are used to detect QRS complex by using two approaches of study , which is accomplished by software and hardware methods [1]. In this paper,

literature review of some significant study and techniques are introduced, which are performed to ECG signal in order to increase the accuracy of diagnosis of heart problem, the study are explained the methods that are applied to extract the ECG signal with different monitoring system either directly or by using remote monitoring system depending on some technique, also the ECG signal algorithms and methods are described in some details. Because QRS complex part of the ECG signal is considered the most significant information of the signal, different algorithm to detect this peak are explained in our study, finally, the classification algorithm of the ECG signal is described, classification is used to determine the statue of the heart activity and according it, classify the problem [1][2].

1.   ECG Monitoring Systems:

There are wide range of interesting fields of IOT researches that are applied to extract the ECG signal for monitoring, this research can be summarized in the following sections.

In 2019, Warish et.al.[1] Proposed a System, by using internet of medical think (IoMT) that can be used detect the Heartbeats and classify different types of abnormal Rhythms. This work was used ECG sensor, Raspberry Pi 3 and temperature sensor to monitor real time state of patients. This technique is used by doctor to detect problems of health, in this work different types of filters was used to eliminate electrograph noise with other functions that is used to preprocess the collected signals. The proposed system delivers appropriate medical assistance by using Deep Neural Networks (DNN) to analysis the collected data.

In 2019, Jasti et.al.[2] proposed work for continuously monitoring patient by using sensors like body temperature sensor, pulse rate and ECG sensor.in this system the sensors read the data continuously, If the sensor values of the temperature and the ECG sensor reading value   greater than specific threshold value, it will alert the patient and patient's relative by sending the SMS to the android mobile otherwise the reading is repeated.

In 2017, Rashida et.al [3] proposed an IOT Gateway based on using Wi-Fi protocols and Zigbee to transmit data between WSNs and mobile communication networks. In this work, the data is checked by checksum bit Before sending it to internet. Checksum bit is transmitted by sensor and it is calculated again at Gateway. If calculated checksum bit is equal to those, which are sent by by sensor nodes, then data is sent to internet.

In 2017, Andre   et.al [4] presented IoT gateway for real-time monitoring, the proposed system is accomplished by hardware, which is used to support multiple communication protocols and flexible to run adaptable software.   Hard ware component of the system was consisting of a Raspberry Pi, which is used as station node, with Arduino in addition to sensors to collect data and a web to be used for monitor the network.

In 2018, Surekha.   et.al. [5] propose health monitor system based on different sensors such as temperature, blood pressure, ECG and heart beat readings, these data are monitored using Microcontroller, also they used amplifier circuit to gain up the signal and transmit the signals to the Microcontroller. The internet it acts as a server. Which sends the data to the website? anybody anywhere in the world can monitor the patient's health using any device connected to the internet. If the sensed data is going abnormal according to some parameters, then the system automatically send SMS alert message to doctors and patient's relative.

In 2016, Poonam   et. al. [6] proposed an idea to save a patient's life, which can be benefited for users as it is save time. The ambulance can arrive at patient location based on the information, which is given through the app and can provide the basic requirement for patient's health. By using this application, the

information about the appropriate hospital which is suitable can be obtained. This data is sent through the ambulance to keep track the patient's status. And this information is send to hospitals helps the hospital staff to give the necessary treatment.

In 2017, Harishchandra et.al.[7] implemented a fog computing system based on Raspberry Pi, which is used for extraction, storage and computing, to collect the various medical data like Phonocardiogram (PCG) signal, and Electrocardiogram (ECG)-based on Q, R, S detection. Their system was constructed from wearable data collection to collect data with gate way, fog architecture, which is assisted the medical internet of think, cloud that is used for storage and computation purpose and display unit that is used for clinical. They are proved that the proposed system can be used to enhance the signal, analysis and processing different kinds of bio-signals.

In 2017, Anand et.al.[8] designed monitoring of health system to measure blood pressure, heart rate and heart sound count using Raspberry Pi. They used IOT device with Raspberry Pi Board to interfaces with device sensor. The sensor is sensed the patient health parameters and send the collected data to the raspberry pi. Also camera can be used to send image of patient to raspberry pi, this image with other sensed data parameters are sent to user interface page, so doctor or any other user can get patient information by access the Raspberry based on address of IP of Raspberry Pi in the internet.

In 2018, Rohit et. al [9] used different sensors for sensing the real time status of the patients such as ECG sensors, blood pressure sensor, etc, in order to diagnosis the patient disease and provided efficient medical services to the patient in fast time. The proposed system includes a data extraction and data processing, which is used to transmit patient data to the medical staff through Internet of things (IoT). this system increased the efficiency of wireless sensor nodes and satisfied high storage capacity serves compared with other system.

In 2018, Chandini et.al in [10] proposed a n ECG monitoring system based on wearable ECG monitoring node, which can collect the ECG signal from patients and transmitted it to IoT cloud based on Wi-Fi by using open source protocols like DTLS/UDP, TLS/TCP, CoAP/HTTP, MQTT and OMALWM2M protocol in data communication. Also they are used Various networks including, Zig-bee, Wi-Fi, Bluetooth and BLE and they are compared between them according to the achieved results. Monitoring methods are produced and implemented for ECG monitoring based different IOT models and protocols.

In 2019, Seena et. al. [11] proposed monitoring system based on different sensors such as, heartbeat sensor, the temperature sensor, an acceleration sensor and an ECG sensor, these sensors are interconnected with the Raspberry Pi device. It gathered the data at every time and they used 3G to displayed the collected information on LCD user devices and also on the doctor's device, those should be synchronized with the server system.

In 2018, Ayaskanta et. al. [12] proposed smart health care monitoring system, they implement it by using AD8232 heart sensor for monitoring heart rate with cloud by using wireless module. the collected data from patient is sent to the processor as stream of data, these data will be sent to the internet, then it will be visualized on web server, stored, processed and presented for specialist to diagnosis and analysis.

In 2018, Mohana et.al. [13] implemented monitor patient''s heart rate. The sensors are connecting to the Raspberry Pi that is act as a server. When the sensor reading are goes to above threshold, it will send alert message to doctor. Raspberry pi sends The data to be stored in a server. Also the system stores detailed information of patients and doctor via website in server. The patients or her relatives can access the website from anywhere, also other people can check them health by using wearable devices with sensors. They use

Wireless Sensor Network (WSN) for monitoring patient's physiological conditions, which is always use Raspberry Pi for acquiring the observed patients physiological signal.

In 2017, Shamika et. al. [14] proposed an embedded system constructed from software and hardware component, the hardware consist of different sensors such as temperature sensor , heart beat sensor etc. while the software component represent programing of reading the information from these sensors ,store ,analysis and process it by sing MYSQL database to store all the information such as ID login, user password ,user name etc. from these central data base system, different android application can be developed that can be used to tell the patient and doctor about his health condition .

In 2019, Jae   et. al. [15] proposed wireless technology from ECG monitoring based on using ECG sensor (AD8232) with wireless power transform, which is received the signal from importable device, later this signal can be transmitted by Bluetooth technique to any personal terminal, in addition to ECG sensor, they are used temperature and battery sensor, which is used to measure the power in order to recharge it. this system is applied for human and animal.

In 2015, Deiaa   et al. [16] produced a real time system for monitoring ECG signal for patients at anywhere. This system is accomplished by using Wearable Wireless Sensor Network, which is used to connected to patient for monitoring. The extracted signal will be sent to the internet to central monitoring system, which is located in hospital. Also in necessary condition of patient, the extracted signal is sent to physician's phone for some required actions. The efficiency of this system is evaluated based on power consumption of power and best distance among the sensors of WSN.

In 2017, Gauravi. et. al. [17] proposed real time ECG signal extraction system. The proposed system is constructed from ECG sensors, which is connected to analog to digital conversion with raspberry pi . Also specific algorithm was used to reduce the noise at low frequency sub band, which shows It shows different shape for the components of ECG signal like. P, QRS peak, and T wave.

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2.   ECG signal de-noising and Enhancement:

Because ECG is contaminated with some types of noises, which may reduce the quality of the signal and affect application of ECG signal, different techniques and method are proposed to reduce or remove these noise, some of these methods are described in this section.

In 2019, Dengyong et.al.[18] proposed technique for ECG signal enhancement by using   wavelet energy with filter. In this method wavelet coefficients which will be applied to threshold operation are selected based on energy of wavelet, while the approximation coefficients will be unchanged, also there is another stage of de-noising, which is represented by using smoothing filter to increase quality of ECG signal. the proposed algorithm is applied on the standard MIT-BIH ECG dataset and the performance of the method are determined based SNR value.

In 2019, Octa   et.al.[19] implemented method to reduce noise that is imposed in ECG signal based on using wavelet transform to achieve near actual ECG signal, also they are used MIT-BIH ECG Dataset. the noisy signal is applied to the proposed system as input, this is accomplished by add WGN noise into original ECG signal. Later Then DWT is used with specific decomposition level, with the specific filter, different filter, threshold, and levels are used.

In 2019, Carlos   et. al. [20] used unbiased shift as finite impulse response for ECG signal de-noising, they are developed this type of filter to be adaptive averaging horizon, which will be optimal in slow behavior's of ECG signal and minimal in fast. This filter is achieved good de-noising and provide best extraction of features in (SNR) measure. This method is used to evaluate interval and other ECG parameters, also they are made comparison with standard linear predictor.

In 2020, Ibtissem   et. al. [21] proposed ECG signal denoising method by repalacing low pass and high pass filter by fractional order ones, which is implemented and compared with the technique of using DWT, the algorithm is applied on different ECG signal of MIT-BIH dataset and they are proved that their proposed work can provide good result and can be used in some application.

In 2019, Pinjala   et.al.[22] introduced description to enhancement of ECG signal, which have baseline noise based on using filters and discrete wavelet transform. The filters are tested on different ECG signals; the results describe that wavelet transform is provided the good efficiency in denoising of ECG signals. They are tested their system by using (SNR), MSE and PSNR, and they are proved from their experimental results that the work is achieved good improvements.

In 2019, Aswathy   et al. [23] introduced a review of the most type of noises and the methods and techniques, which are used to enhance and de-noise the ECG signal, they are explain the power of interference and the value of the frequency, the low frequency noise with channel noise and the noise that is introduced from contact between electrode and skin, then they are described the filtering methods with the different types of filters.

in 2019, Rahul   et.al.[24] described most important techniques, which is used to remove electrode motion artifacts based on using adaptive filters, this filter is constructed from two inputs, named as primary and reference signal. The weight of the adaptive filter is modified as every samples of   input signal is extracted according to the difference between the two input signal, which are   noisy signal and another correlated signal, which come from another source. The most significant algorithms are (LMS) and (RLS)

In 2017, Ragini et.al. [25] presented the comparative study between the used filters, also they are proposed a technique which is produced good maintain quality with less complexity of hardware. the algorithm is implemented by MATLAB tool. They are discussed the differences between some filters such as Haar filter and Daubechies filter with different types of it such db2, db4mdb6.

In 2018, Xiong .et. al. [26] proposed efficient denoising a method to develop performance of denoising auto-encoders (DAEs) that is used to denoise ECG signal. This technique is worked based on Jacobean matrix, which is used to learn features of input, the (CDAE) is builded based on a deep neural network, which enhance features of ECG based on different level of feature extraction. They are used MIT-BIH dataset. Their results are proved that it produced more than 2.40 dB improvement (SNR)

In 2020, Said   et.al.[27] proposed different structures of combinations of algorithms to develop anew techniques for signal denoising for different types of noise of ECG signal. The proposed methods are used to remove: power line noise, baseline noise, the noise that is produced from motion of electrode artifact, and other noised. then, they are compared their results with the results wavelet transform, and with adaptive filter method. Performance measure of proposed structures are determined by signal to noise ratio and Mean Square Error.

In 2015, Jenkal   et.al. [28] proposed good method for de-noising ECG signals from baseline wandering and noise of high frequency. They are proposed extracted baseline noise from ECG signal. The method is developed using mean filter in adaptive technique, dual threshold filter is used to reduce noises of high frequency. The algorithm is tested by using MIT-BIH dataset, and it is applied for input signal from   of 5dB to 20dB. The basic purpose of this method is to produce real time systems.

In 2019, Zhaoyang et.al.[29] presented a method based on modified wavelet method to apply to de-noise ECG signal. coefficients of designed filter are obtained based on approximating amplitude of frequency response of filter; the wavelet is constructed based on the coefficients. The method is applied on clinical data. The results described that proposed work is reduce noise of high frequency and increase quality of signal properties like P waves and T waves. [29]

3.   QRS complex recognition and detection:

Different studies and methods are performed for detection peaksof QRS complex, because it represents the basic features of the signal, some of these algorithms and methods is described as following:

In 2017, Xiaoran   et al. [30] proposed a new method for QRS detection by using derivatives of sparse. This method is applied (8-20) Hz pass band filter to remove noise of high frequency and noise of baseline, later the signal is segmented and hilber transformation is applied and the proposed threshold is determined based on MSE, the detected QRS is maximum point of the ECG samples of signal.

In 2017, Seon   et al. [31] introduced a new algorithm to recognize QRS complex by using DWT, this method is applied to remove or reduce noise and create Shannon envelope of energy by using first derivative, this is satisfied based on first order (HPF), then normalization is applied, which is extract peak energy, which is used to determine R peak by determine R-R interval, also in this method different types of filters are used to smooth the signal.

In 2017, He1 et al. [32] introduced QRS complex recognition techniques in real time, in this method, the baseline noise is reduced by applying (BPF), the detection method is designed based on PSO and KNN methods, PSO technique is applied to determine the best parameters, which can increase accuracy of the QRS recognition algorithm. In this work, first derivative with five points are used, which is increased QRS features of the signal.

In 2018, Suleyman   et.al.[33] introduced a technique to detect QRS complex based on using digital filter with DWT, SGF technique is used to remove high frequency from the signal, also they are applied BPF to recognize the P and T wave and isolate QRS complex. Later, DWT is used to make QRS complex more distinct, then region of interest of QRS complex is isolated, then HPF is used to reduce the effect of noise of baseline.

In 2019, Barhatte et. al. [34] introduced curvelet transform based on adaptive threshold to recognize the ROI and boundaries of R peak, then, the exact coordinate of R-peaks is determined later. At first curvelet energy is applied on ECG signal, threshold is applied to evaluate the ROI, which can be used to recognize R peak, these Peaks are modified to reduce incorrect peaks based on updating threshold according peaks numbers.

In 2018, Antonio et.al. [35] proposed a method to detect for QRS complex. The algorithms are used multi channel ECGs, which is extracted from patients. Different metrics are used to determine the accuracy of the algorithm, which are identify QRS complexe and detect complexes of most prevalent morphology, the performance of the algorithm is determined by sensitivity positive predictively, and error, and their result show that the algorithms is achieved similar result to other standard.

In 2018, Xuanyu et.al. [36] proposed threshold algorithm to be used for QRS detection. The significant tasks of this method are processing, peak detection and proposed threshold for detecting of QRS. They are achieved good rate of detection with high sensitivity and the specificity, the exprements are performed on MIT-BIH Arrhythmia dataset, and they are compared their work with other algorithms and they are used this algorithm to evaluate RR time.

In 2020, Aiyun et. al. [37] proposed a simple, technique to detect QRS complex. The original ECG signal is pre-processed by some filters such as a band pass filter, exponential transform and first-order derivative. also the extreme points of the signal are determined by using moving window, then a threshold is utilized to detect QRS complex. The algorithm is Tested on MIT BIH Dataset; the results are proved that the proposed work is achieved good accuracy.

In 2019 Trio   et. al. [38] presented peak detection of peak of QRS complex based on average filter with thresholding operation. The signal is detrended in order to reduce baseline shift of ECG signal. Then

it is applied to band pass filter, which is contained high pass and low pass filter to reduce different types of noises QRS complex region of the signal, also they are used squaring process to make all the points of the signal positive, then applied moving average and thresholding operation.

In 2018, Daizong et. al. [39] introduced an efficient detection algorithm for QRS complex. It is used a differentiator with variable frequency center to derive first derivative frequency band information of ECG signal, later, they are used Hilbert transform create envelope of first derivative. Then, they are introduced method for threshold to reduce FN and FP. The algorithm is applied on MIT-BIH arrhythmia dataset, which is proved that it achieved good results in terms of Sensitivity and error rate with very little execution time.

In 2019, Hung et. al. [40] proposed an improved algorithm for QRS complex detection by using a four level of bi-orthogonal spline of wavelet, which is used to reduce amount of noises and to best detail of wavelet of the signal without removing all high frequency sub band. Then QRS peaks is detected by select extremum pairs from details coefficients with   suggested rules of decision. The satisfied results are described that the proposed algorithm is achieved high accuracy with low error rate, sensitivity, positive prediction value, the algorithm is applied on MIT-BIT dataset.

In 2019, Billal   et. al. [41] proposed a new approach to recognize QRS complex with P detection for (ECG) signal. This method is reconstructed two t signals in order to detect QRS. This method reduces the need to conventional filtering. The QRS complex locations is located at first, then remove of it from reconstructed to detect P wave. A new method to detect P wave ECG signal is proposed. The proposed detection method is identified P waves without any other information. This method is tested on MIT BIH dataset and good result are satisfied in terms of sensitivity, positive predictive, and error rate.

4.   ECG classification Techniques and Methods:

The most important part of ECG processing field is classification, which is used to classify the signal according to its features, so different algorithms and techniques are performed, some of these method can be described in the following section.

In 2016, Subha   et. al. [42] presented a study on classification of cardiovascular disease based on Machine Learning, they give comprehensive review for the prediction of cardiovascular disease by DL approaches. Also they provide detail description of machine and DL that was used in heart classification.

In 2017, Karthikeyan   et al. [43] proposed Heart Disease Prediction method by based on Deep Belief Network classification network to detect of heart diseases. Deep Belief network is type of   proficient DL approach in Deep Neural Network. At first the features are selected from different attribute then it is applied to deep belief network classification algorithm, which is the deep learning approach that is utilize the pre-processed data from the data mining process for prediction of heart disease.

In 2017, Ramin   et al. [44] proposed automatic system to diagnosis heart disease diagnosis based on data mining method, these study was used to early detection of heart disease by suing different database techniques ,data mining is applied to heart related data base ,researchers employ different data mining techniques such as decision tree in which they are used entropy technique ,Bayesian network , which is used to predict membership class ,K nearest neighbor which is named memory based technique and Support vector machine (SVM), they are used only data, which is inside in support vectors for building model.

In 2018, Kathleen   et al. [45] proposed a development on DNN to be used as classification model and a prediction model to diagnosis patient cases based on Cleveland Clinic Foundation dataset. DNN model is worked as parallel distributed processor, which is learned and stored knowledge. This knowledge is acquired through a learning process. Learning algorithms are used through training to modify weights of

neuron units of the layers in network of DNN classification, which is used to achieve better objective, they used minimum mean squared error (MMSE) to measure the accuracy of the training model.

In 2018, Abhay et al. [46] proposed a heart disease prediction method by using DL techniques to detect the likely possibilities of heart diseases of the patient. Used they Recurrent Neural Network (RNN), the proposed system was incorporating deep learning and data mining to increase the accuracy of the results and provide minimum errors. there is two type of gates was used in gated recurrent unit which is update gate, that is used to pass the past data to next layer, while the second gate was reset gate that is used to forget the past data.

In 2019, Youness et al. [47] performed a heart disease classification system based on many methods like K nearest neighbour, support vector machine. They are combined the neural network that is optimized by particle swarm optimization technique, which is combined with ant colony method. The analysis is demonstrated effectiveness of mixing PSO optimization and ACO method that is used to select the features which may be very complex task to disease diagnosis. The proposed optimized model results are compared with other approaches.

In 2014, Ankit et. al. [48] proposed an ECG classification model based on extraction feature of ECG image by using wavelet transform to enhance the signal, they are exploited wavelet transform to separate the characteristics of ECG into different scales with various resolutions, that can be used to extract basic characteristics of ECG signal for analysis the signals.

In 2015, Stalin et. al. [49] proposed a system to classify the ECG signal into normal or up normal by prepressing the input signal to remove the signal noise, in which, different types of filters used like median filter, Gaussian filter FIR filter, and Butterworth filter to enhance the signal, the prepressed signal is extracted by use wavelet decomposition, then the extracted feature is used as input to the classifier. In this work, they are used (SVM) with back propagation Network (BPN).

In 2017, Zhaohan et. al. [50] demonstrated a CNN model for ECG classification, especially for AF, which could be used to self-diagnosis for patients. They used 16-layer 1D (CNN). Also they used batch normalization to normalize the layers, down sampling is used by adding pooling layer which represented by maxpooling or average pooling, the data that is used was 8528 for training while for testing they used 3658.

In 2018, Venkatesani et al. [51] proposed a system to detect the up normality of ECG signal by prepressing the input signal with DENLMS technique based on adaptive filter, which is used to achieve better performance. DWT was used to extract features, the R-peaks are detected to evaluate the basic features of the signal, then they used frequency domain features which is classified by using SVM classification to detect up normality.

In 2018, Mohammad et. al. [52] presented a method for ECG heartbeat classification based on a transferable representation. The proposed work was constructed from five layers with pooling and rectifier unit as activation function.

In 2018, Tae et. al. [53] proposed an ECG classification approach by use two-dimensional 2-D CNN model with ECG image as an input signal, they used 2D ECG signal to classify it into eight classes of ECG beats. The classification system was made with deep learning CNN model with (11) layers that is constructed from convolutional layers with activation and pooling layers.

In 2018, Shraddha et al. [54] used Recurrent Neural Networks (RNN) to classify normal and abnormal signal of ECG, the basic task of this method is to classify the signal into regular and irregular beats, this method is tested and trained on MIT-BIH ECG dataset, which is used to evaluate performance of classification system. The data set is divided into train and test data set, after traing the model, it is

applied on the test set to determine the performance measure, which are accuracy, sensitivity and specificity, the expremental results show that it is produced goo results.

In 2014, Gaurav et. al. [55]   are proposed ANN algorithm to classify ECG signal, the detection and classification of ECG signal are constructed from signal preprocessing, detection of QRS, extraction of feature then   and ANN (Artificial Neural Network) classification. At first collection of ECG signal, which have different abnormalities, The QRS detection is used to determine the basic features of the signal, later the set of features are maximize to be used as input for classification stage, which is used ANN.

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5.   Conclusions:

Cardiovascular disease is considered the biggest threat to human health in last years, and too many people is died because of treatment is delayed, so (ECG) signal can be used to analysis the patient's statue because it provides high indication about heart activity, ECG analysis is become key point of analysis patient condition, and this make it very important signal, ECG has different characteristics. As most important information of signal is QRS complex. In this paper, we are introduced literature review of significant study, techniques and algorithms, which are applied to ECG signal, some of these method are used to pre-process the   signal to increase accuracy of diagnosis of heart problem, while other techniques are used to classify the signal automatically. Different research and study are used raspberry pi or arduino with AD8232 sensors in addition to other interfacing circuit to extract the ECG signal and send it remotely to center unit to be processed and classified , later these signals can be used by doctor for analysis the patients status , the most significant part of ECG is QRS Peak, because it represents the most important properties of the ECG signal, so most algorithms and techniques are applied to detect these peaks to recognize the type of the signal. Also because ECG signal is suffered from different types of noise, different algorithms and methods are used to remove or reduce these noise to minimum level as possible. The most important task in ECG processing is the classification, which can be used to analysis the type of the signal and therefore diagnosis the problem of the heart. Our study is explained the methods that are applied to extract the ECG signal with different monitoring system either directly or by using remote monitoring system depending on some technique, also the ECG signal algorithms and methods are described in some details. Because QRS complex part of the signal is considered the most important information of signal, different algorithm to detect this peak are explained in our study, finally, the classification algorithm of the ECG signal is described, classification is used to determine the statue of the heart activity and according it, classify the problem.

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