**2.1 Existing Techniques:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Ref | System | Technique Used | Advantages | Disadvantages |
| 1 | WBAN  for Heart Attack Detection | ST Evaluation | Low Cost, Low Energy. | No Remote Monitoring, No Cloud |
| 2 | Continuous Change Detection in ECG | Markov-Model | Low Energy | No Remote Monitoring, No Cloud. |
| 3 | Prediction System of Cardiac Arrest | ST Evaluation | Emergency Responses System. | No Remote Monitoring, No Cloud. |
| 4 | Ambulant ECG  Monitoring | Pan-Tompkins | Low Cost | No Remote Monitoring, No Cloud. |

**4.3 Results and Decision**

In this Study we developed a mini embedded device to collect ECG signal from patient’s body to monitor and analyze it. We used a wireless body area network for real time detection of abnormalities in ECG. The implemented algorithm shows high accuracy to distinguish between normal and abnormal Electrocardiography patterns. The system can successfully detect abnormalities caused by brachycardia, tachycardia, and sinus arrhythmia.

|  |  |  |  |
| --- | --- | --- | --- |
| Patient ID | Actual Heart Rate | Detected Heart Rate | Accuracy (%) |
| 1 | 86 | 79 | 91.86% |
| 2 | 89 | 83 | 94.38% |
| 3 | 66 | 62 | 93.93% |
| 4 | 84 | 79 | 94.04% |
| 5 | 75 | 72 | 96% |

Table: QRS Detection

The system can detect QRS from Electrocardiography signal with a success rate of 94.6% from Electrocardiography signal taken from human body. From table -- , it can be concluded that the QRS detection algorithm is implemented well. We tested our system by putting the device to the patient’s chest and patients are allowed to move freely. The proposed system shows the good result in terms of success rate.

**4.4 Comparative Study**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Ref | System | Application | Benefits | Technique Used |
| 1 | WBAN  for Heart Attack Detection | Heart Attack Detection | Low Cost, Low Energy | ST Evaluation |
| 2 | Continuous Change Detection in ECG | Anomaly Detection | Low Energy | Markov-Model |
| 3 | Prediction System of Cardiac Arrest | Sudden cardiac arrest Detection | Low Energy | ST Evaluation |
| 4 | Ambulant ECG  Monitoring | ECG Monitoring | Daily activity recorder | Pan-Tompkins |
| 5 | Proposed System | Real Time ECG Monitoring | Low Cost, Remote Monitoring, Emergency alert System | QRS Detection |

The paper at [1] is mainly focused to transmit the Electrocardiography Signal to Mobile Application. This Study describes a body area network (BAN) for measuring an electrocardiogram (ECG) signal and transmitting it to a smartphone via Bluetooth for data analysis. The BAN uses a specially designed planar inverted F-antenna (PIFA) with a small form factor, realizable with low-fabrication cost techniques. Furthermore, due to the human body’s electrical properties, the antenna was designed to enable surface-wave propagation around the body. The system utilizes the user’s own smartphone for data processing, and the built-in communications can be used to raise an alarm if a heart attack is detected. This is managed by an application for Android smartphones that has been developed for this system. The good functionality of the system was confirmed in three real-life user case scenarios.

The paper at [2] developed wireless body area networks (WBANs) for healthcare and remote monitoring have brought a revolution in the medical research field. Numerous physiological sensors are integrated in a WBAN architecture in order to monitor any significant changes in normal health conditions. This monitored data are then wirelessly transferred to a centralized personal server (PS). However, this transferred information can be captured and altered by an adversary during communication between the physiological sensors and the PS. Another scenario where changes can occur in the physiological data is an emergency situation, when there is a sudden change in the physiological values, e.g., changes occur in electrocardiogram (ECG) values just before the occurrence of a heart attack. This paper presents a centralized approach for the detection of abnormalities, as well as intrusions, such as forgery, insertions, and modifications in the ECG data. A simplified Markov model-based detection mechanism is used to detect changes in the ECG data. The features are extracted from the ECG data to form a feature set, which is then divided into sequences. The probability of each sequence is calculated, and based on this probability, the system decides whether the change has occurred or not. The experiments and analyses show that the proposed scheme has a high detection rate for 5% as well as 10% abnormalities in the data set.

The paper at [3] developed an embedded IoT system to monitor heart rates and body temperatures using smartphones. ECG sensor system is used and the real time detection of abnormality in users’ ECG patterns. The results from sensors’ data are also presented to show that this approach provides a high rate of classification correctness in distinguishing between normal and abnormal ECG patterns. The system may also find multiple applications in heart behavior detection for people with various disabilities who are at a high risk of cardiac arrest. To test the permanence and long-term feasibility of our approach in the future, we plan to test our system with data from elderly people who suffer from chronic heart problems. Additionally, the system can be used in smart home monitoring systems for future wireless technologies.

In this work [4], an android application was proposed which can continuously receive ECG signals from acquisition device wirelessly, detect QRS complex, compute heart rate and plot the real time ECG signal on mobile phone for displaying. Also, it can send this information to concerned physician via server for medical decision. Experiments show that the proposed system is unobtrusive and can be comfortably used by the user during daily activities. The paper sets a foundation for future developments that can improve proposed application for wireless health solutions. Some of the features that can be included are detection of irregularities in the rhythms of the heart, monitoring and analyzing ECG signals at home and simultaneous automatic alert to the doctor of any emergencies. It is also important to include more options like zooming functionality, which will improve the usability of the app.

In this study [5] proposed low cost wireless communication have greatly assisted in coping with the problem of fewer medical facilities. The main purpose of this research work is to develop a wireless sensor network system that can continuously monitor and detect cardiovascular disease experienced in patients at remote areas. One of the most prevalent healthcare problems today is the poor survival rate of out-of-hospital sudden cardiac arrests. The Objective of this study is to present a Wearable Body Area Network System to continuously capture and sent the ECG signal to patient’s Mobile Phone. By analyzing the signal critical situation will be identified and alert will be sent to doctor, relatives and Ambulance services using data processing algorithm implemented on patient’s mobile phone. A wireless transmission system is also proposed for continuous data transmitting to a server system where a doctor can monitor the patient Electrocardiography (ECG) from a long distance. In this project we developed a wearable ECG device and a real time brachycardia, tachycardia, and sinus arrhythmia detection based android mobile application. ECG signals from patient’s body is collected by the mini ECG device and sent through a Bluetooth module to Android mobile Application. On Android application processed data analysis based Pan Tompkins algorithms to detect complex QRS ECG signal and heart beats. From the number of heart rate can be detected abnormalities. Upon completing the system, we tested the system using signals generated by Fluke PS400 and real data. There are three categories of abnormalities under study: brachycardia, tachycardia, and sinus arrhythmia. Normal heart signal is also included in the test. We have tested this application in real time by collecting the ECG from the patient in stationary as well as simulated data. In both situations the application fulfils requirements of the proposed system.

**4.5 Conclusion**

Most of the study, we discussed, have some flaws such as cloud storage and there is no remote monitoring system so that the doctor or physician can observe the Electrocardiography of the patient’s from a distance place. This is a big advantage of Real Time monitoring. In case of any Emergency, the system will generate an alert message to doctor, relative, Ambulance services etc. When the doctor will get an alert message, he will have an opportunity the check the Electrocardiography to observe how much critical condition the patient have and can suggest some emergency medicines so that the patient can buy some time. We also proposed a cloud server to patients ECG signal for later analysis. The system is now under testing phase. We tested the system using real time and simulated data and the system yield high accuracy in both cases.