PREDICTING LIFE STYLE RELATED HEALTH RISK USING SLEEP PATTERN AND PULSE

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ABSTRACT

In recent years, lifestyle-related health disorders such as cardiovascular diseases, stress, obesity, and hypertension have increased significantly due to irregular sleep habits and abnormal physiological conditions. This project proposes a predictive system that analyzes sleep patterns and pulse rate data to assess potential health risks. By collecting real-time or historical data from wearable devices or health monitoring systems, the model identifies patterns associated with unhealthy lifestyles. Machine learning techniques are employed to classify individuals into different risk categories based on features such as sleep duration, sleep quality, resting pulse rate, and variability. The system aims to provide early warnings and personalized insights, enabling users to take preventive measures and adopt healthier routines. This approach not only enhances awareness but also contributes to proactive healthcare management, reducing the likelihood of severe health complications.

Keywords: Lifestyle Diseases, Sleep Pattern Analysis, Pulse Rate Monitoring, Health Risk Prediction, Machine Learning, Wearable Devices, Preventive Healthcare.

INTRODUCTION

In the modern digital era, rapid urbanization, sedentary lifestyles, increased screen time, and irregular daily routines have significantly contributed to the rise of lifestyle-related health issues. Disorders such as cardiovascular diseases, hypertension, obesity, diabetes, and mental stress are increasingly affecting people across all age groups. One of the primary factors influencing these conditions is the disruption of natural biological rhythms, particularly sleep patterns. Adequate and quality sleep plays a vital role in maintaining physical health, cognitive function, and emotional well-being. However, due to work pressure, excessive use of electronic devices, and poor lifestyle choices, many individuals suffer from insufficient or irregular sleep, which directly impacts their overall health.

In addition to sleep, pulse rate (heart rate) is a critical physiological parameter that reflects the body's internal condition. Abnormal pulse rates—either too high or too low—can indicate stress, fatigue, cardiovascular problems, or other underlying health issues. Continuous monitoring of pulse rate, especially when combined with sleep data, provides valuable insights into a person's health status. Advances in wearable technology, such as smartwatches and fitness trackers, have made it possible to collect real-time data on these parameters, enabling continuous and non-invasive health monitoring.

With the availability of such data, there is a growing opportunity to leverage machine learning and data analytics techniques to predict potential health risks before they become severe. By analyzing patterns in sleep duration, sleep quality, heart rate variability, and resting pulse rate, predictive models can identify early signs of lifestyle-related disorders. This proactive approach shifts healthcare from reactive treatment to

preventive care, allowing individuals to make informed decisions about their habits and lifestyle.

The proposed system focuses on developing an intelligent health risk prediction model that integrates sleep pattern analysis and pulse monitoring. By classifying individuals into different risk categories, the system aims to provide timely alerts and personalized recommendations for improving lifestyle habits. Ultimately, this approach promotes healthier living, reduces healthcare costs, and enhances overall quality of life by enabling early detection and prevention of potential health complications.

I. LITERATURE SURVEY

1. Title: Sleep Quality Prediction from Wearable Data Using Deep Learning

Authors: A. Sathyanarayana et al. (2016)

Abstract:

This study focuses on predicting sleep quality using wearable device data and deep learning techniques. The authors utilized actigraphy data collected during awake periods and applied models such as Convolutional Neural Networks (CNN) and other machine learning approaches. The results demonstrated that deep learning models significantly outperform traditional regression methods, achieving high accuracy and reliability in classifying sleep efficiency. The study highlights the potential of wearable technology combined with artificial intelligence to monitor and improve sleep-related health conditions.

2. Title: Machine Learning for Healthcare Wearable Devices

Authors: F. Sabry et al. (2022)

Abstract:

This research presents a comprehensive overview of machine learning applications in wearable healthcare systems. The study explores various use cases such as activity recognition, stress detection, heart rate monitoring, and rehabilitation support. It emphasizes the role of sensors like accelerometers and heart rate monitors in collecting physiological data, which is then analyzed using machine learning algorithms. The paper concludes that wearable devices integrated with AI can effectively monitor vital signs and predict potential health risks, contributing to improved patient care and preventive healthcare solutions.

3. Title: Machine Learning in Heart Rate Monitoring and Prediction

Authors: K. Staszak et al. (2023)

Abstract:

This paper reviews advancements in heart rate monitoring systems enhanced by machine learning techniques. It discusses the use of ECG and PPG sensors to collect heart-related data and the application of AI models to process and interpret this data. The study highlights that machine learning improves the accuracy of detecting abnormalities in heart rate and assists in predicting cardiovascular conditions. Although current systems require further improvements, the research emphasizes their growing importance in real-time health monitoring and early disease detection.

4. Title: Evaluating Machine Learning Models for Predicting Sleep Disorders

Authors: Gregorius Airlangga (2024)

Abstract:

This study evaluates different machine learning models for identifying sleep disorders using lifestyle and health-related data. The dataset includes various attributes such as sleep metrics, demographic details, and health parameters. The research compares multiple algorithms to determine the most effective model for accurate prediction. The findings suggest that machine learning techniques can successfully classify sleep disorders despite the complexity and variability of influencing factors, making them useful for healthcare diagnostics and monitoring systems.

5. Title: Predicting Fatigue Using Heart Rate Variability and Sleep Patterns

Authors: N. Y. Aboagye et al. (2025)

Abstract:
This research explores the prediction of next-day fatigue levels by combining physiological and behavioral data, including heart rate variability (HRV) and sleep patterns. The model analyzes previous-day data to estimate fatigue conditions, providing insights into how sleep and physiological signals influence overall health. The study demonstrates that integrating multiple data sources improves prediction accuracy and helps in understanding the relationship between lifestyle factors and health outcomes.

II. EXISTING SYSTEM

The existing systems for predicting lifestyle-related health risks primarily rely on traditional healthcare monitoring methods and basic machine learning approaches. In most cases, health assessment is conducted through periodic medical checkups, where parameters such as heart rate, blood pressure, and sleep quality are measured separately. These systems often depend on manual data collection and lack continuous monitoring, making it difficult to detect early signs of potential health risks. Additionally, conventional systems typically analyze individual parameters in isolation rather than considering the combined effect of sleep patterns and pulse rate, which limits the accuracy and depth of health predictions.

With the advent of wearable devices, some modern systems have started collecting real-time physiological data such as heart rate and activity levels. However, many of these systems focus mainly on tracking and visualization rather than intelligent prediction. Basic machine learning models like linear regression, decision trees, or simple classification techniques are sometimes used, but they often struggle to capture complex relationships between multiple lifestyle factors. Furthermore, these systems may suffer from issues such as limited datasets, lack of personalization, and insufficient integration of behavioral patterns like sleep cycles.

Another limitation of existing systems is their inability to provide proactive and preventive healthcare solutions. Most systems are reactive in nature, offering insights only after a health issue has already developed. They also lack adaptive learning capabilities, meaning they cannot continuously improve their predictions based on new data. As a result, the effectiveness of these systems in identifying long-term lifestyle-related risks remains limited. Therefore, there is a need for a more advanced, integrated, and intelligent system that can analyze multiple health parameters simultaneously and provide accurate, real-time predictions for better health management.

III. PROPOSED SYSTEM

The proposed system introduces an intelligent and data-driven approach for predicting lifestyle-related health risks by integrating sleep pattern analysis and pulse rate monitoring. Unlike existing systems that analyze parameters independently, this system combines multiple physiological and behavioral features such as sleep duration, sleep quality, resting pulse rate, and heart rate variability to provide a more comprehensive assessment of an individual's health condition. Data is collected either from wearable devices or user input and is preprocessed to remove noise, handle missing values, and normalize the features for accurate analysis.

The core of the system is a machine learning-based predictive model that learns patterns from historical health data to classify individuals into different risk categories such as low, medium, or high risk. Advanced algorithms such as Random Forest, Support Vector Machine, or Neural Networks can be utilized to improve prediction accuracy and handle complex relationships between features. The model is trained and validated using labeled datasets to ensure reliability and generalization

across different users. Additionally, feature selection techniques are applied to identify the most influential factors contributing to health risks.

The proposed system also includes a user-friendly interface that allows individuals to monitor their health status and receive real-time predictions. Based on the output, the system provides personalized recommendations such as improving sleep habits, reducing stress, or maintaining a healthy lifestyle. Unlike traditional systems, this approach emphasizes preventive healthcare by identifying potential risks at an early stage, enabling timely intervention. Overall, the proposed system aims to enhance health awareness, improve quality of life, and reduce the burden of lifestyle-related diseases through continuous monitoring and intelligent prediction.

IV. SYSTEM ARCHITECTURE

The system architecture for predicting lifestyle-related health risks using sleep patterns and pulse rate is designed as a structured, multi-stage pipeline that ensures accurate data processing and intelligent prediction. The process begins with the data collection stage, where input is gathered either through wearable devices such as smartwatches and fitness bands or through manual user input. These devices continuously monitor key physiological parameters like sleep duration, sleep quality, and pulse rate, providing real-time and historical data for analysis.

Once the data is collected, it moves to the data preprocessing stage, which is essential for improving data quality and model performance. In this stage, raw data undergoes cleaning to remove noise and inconsistencies, missing values are handled appropriately, and important features are extracted. Additionally, normalization techniques are applied to ensure that all input parameters are on a similar scale, which helps in enhancing the efficiency and accuracy of the machine learning model.

The processed data is then fed into the machine learning model, which forms the core of the system. Here, advanced algorithms analyze both sleep patterns and pulse rate simultaneously to identify hidden relationships and patterns. Based on this analysis, the system performs risk classification, categorizing individuals into different levels such as low risk, medium risk, or high risk. This classification enables a clear understanding of the user's health condition and potential threats.

Finally, in the output and feedback stage, the system presents the results in an understandable format. Users receive health risk alerts along with personalized recommendations aimed at improving their lifestyle, such as better sleep habits, stress management, or physical activity suggestions. This stage emphasizes preventive healthcare by guiding users toward healthier behaviors. Overall, the architecture ensures a seamless flow from data acquisition to actionable insights, making the system effective for early detection and management of lifestyle-related health risks.

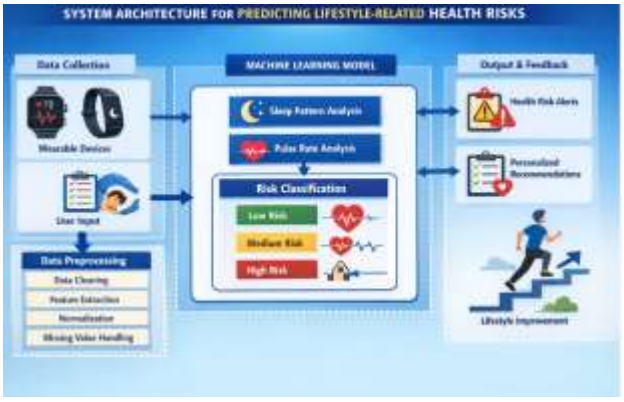

Fig 5.1: Structure of the Proposed System

V. IMPLEMENTATION

Fig 6.1:Home page

Fig 6.2: Risk Level

Fig 6.3: Correlational Heat-map

Fig 6.4: Analysis

VI. CONCLUSION

The proposed system for predicting lifestyle-related health risks using sleep patterns and pulse rate presents an effective and intelligent approach toward preventive healthcare. By integrating physiological and behavioral data, the system provides a comprehensive understanding of an individual's health condition rather than relying on isolated parameters. The use of machine learning techniques enhances the accuracy of predictions and enables early identification of potential risks such as stress, cardiovascular issues, and other lifestyle disorders. Unlike traditional methods, this system emphasizes continuous monitoring and proactive intervention, allowing users to make informed decisions about their daily habits. Furthermore, the incorporation of personalized recommendations helps individuals adopt healthier lifestyles and reduce the chances of severe health complications. Overall, the system contributes to improving quality of life, promoting health awareness, and supporting the transition from reactive to preventive healthcare solutions.

VII. FUTURE SCOPE

The future scope of the proposed system lies in enhancing its accuracy, scalability, and real-time applicability by integrating more advanced technologies and diverse health parameters. In upcoming developments, additional physiological signals such as blood pressure, oxygen saturation (SpO_2), physical activity levels, and stress indicators can be incorporated to provide a more holistic view of an individual's health. The use of advanced deep learning models and hybrid algorithms can further improve prediction performance by capturing complex patterns in large-scale health data. Moreover, integrating the system with Internet of Things (IoT)-based healthcare devices and mobile applications will enable continuous, real-time monitoring and instant feedback to users.

Another promising direction is the inclusion of personalized and adaptive learning systems that can adjust predictions based on individual lifestyle changes over time. Cloud-based deployment can enhance

accessibility and allow healthcare professionals to remotely monitor patients and provide timely interventions. Additionally, incorporating features such as multilingual support, voice-based interaction, and user-friendly dashboards can improve usability for a wider audience. Future research can also focus on ensuring data privacy and security using advanced encryption and blockchain technologies. Overall, the system has the potential to evolve into a comprehensive digital health assistant that supports early diagnosis, personalized healthcare, and improved well-being on a global scale.

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