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SURVEY PAPER ON FRAMEWORK FOR IOT-ASSISTED ECG MONITORING WITH SECURE DATA TRANSMISSION FOR HEALTHCARE APPLICATIONS

Mr. Vijay S. Parit, Student, Dept. Computer Science and Engineering (Data Science), DY Patil Agriculture and Technical University, Talsande.
Dr. Jaydeep B. Patil, Associate Professor (Associate Dean), Dept. Computer Science and Engineering, DY Patil Agriculture and Technical University, Talsande.
Dr. Sangram T. Patil, Dean, School of Engineering and Technology, DY Patil Agriculture and Technical University, Talsande.

ABSTRACT
Sensors, embedded systems, and other services that allow us to comprehend our environment can be produced thanks to the new IoT architecture, which enables us to construct tiny devices that can sense, process, and communicate. The IoT-assisted electrocardiogram (ECG) system for secure data transmission has been proposed for ongoing cardiovascular health monitoring. The development of small devices with sensing, processing, and communication capabilities is made possible by the current Internet of Things paradigm, which gives sensors, embedded devices, and other "stuff" the ability to comprehend their surroundings. Smart medical gadgets and the Internet of Things (IoT) have revolutionized healthcare systems by making it possible to monitor and screen patients' health issues at any time and from any location. Patients must be continuously followed until any major illness or infection occurs because of the abrupt and massive increase in patients during a coronavirus pandemic. The massive volume of private health data generated by patients who do not want to share their personal medical information indicates that worries regarding IoT data security remain a major problem. Recent developments in IoT technology have facilitated transparent interactions between smart objects and other entities via the Internet. Healthcare, sensors, processor aggregators, and data storage platforms are a few of the uses for the Internet of Things.

Keywords:
Sensors, embedded systems, electrocardiogram

I. Introduction
Rapid population growth and preservation use have made medical care services one among the biggest issues facing both individuals and governments. However, according to a World Health Organization (WHO) report, the issues facing the aging population are more pressing. An important test of the current medical frameworks is the need for more frequent evaluations of the health state of the elderly. It is important to think carefully about how to accurately and comfortably identify human diseases at a reasonable cost. The development, experience, and proficiency in cardiac analysis over the years have led to a wide range of connections between the electric cardiogram (ECG) diagnostics employed in medical research and treatment. In professional medical foundations, the ECG is widely recognized by large, fixed machines. Twelve electrodes are typically used by the equipment to gather ECG data in a single, central area. Because the system may not be flexible, the patients' options for activities during information collection are severely restricted. However, because these gadgets are typically too costly for use at home, patients must constantly visit a doctor's office, which ultimately adds to the burden on the healthcare system. The need for an affordable, adaptable long-distance ECG signal identification system is high.
People with chronic diseases like obesity, high blood pressure, diabetes, hyperglycemia, asthma, depression, elder care assistance, preventative treatment, and general well-being can be remotely and continuously monitored with IoT-driven health and wellness solutions. Improving IoT health and wellbeing will be greatly aided by lowering treatment expenses and everyday travel, as well as by increasing the affordability and quality of care. The Internet of Things (IoT)-based healthcare system

makes use of networked biosensors that gather a variety of biological signals and connection to quickly exchange and convey the signals to medical professionals and the internet. Additionally, IoT-enabled remote monitoring apps can drastically cut down on long-term monitoring applications in terms of time, money, and travel.
The Internet of Things (IoT) has emerged as a highly effective method for collecting information and facilitating communication within health and fitness monitoring settings, which encompass highly tailored health services, environmentally-supported living, user attitude detection, and behavior recognition. The author created Wireless Sensor Networks to assess joint angles and vital signs, aiding physiotherapists in real-time through an IoT-driven physiotherapy network. In the realm of wireless health monitoring systems, maintaining long-lasting communication poses significant challenges for Wireless Body Area Networks (WBANs) given the energy limitations of compact sensor nodes.

II. Literature

Moeen Hassanalieragh, Alex Page, Tolga Soyata, Gaurav Sharma, "Health Monitoring and Management Using Internet-of-Things (IoT) Sensing with Cloud-based Processing: Opportunities and Challenges" [1], One of the most significant applications made possible by the Internet of Things (IoT) is smart and linked health care. Rich data about our physical and mental health may be gathered thanks to networked sensors, which can be worn on the body or integrated into our living spaces. Continuously collected, combined, and skilfully mined, this data has the potential to positively revolutionize the health care system. Specifically, the availability of data at previously unthinkable scales and temporal longitudes, along with a new generation of intelligent processing algorithms, can: (a) help medicine move away from the current post facto diagnose-and-treat reactive paradigm and toward a proactive framework for prognosticating diseases at an early stage, along with prevention, cure, and overall management of health instead of disease; (b) enable personalization of treatment and management options that are specifically tailored to the individual's needs and circumstances; and (c) help lower health care costs while improving results. In order to realize this vision of the future of healthcare, we highlight in this article the opportunities and problems presented by the Internet of Things.
Farah Nasri, Abdellatif Mtibaa, "Smart Mobile Healthcare System Based On WBSN And 5G" [2], The Internet of Things' ability to make intelligent use of resources has increased both the technical and consumer communities' expectations. However, there are other obstacles to overcome when creating an IoT healthcare system, such as data exchange, security, and authentication. The Internet of Things (IoT) is converting commonplace physical items and medical equipment into an integrated smart healthcare system. Given the exponential expansion in medical costs and the human population, public healthcare has received more attention. An efficient monitoring healthcare system is reported to be able to diagnose patients based on sensing (WBSN) data and identify health state problems in real time. In this research, a general architecture for a smart mobile IoT healthcare system that uses a smartphone and 5G to monitor patient risk is proposed. the multi-protocol unit's design for ubiquitous networking. Applications for the web and mobile devices were created to satisfy the demands of physicians, patients, lab analysis, and hospital services. In order to take preventive action and save lives in critical care and emergency situations, the system notifies and warns doctors and medical assistants in real time about changes in the patients' vital parameters, such as body temperature, pulse, blood oxygen levels, etc., as well as significant changes in environmental parameters.
Taiyang Wu, Fan Wu, Jean Michel Redoute, Mehmet Rasit Yuce, "An Autonomous Wireless Body Area Network Implementation Towards IoT Connected Healthcare Applications" [3], A new technology paradigm known as the Internet of Things (IoT) uses the Internet to link objects from different fields. The wireless body area network (WBAN) is becoming more and more popular for IoT-connected healthcare applications as wearable technology enters the market. In order to facilitate

the deployment of an autonomous WBAN, this article suggests a wearable sensor node that has the ability to harvest solar energy and transmit Bluetooth low energy (BLE). Several sensor nodes can be placed in various body locations to measure the subject's heart rate, body temperature distribution, and fall detection. The sensor data and fall notice are also shown via a web-based smartphone application. A flexible solar energy harvester using an output-based maximum power point tracking (MPPT) technique powers the wearable sensor node in order to prolong its lifespan. According to experimental findings, the wearable sensor node functions effectively when it is powered by a solar energy harvester. The experimental results enable the autonomous operation for twenty-four hours. As long as the subject spends a small amount of time outside each day, the suggested system with solar energy harvesting shows that long-term continuous medical monitoring based on WBAN is feasible.

Higinio Mora ID, David Gil ID, Rafael Muñoz Terol D, Jorge Azorin, D Andjulian Szymanski, "An IoT-Based Computational Framework For Healthcare Monitoring In Mobile
Environments" [4], The development of sensors, embedded devices, and other "things" that are prepared to comprehend their surroundings is made possible by the new Internet of Things paradigm, which permits the design of tiny devices with sensing, processing, and communication capabilities. This research proposes a distributed platform for monitoring human biological signals during physical exertion activities, based on the internet of things paradigm. The flexibility in calculating the health application by utilizing resources from available devices within the user's body area network is one of the primary benefits and innovations of the suggested system. This suggested paradigm can be used in different mobile contexts, particularly those with high processing demands and intensive data collection. In order to validate our proposal, we conclude with a case study that involves tracking football players' heart rates during a game. The ability to forecast not only instances of unexpected mortality but also potential injury is an obvious social goal presented by the real-time data collected by these devices.

Carsten Maple "Security and privacy in the internet of things" [5], The technology known as the internet of things (IoT) has the potential to completely transform our way of life in a number of areas, including transportation, health, entertainment, and our relationships with the government. This amazing opportunity also brings a number of serious problems. As we fight to create laws, regulations, and governance that influence this progress without limiting innovation, the proliferation of devices and their rapid expansion pose threats to our security and liberties. The development of the Internet of Things, its different definitions, and some of its most important use cases are covered in this presentation. Both generally and in relation to specific applications, security and privacy issues and future difficulties are covered.

Godavarthi Rajesh, M.K. Srilekha, "Advanced Healthcare Monitoring System Using CC3200 microcontroller" [6], In hospitals, telemedicine is essential for quick decision-making and treatment since it allows doctors to receive medical data quickly. For consultations and remote medical exams, doctors receive the medical data via mobile devices and servers. This study describes the experience, a practice used, and points of interest in many strategy aspects to be taken into consideration for the development of a more effective telemedicine patient observation approach. The patient's vital indicators, such as their EMG, blood pressure, glucose level, and bilirubin count, are so recorded, and the data is entered into the database. After then, it will be updated on the online server and sent as Android apps to the doctor's phone. Additionally, it allows the physicians to immediately transmit their feedback back to the nursing station.

Dr. S. Mohan Kumar and Darpan Majumder "Healthcare Solution based on Machine Learning Applications in IOT and Edge Computing" [7], Despite not being directly related, cloud computing and the Internet of Things (IOT) are two technologies that play a big part in our daily lives. These two technologies can be combined to address issues in the fields of asset tracking, assisted living, healthcare, surveillance, and agriculture. However, because of the significant network latency, cloud computing is not the best option for applications that need real-time replies. As a result, a novel

method known as "edge computing" was presented, which aims to decrease network latency by pushing computation to the "edge of the network." Data safety and privacy issues, battery power consumption, bandwidth costs, and real-time answers can all be resolved via edge computing. This paper will examine how edge computing and IOT are being used in the healthcare industry. In this study in particular, we are investigating the potential for combining the paradigms of cloud/edge computing and machine learning into an IOT framework based on distributed computing. The goal is to be able to separate pertinent information of interest from the massive amounts of data that are usually produced by the front-end sensor frameworks in Internet of Things devices. It is possible to incorporate some intelligence into the front-end module itself so that it can decide which data is most important. An IOT server with a backend can offers guidance on how to accomplish this. In order to automatically learn data signatures of interest based on the data it has already received; it is suggested that the backend server have machine learning-based implementations.

Rameswari.R, Divya.N "Smart Health Care Monitoring System Using Android Application: A Review" [8], The world is changing due to innovation, which is also pushing us in the direction of a more practical, specialized world. The impact of the growing ICT and IOT on human services has been profound. It improves the quality of service, increases patient security and information insurance, and lowers operating and regulatory expenses. The correspondence gap has completely disappeared as a result of the media transmission devices being simpler for everyone to use and comprehend globally. A section of the correspondence innovation and specific protocols for transmitting information in a secure manner namely, how patients' urgent indications are forwarded to the medical consultant for additional treatment.

Ayaskanta Mishra, Akanksha Kumari, Pooja Sajit, Pranjal Pandey, "Remote Web Based Ecg Monitoring Using MQTT Protocol for IOT In Healthcare" [9], Given the current exponential expansion in the population and the rising cost of healthcare, general public healthcare is a highly critical issue. People who live far from a metropolis and competent medical care frequently suffer from a lack of available medical services. It is now essential to have a health monitoring system that works well enough to identify health issues as they deteriorate and to enable prompt action based on the data collected. A novel approach to ECG monitoring based on lightweight MQTT has been proposed in this research with the Internet of Things (IoT) in mind. An ECG monitoring sensor (AD8232) from Texas Instruments collects ECG data, which is then sent via an ADS1115 16-bit ADC interfaced with a Raspberry Pi using the I2C protocol. Using an IEEE 802.11 (WLAN) included inside the Raspberry Pi 3, the digital ECG sensor data obtained from ADC is published to a Cloud MQTT broker using a MQTT mosquitto client. Any remote medical facility, hospital, or treating physician can use a graphical user interface (GUI) to view the ECG with a MQTT subscription.

Prajoona Valsalan, Tariq Ahmed Barham Baomar, Ali Hussain Omar Baabood "IoT Based Health Monitoring System" [10], These days, every nation places a high priority on healthcare due to the new corona virus. An Internet of Things-based health monitoring system is therefore the most effective remedy for this kind of outbreak. A rapidly expanding field of study, particularly in the medical field, is the Internet of Things (IoT). As wearable sensors and smartphones have become more popular, remote health care monitoring has advanced quickly. In addition to minimizing the spread of illness, IoT health monitoring enables accurate detection of health conditions, even when a doctor is located far away. This research presents a portable physiological checking framework that can continuously monitor the patient's temperature, heart rate, and other fundamental room parameters. Using Wi-Fi Module-based remote correspondence, we suggested a continuous monitoring and control tool to screen the patient's status and store the patient data on the server. A suggested IoT-based remote health monitoring system would allow authorized personnel to access data stored on any IoT platform, and clinicians could diagnose ailments remotely depending on the data they receive.

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The primary contribution is a novel analysis of the cardiovascular IoT signal strength for wearable networks in medical body regions. To put a methodology into practice for a trustworthy lightweight signal quality evaluation that lowers traffic, bandwidth, and cloud-based processing expenses while extending battery life for wearables with IoT capabilities. To increase the security of data transmission, Lightweight Access Control (LAC) and Lightweight Secure IoT (LS-IoT) have been proposed.

III. Proposed System

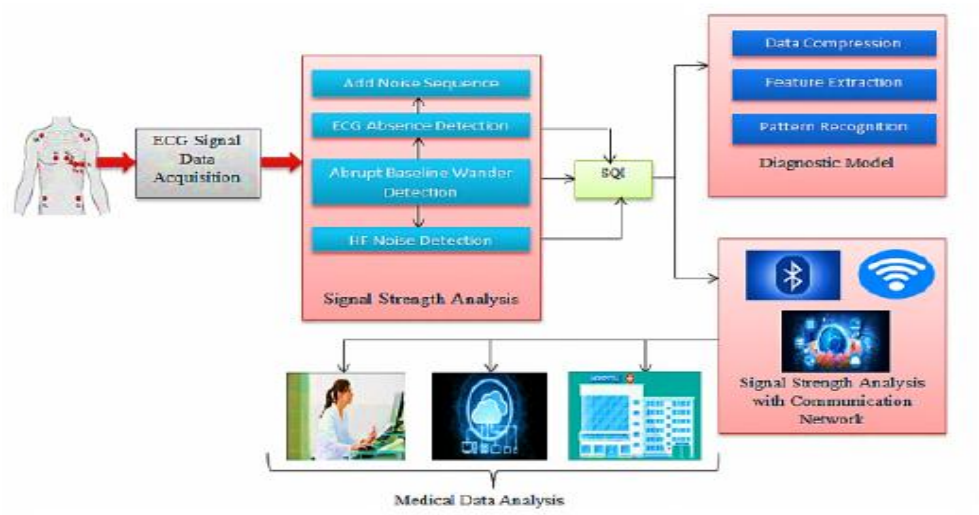

Figure 1- Proposed Signal Strength Analysis (SSA) Framework based on IoT platform.

Signal strength analysis (SSA)-IoT platform's core components are comprised of three modules: (1) an ECG module for signal detection, (2) an automated module for signal quality assessment, and (3) an ECG analysis and transmitter module for signal quality.

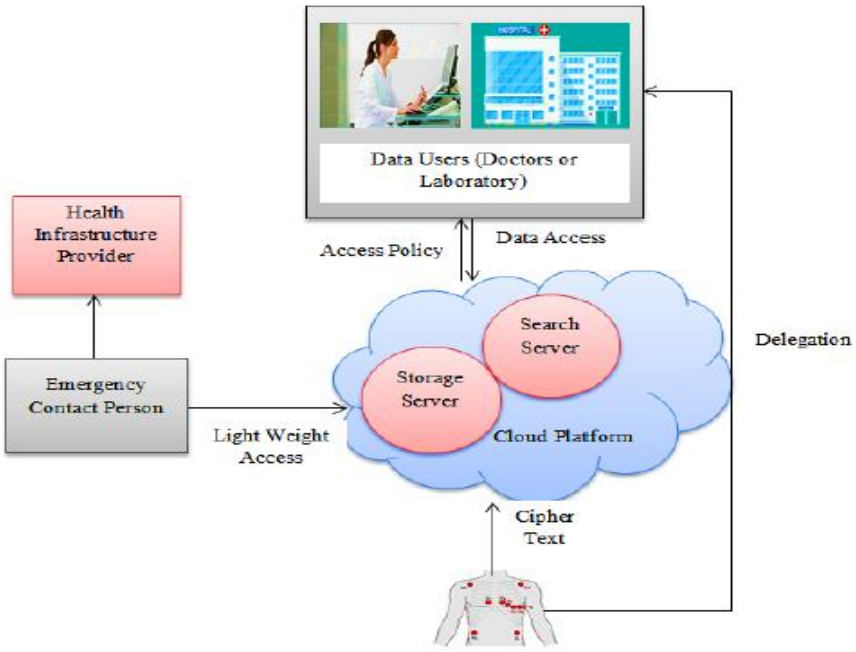

Figure 2- Lightweight access control for secure ECG data transmission.

The primary data generation core, a cloud platform (PT), data owners, patients, data consumers, and an emergency contact person are all part of the LAC architecture. For the attribute-based access (ABE) encrypted medical records to be secure, the device must be indistinguishable from a plaintext attack. An adversary cannot distinguish between the two underlying complaints and the two ciphertexts of danger in the fundamental safety model. The attack's security model is completely secure. According to the security paradigm, rather than in the beginning, the attacker chooses the access policy for challenges at this difficult point. The comprehensive security model clearly offers a higher degree of protection than the other selective models.

IV. Conclusion

This research presents a novel Internet of Things-assisted signal analysis system for heart health surveillance applications based on ECG quality. An ECG-SSA methodology for the automated assessment of the quality of ECG signals derived from patient and physical activity is presented in this research. According to the analysis, when physical activity increases, the ECG signals get seriously distorted. However, real-time evaluation results demonstrate that by sending adequate ECG signals in IoT devices in undesirable ECG signals, the suggested lightweight ECG Signal Strength Analysis (SSA) significantly reduces battery energy usage. Better security for ECG data transfer is offered by Lightweight Access Control (LAC) and Lightweight Secure IoT (LS-IoT). According to this study, by lowering the false alarm levels for significant ECG noise recordings, the ECG Signal Strength Analysis (SSA) implementation with a cardiac health control enabled IoT device has enormous potential to improve the resource effectiveness, security, and reliability of noncontrolled signal analyzers and diagnostic systems.

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