Contemporary Engineering Theme 1 Coursework – ECG

1. Introduction

Electrocardiography (ECG) is a medical diagnostic technique that detects and analyses abnormalities in the heart by measuring its electrical activity[1]. The field has undergone significant advances, with new technologies and algorithms constantly improving the accuracy of ECG measurements. Hospitals now routinely employ this technology to identify a variety of cardiac problems, such as arrhythmias and heart failure [2]. As the incidence of cardiovascular disease increases globally, the field of technology continues to evolve and promises to provide patients with better diagnostic tools in the future.

2. Content of the technology

ECG operates by detecting the electrical potential difference between two points on the skin surface, which is generated by the depolarization and repolarization of cardiac cells. The resulting waveforms can provide information about the rhythm and electrical activity of the heart [2]. Figure 1 shows this device.

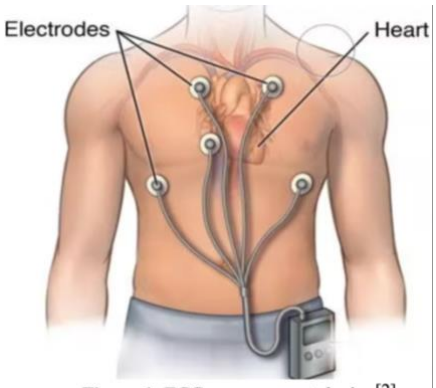

Figure 1: ECG measurement device [2]

The cost drivers of ECG technology include the cost of the machine, disposable electrodes, and skilled personnel to operate the equipment. However, advances in technology have helped to reduce these costs, while improving their accuracy. For example, the advent of portable ECG devices has made their testing more convenient and reduced the waste of healthcare resources. In addition, the use of artificial intelligence algorithms to analyse ECG data can improve the efficiency of their detection, thereby reducing the cost of operating and maintaining the equipment. To increase the precision of ECG diagnosis, one study suggested using statistical characteristics and multilayer perceptron neural networks [3]. These advances are promising and have the potential to make ECG technology more accessible to patients in the future.

3. Application of the technology

Advances in technology have led to the emergence of wearable ECG devices, the benefits of which include convenience and ease of use compared to traditional ECG devices. Wearable ECG devices come in different forms, depending on the market they are aimed at. For example, wearable ECG garments and patches can be used to monitor the heart activity of athletes during training or to diagnose arrhythmias in patients with a history of heart disease. In addition, wearable ECG smartwatches can play a role in the early detection of heart disease and promote preventive care [4]. There are still some issues with wearable ECG devices, regarding the ethical aspects, the data collected needs to be protected for privacy, which requires appropriate measures to protect the data from unauthorised access. Cost is another issue, especially for low-income populations. Associated costs include equipment costs, data storage, and analysis. In addition, the accuracy of wearable ECG devices depends on the quality of the sensor, the algorithms used to analyse the data, and the calibration of the device. All these factors will be affected if costs are reduced.

Advances in wearable ECG technology have helped to address some of these limitations. For example, the use of artificial intelligence algorithms in ECG data analysis has shown promising results in improving the accuracy and efficiency of ECG measurements. Deep learning algorithms have been applied in several studies to detect and classify different types of arrhythmias with high levels of accuracy [3]. In addition, advances in sensor technology have led to the development of low-cost and high-performance sensors that can be integrated into wearable ECG devices [4]. The study of these sensors and the processing of the acquired signals are of great relevance to Electrical and Electronic Engineering.

4. Advantage and disadvantage

One of the main advantages of the prior failure of ECG technology is that it helps to understand the limitations of the technology so that new techniques can be developed to solve the problem. For example, the failure of early signal averaged electrocardiography (SAECG) techniques has led to the development of more advanced ECG techniques that are more sensitive in detecting abnormalities [4]. The advent of wearable technology enables ongoing monitoring of the electrical functions of the heart, offering more detailed information than conventional ECGs [4]. Figure 2 shows a comparison of wearable and traditional devices. Advances in AI and machine learning algorithms have led to improvements in ECG analysis, including the detection of abnormalities that may have been missed by traditional methods [3].

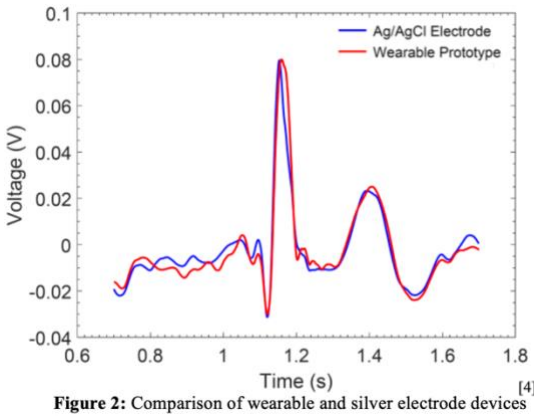

Figure 2: Comparison of wearable and silver electrode devices [4]

One of the main disadvantages of the failure of previous ECG techniques is that they can lead to inaccurate diagnoses, which can be dangerous for patients with serious heart conditions. In addition, they can lead to a waste of resources and stagnation of progress in the field. Failing innovations can also result in a lack of confidence and faith in the technology, making it harder to persuade stakeholders to fund additional research. Finally, previous failures of ECG technology can also be costly, both in terms of financial resources and human lives [5].

Despite these disadvantages, significant advances in ECG technology have been made in recent years. Advances in machine learning algorithms have made their analysis more accurate. In addition, new wearable devices that continuously track the electrical activity of the heart could also lead to better patient outcomes. However, healthcare facilities may find it difficult to implement new technology because of their high cost [6]. In addition, the accuracy of artificial intelligence and machine learning algorithms is a challenge.

5. Conclusion

In summary, ECG technology has a rich history and significant recent advances, including monitoring a range of cardiac conditions and convenience with wearable devices. Disadvantages include cost, accuracy limitations, and privacy concerns. Failures led to new developments but can cause inaccurate diagnoses, wasted resources, and loss of confidence. Despite challenges, ECG holds promise for improving patient outcomes, and ongoing research is needed.

6. Reference

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