IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

ECG MONITORING SYSTEM

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Abstract: Public healthcare has been paid an increasing attention given the exponential growth human population and medical expenses. It is well known that an effective health monitoring system can detect abnormalities of health conditions in time and make diagnoses according to the gleaned data. As a vital approach to diagnose heart diseases, ECG monitoring is widely studied and applied. However, nearly all existing portable ECG monitoring systems cannot work without a mobile application, which is responsible for data collection and display. In this paper, we propose a new method for ECG monitoring based on Internet of-Things (IoT) techniques. Experiments are carried out on healthy volunteers in order to verify the reliability of the entire system. Experimental results reveal that the proposed system is reliable in collecting and displaying real-time ECG data, which can aid in the primary diagnosis of certain heart diseases.

Index Terms **– Arduino IDE, Android Studio, Arduino UNO, ECG Sensor, PPG sensor, Mobile device, Bluetooth Module.**

I. INTRODUCTION

As we are well aware that death and disability due to heart attacks is increasing day by day in India. With a rapid growth in human population and medical expenditure, healthcare has become one of most significant issues for both individuals and governments. Meanwhile, according to a report from the World Health Organization (WHO),the problem of population aging is becoming more serious. Health conditions of aged people usually need to be checked more frequently, which poses a greater challenge to existing medical systems. Therefore, how to identify human diseases in a timely and accurate manner with low costs has been paid an increasing attention. Due to the dominance in the diagnosis of heart-related diseases, electrocardiogram (ECG) monitoring has been widely applied in both hospitals and medical research. Traditionally, the ECG is detected through large and stationary equipment in professional medical institutions. The kind of equipment usually employs twelve electrodes to collect ECG data due to their good performance in short-term measuring. However, the equipment is unlikely to be portable, which means that patients' activities are severely limited during the period of data collection. Moreover, as these devices are usually too expensive for home use, patients have to go to hospital frequently, which will inevitably increase the burden of hospitals. Therefore, a portable system for a long-term ECG signal detection with low costs is highly desired. Existing approaches ECG bio-signal faulted due to high noise signal interference, electronic and software fault, mechanical fault like sensor contacts failures, wear and tear of equipment. In this Project segregation of the actual fault-free signal and extract the abnormality of the vital feature for prognostic diagnostics is done.

II. LITERATURE SURVEY

The device detects the heart rate, temperature. These signals are sending to a receiver unit. The receiver unit is connecting to the computer. This system is operated with the help of battery power. A patient has to be monitored continuously using wireless sensors networks. This system has been designed with a host computer, wireless sensors. A perspective study on patient monitoring systems based on wireless sensor network, its development and future challenges is about the recent works addressing the Patient Monitoring Systems based on Wireless Sensor Networks. Wireless Sensor Network consists of a number of sensor nodes. Each sensor node includes a radio transreceiver along with an antenna, a micro controller, an interfacing electronic circuit and a battery as the energy source. In Wearable Wellness Monitoring Using ECG and Accelerometer Data paper, the hardware allows data to be transmitted wirelessly from on-body sensors to a handheld device using Bluetooth. Data is then transmitted to a backend server for analysis using either a wireless internet connection, if available, or a cellular phone service.

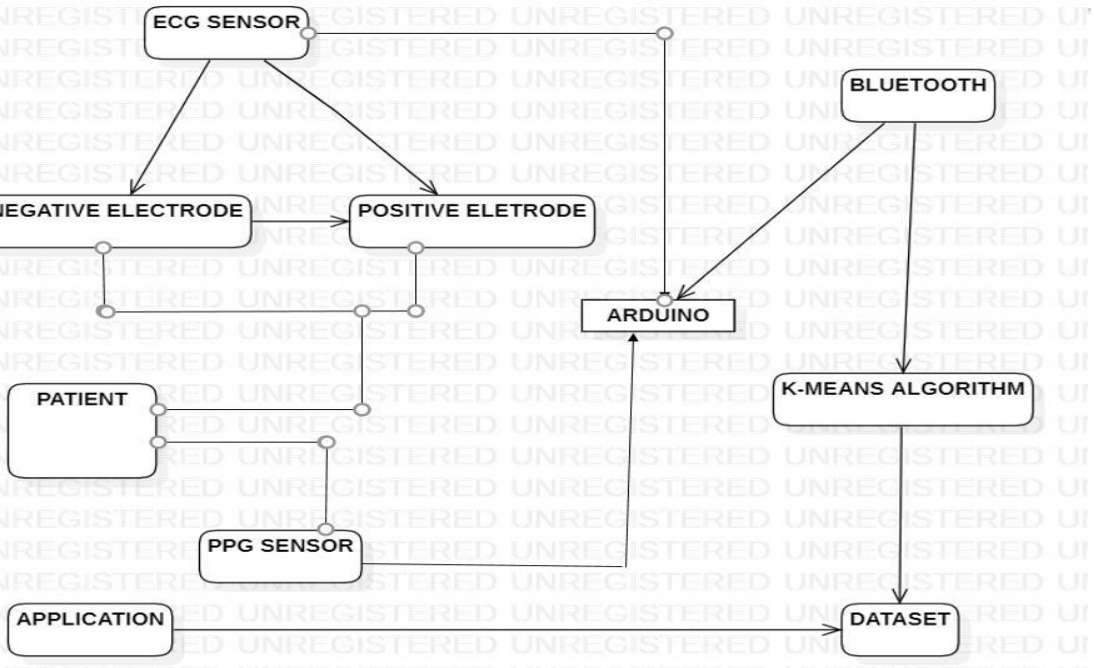
III. PROPOSED SYSTEM

In the proposed system, we will collect noise free signals and filter all faulty signals and provide accurate signals for prognostic health diagnosis. This system replace the previous faulty system with more accuracy.

IV. ADVANTAGES

Health buffs who actively track their physical progress can have a reliable tracker for heart activity. Users who have not yet been diagnosed with heart ailments like Atrial Fibrillation or A Fib but occasionally encounter symptoms like irregular or skipping heartbeats. Using the ECG Application, they can monitor and record these symptoms for further analysis by doctors. Reveal possible heart conditions that could potentially lead to more serious diseases. Patients with existing heart ailments can monitor their health and medical progress. Aging patients will be alleviated of travel and stress every time they need an ECG. Some doctors suggest that the best use case for the ECG app is to monitor patients with existing heart problems, instead of monitoring otherwise healthy patients. Increase the level of awareness on heart care.

V. SYSTEM ARCHITECTURE

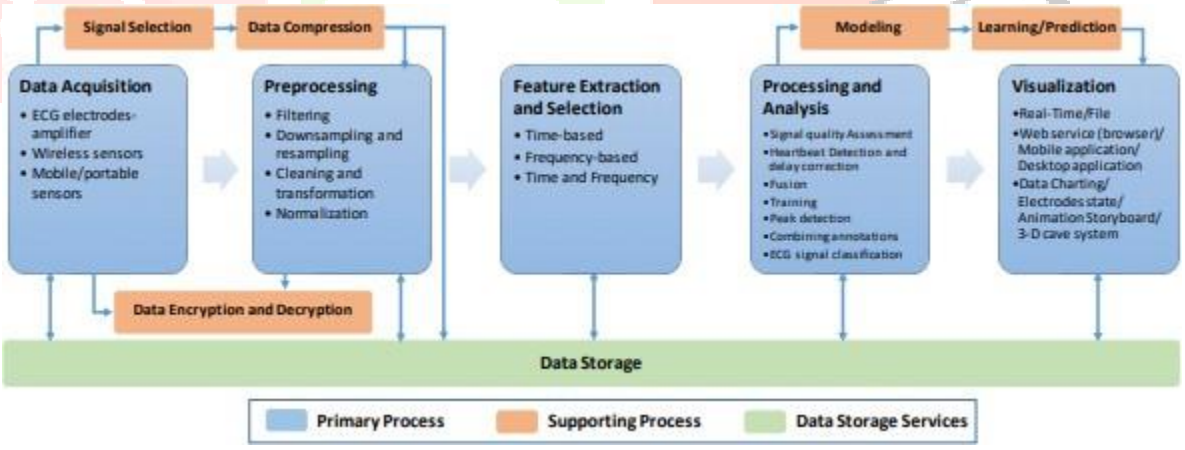


VI. PREPROCESSING

Preprocessing is intended to enhance the accuracy of prediction it improves the quality of the raw signal, removes the noise, and removes the baseline wander and powerline interference. The noise is classified, in the literature, into five main groups' powerline interference, baseline wander, electrode contact noise, electrode motion artifacts, and muscle contractions. The most common preprocessing and noise removal techniques are classified into three main categories Wavelet Transform-based, curvelet transform-based, and adaptive digital filters. The preprocessing of ECG signals related to the cardiac cycle, such as duration of the QRS complex and the ST–T segment level, is better handled using linear filters to prevent phase distortion from fluctuating wave properties. However, reducing the effect of noise caused by muscle activity requires averaging techniques to the time-aligned heartbeats. Existing standard filtering techniques lack efficiency in handling the signals. Therefore, hybrid filtering is rather more adaptive to raw ECG signals and, thus, was introduced in some research work to improve filtering results. Despite being challenging for preserving important signal information, and adapting to the patient's features, preprocessing has attracted the attention of researchers. Cleaning and transformation are also performed during the preprocessing stage. Other techniques are also used during the preprocessing stage, such as down sampling, resampling and signal normalization.

6.1 PROCESSING AND ANALYSIS

Intensive research was devoted to improve the efficiency of processing and analysis of ECG signals to achieve high diagnostic accuracy. During the processing phase, advanced information technologies are carried out through the development of diverse algorithms and intelligent techniques, such as analysis, modification, and synthesis applied to ECG signals to recognize and identify its significant components, with the purpose of discovering diagnostic information. These include, but are not limited to signal quality assessment, ECG signal classification, heartbeat detection and delay correction, peak detection, and training. Processing ECG signals is challenging due to their special characteristics, such as dynamicity, noise vulnerability, and inconsistency among individuals. Therefore, the optimization and development of ECG signal processing techniques has attracted research interest. AI methods and neural networks are typically very useful in providing ECG signal interpretation.



ECG Monitoring Lifecycle.

VII. VISUALIZATION

The visualization process typically includes all the functionalities that will allow users to inspect and interact with recorded or annotated ECG signals in real-time, as well as online from a file. This process acquires its importance throughout the value chain as it helps the human brain to better understand and analyze patterns, and detect abnormalities, especially with large datasets. The visualization applications vary in terms of the hosting application, nature of information projected, and the functionalities supported, which can be implemented as a web service through a browser, mobile applications, or desktop application. There are many commercial applications for ECG monitoring in the market, such as Custo Med, Philips, NORAV, and MEDSET. proposed a design for web application visualization to display data from the ECG device. The application included data charting, electrode state, and animation storyboard functionalities. A three-dimensional cave interactive system was proposed in which provides a graphic user interface that demonstrates a three-dimensional modeling and animation of a human heart using the R-wave of the electrocardiographic signal.

VIII. KEY CHALLENGES OF ECG MONITORING SYSTEM

As discussed in this paper, ECG monitoring systems involve many components, variable contexts and various stakeholders and encompasses diverse technologies. This diversity and variability of ECG monitoring system contexts and components impose a number of challenges that have been highlighted by several researchers. In the subsequent sections, we discuss ECG monitoring challenges related to the use of monitoring devices, signal quality, sensor design, and durability, the size of the data, visualization, and integration.

IX. TARGETS AND PURPOSES OF SYSTEM

Several ECG monitoring systems in the literature have been developed to serve a certain purpose or to target a specific functionality, which we grouped into the fourth cluster. In this cluster, we classify ECG monitoring systems as service-based or performance-based systems. The service-based systems are focus on either medical or non-medical purposes. However, performance-based monitoring systems intend to concentrate on performance improvements. The following subsections detail the classification of several proposed ECG monitoring systems, along with examples of selected systems highlighting special key features and key research problems.

X. CONCLUSION AND FUTURE SCOPE

ECG monitoring systems have been studied thoroughly in the literature; however, the multi-dimensional aspects of these systems make it difficult for researchers, medical practitioners, and others to select, among these systems, those that fulfill their monitoring needs, match the context of their use, and support the required disease monitoring requirements. In this paper, we carried out an extensive review of the literature related to ECG monitoring systems, focusing on different aspects including applicability, the technology used, architecture, lifecycle, classification, and challenges. We presented and discussed an expert-verified classification model. In our experts' taxonomy, we decomposed ECG monitoring systems into context-aware ECG monitoring systems, technology-aware ECG monitoring systems, ECG monitoring systems based on schemes and frequency, ECG monitoring systems targets and purposes, and futuristic ECG monitoring systems. Current development in ECG monitoring systems leveraged new technologies, such as deep learning, AI, Big Data and IoT to provide efficient, cost-efficient, fully connected, and powerful monitoring system. Enabling technologies provide huge opportunities for the advancement of ECG monitoring systems. IoT brings in remote, unconstrained connectivity and services that leverage data and facilitate timely, meaningful, and critical decisions for a better lifestyle. Furthermore, Fog processing and cloud processing contribute to an increased opportunity to improve efficiency and fulfill numerous in-demand scalable application services. As a future direction, exploring the field of robotics and healthcare automation has the potential to transform the next generation of ECG monitoring systems and to simplify robotic-assisted surgery procedures, elderly care, and remote and in-hospital continuous patient monitoring. Robotic-assisted surgery should be performed with higher precision, control, and improved vision, paving the way for the revolutionary healthcare of tomorrow. Further future research directions include exploring the use of the fast-growing IoT and smart connected devices for preventive healthcare and supporting the detection of patients' unusual medical problems or a change in behavioral patterns. Also, personalized monitoring systems should be raised to the next level in terms of being highly customized according to patients' needs and interactive to allow special configurations and adaptations to users' requirements for a better quality of life. Finally, another possible research direction is to add more intelligence to the patients' surroundings, for example, embedding more sensors in the carpet to accurately detect patients' movements in order to establish behavior patterns and detect any abnormalities, as suggested in patients' movements in order to establish behavior patterns and detect any abnormalities, as suggested in. To that end, we endorse that this work, with a detailed discussion on many relevant research works, provides a comprehensive state-of-the-art review of ECG monitoring systems. It can serve as reference for various researchers and stakeholders in the field to compare, understand, and value ECG monitoring system features. It also highlights the main challenges these systems exhibit in terms of adaptability, integration, monitoring quality and durability. Finally, it outlines a future vision of the next-generation ECG monitoring systems for healthcare.

ACKNOWLEDGMENT

We would like to thank all the working staff of D.Y Patil Institute of Engineering and Technology and a great thank to our project guide Prof. Pritam Ahire who gave his best to do this great project. Moreover, thanks to all the authors whose papers and books we referred during this project. Without help of all these resources, we would have never completed this project.

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