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Thyroid Disease Detection Using Feature-Based Filter Selection

***Mr. Mahendra S.M*[*1], *Ms. Lisha Rai S*[#2], *Ms. Sahana N S*[#3]**

[*1]Assistant Professor, Department of Electronics and Communication Engineering,
Coorg Institute of Technology, Ponnampet, Karnataka, India.
mahendrasm1984@gmail.com.
[#2, #3] 8th Semester, Department of Electronics and Communication Engineering,
Coorg Institute of Technology, Ponnampet, Karnataka, India
lisharaisuresh@gmail.com , sahanagowda6743@gmail.com.

ABSTRACT—

Thyroid disorders, including hypothyroidism and hyperthyroidism, are prevalent endocrine conditions that necessitate timely detection and continuous monitoring for effective management. In recent years, machine learning (ML) techniques have emerged as powerful tools for early diagnosis, yet individual ML models often suffer from limited accuracy due to data imbalance and irrelevant features. This study presents a framework that utilizes a filter-based feature selection method to enhance the performance of ML algorithms in thyroid disease detection. Additionally, an IoT-enabled hardware prototype incorporating the MAX30100 sensor, Arduino microcontroller, and LCD interface is developed to support real-time health monitoring. The collected physiological data, including heart rate and oxygen saturation, is analysed using Convolutional Neural Network (CNN)-based algorithms to identify potential thyroid abnormalities. Experimental results on a clinical dataset show promising predictive performance, with a high ROC-AUC score of 99.9%. The integration of ML and IoT offers a scalable, cost-effective solution for accessible and accurate thyroid disease management.

INDEX TERMS—Artificial intelligence,healthcare, machine learning, filter-based feature selection, thyroid disease.

INTRODUCTION

Approximately 40% of the global population suffers from iodine deficiencies, leading to thyroid-related diseases that affect over 200 million people worldwide. The manifestation of thyroid diseases is largely influenced by dietary iodine, an essential component of thyroid hormones. An imbalance in thyroid hormone production can lead to various thyroid diseases, which constitute a significant global health issue. These diseases notably impair the physical and psychosocial well-being of affected individuals, particularly during early life due to their impact on cognition and growth. Common thyroid diseases, including hypothyroidism, hyperthyroidism, thyroid nodules, goitre, and thyroid cancer, which are all influenced by hormonal imbalances

Recent advancements in sensor technology and machine learning offer innovative solutions for more efficient and accessible health monitoring. In particular, wearable sensors combined with artificial intelligence (AI) have the potential to revolutionize the way thyroid disorders are detected and managed. This project proposes a system that integrates Convolutional Neural Networks (CNNs) for thyroid disorder prediction with an Internet of Things (IoT) framework for real-time monitoring.

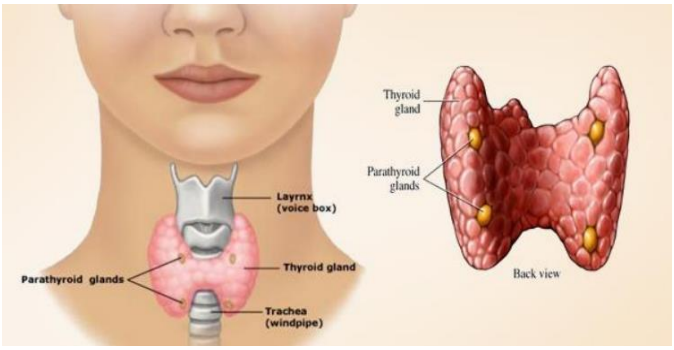

Fig 1: Thyroid disease representation

LITERATURE SURVEY

The advancements in technology have significantly enhanced the diagnosis and management of thyroid disorders. Numerous studies have explored innovative methods to overcome the limitations of traditional diagnostic approaches, such as blood tests and clinical examinations, which are often time-consuming, invasive, and inaccessible in remote areas.

[1] According to Koyyada, A. (2020). "Clinical Study on Interpretation of Hypo and Hyperthyroid Disorders with Various Menstrual Disturbances". The study delves into the clinical correlations between thyroid dysfunctions and menstrual irregularities, emphasizing the importance of early diagnosis and treatment. It provides valuable insights into how hypothyroidism and hyperthyroidism affect metabolic and hormonal pathways, which can lead to secondary health complications.

[2] According to Yadav, A., Ali, I., Helmy, A., & Rizkalla, M. (2019). "Highly Sensitive Graphene Devices for Non-Invasive Early Diagnosis of Hyperthyroidism: A Feasibility Study" The authors present an innovative approach using graphene-based sensors for the non-invasive detection of hyperthyroidism. These devices demonstrate high sensitivity in detecting thyroid hormone imbalances.
[3] According to Malathi, M., Keerthigasri, P., & Balambigai, S. (2019). "A Non-Invasive Technique to Detect Thyroid Using Infrared Sensor". The research proposes a novel method using infrared sensors to monitor thyroid abnormalities non-invasively. The study highlights the effectiveness of wearable devices for continuous health monitoring and provides a basis for developing cost-effective and portable systems for thyroid disorder detection

[4] According to Zhao, W., Liu, J., & Zhang, Y. (2021). "IoT-Based Health Monitoring Systems: A Comprehensive Review" The review discusses IoT-based solutions for real-time health monitoring, highlighting their potential to transform healthcare. It underscores the importance of integrating IoT for remote monitoring and early detection.

PROBLEM STATEMENT

Thyroid disorders like hypothyroidism and hyperthyroidism often remain undiagnosed or are detected late, leading to serious health issues. Traditional diagnostic methods involving blood tests and consultations are costly, time-consuming, and inaccessible in remote areas, and they lack real-time monitoring. This project proposes a non-invasive, portable, and real-time thyroid monitoring system using IoT and Convolutional Neural Networks (CNNs) to enable early detection and continuous tracking. By eliminating the discomfort of invasive procedures and leveraging wearable sensors with advanced machine learning, the system aims to provide accurate, timely predictions, empowering patients and healthcare providers with actionable insights for better thyroid health management.

PROPOSED SYSTEM

The proposed system is a portable, non-invasive thyroid monitoring solution that integrates Internet of Things (IoT) technology with Convolutional Neural Networks (CNNs) to enable early detection and continuous tracking of thyroid disorders. Wearable sensors are employed to collect real-time physiological data, eliminating the need for invasive blood tests. This data is transmitted to a cloud-based platform where CNN algorithms process and analyze the input to detect patterns indicative of thyroid abnormalities.
The system aims to provide accurate, real-time predictions and alerts, supporting timely medical intervention. Its user-friendly interface ensures accessibility for both patients and healthcare providers, making thyroid health management more efficient and accessible, especially in resource-limited settings.

V.OBJECTIVE

The primary objective of this project is to design and implement a smart, real-time thyroid health monitoring system using IoT and machine learning, particularly Convolutional Neural Networks (CNNs). This system aims to provide a non-invasive, cost-effective, and accessible alternative to conventional blood-based thyroid diagnostics. By continuously capturing physiological data through wearable sensors and analysing it using deep learning algorithms, the project seeks to facilitate early detection of thyroid abnormalities, enable timely interventions, and reduce the burden of delayed diagnosis. The solution also aspires to empower patients and healthcare professionals with continuous, data-driven insights, ultimately contributing to better disease management and improved quality of life.

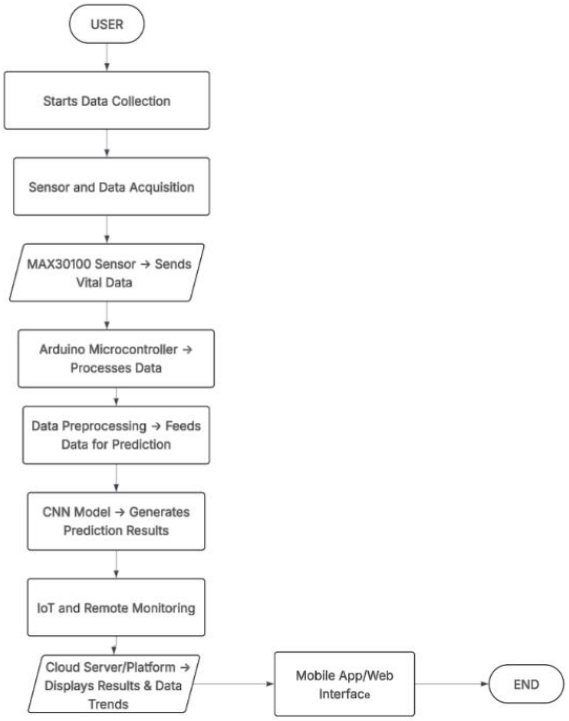

Fig 2. Flow chart

VI. WORKING PRINCIPLE

The Thyroid Monitoring System operates by collecting vital signs such as heart rate and oxygen saturation using the MAX30100 sensor, which sends this data to the Arduino microcontroller for initial processing. The processed data is then displayed in real-time on an LCD display and transmitted via a Wi-Fi or Bluetooth module to a connected cloud platform. Simultaneously, the data is used to feed a trained Convolutional Neural Network (CNN) model developed using Python (TensorFlow/Keras), which predicts potential thyroid abnormalities. The prediction results and historical health data are stored in the cloud server and made accessible through a mobile or web application for both users and healthcare providers, enabling remote monitoring and timely medical intervention. The predictions, along with historical health records, are stored on the cloud and made accessible via mobile or web application, facilitating remote monitoring and enabling timely intervention by healthcare providers.

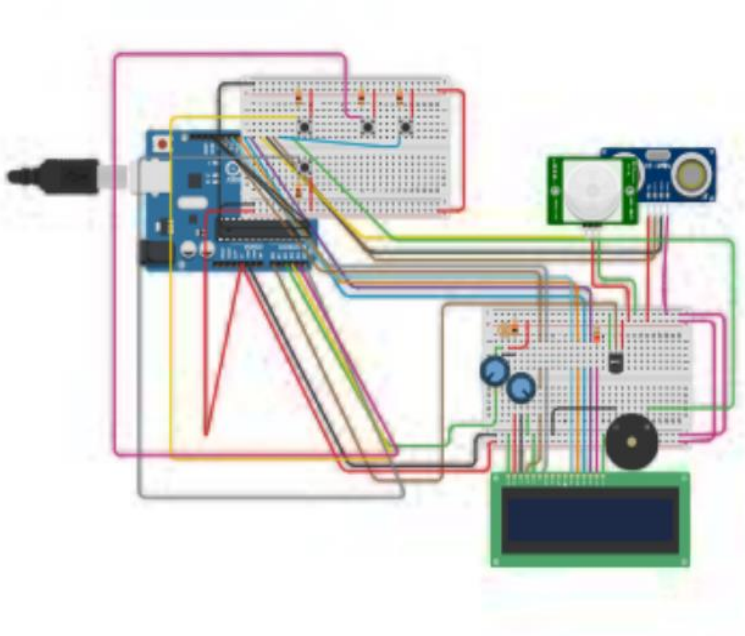

Fig 3: Virtual Model of Thyroid Health Monitor in Tinkercad

CONCLUSION

This project demonstrates an innovative approach to thyroid disorder prediction and monitoring by integrating thyroid conditions. The project highlights the potential of accessible, portable devices to improve patient outcomes and healthcare efficiency, with future work focusing on refining the CNN model, adding more sensors, and expanding disease detection capabilities. Ultimately, it underscores the transformative role of IoT and machine learning in creating user-friendly, impactful health monitoring systems. CNN-based machine learning with IoT-enabled health devices.

Using an Arduino microcontroller and MAX30100 sensor, the system provides a compact and cost-effective solution for monitoring key health metrics indicative of thyroid abnormalities. By transmitting data to a mobile app or cloud platform, users can continuously track their health at home, facilitating early detection and efficient management of thyroid conditions. The project highlights the potential of accessible, portable devices to improve patient outcomes and healthcare efficiency, with future work focusing on refining the CNN model, adding more sensors, and expanding disease detection capabilities..

Ultimately, this project demonstrates the transformative potential of IoT and machine learning technologies in making health monitoring systems more user-friendly, cost-effective, and impactful, paving the way for a future where personalized healthcare is more accessible and efficient.

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