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A STUDY ON LSTM AND RECURRENT NEURAL NETWORKS FOR CARDIOVASCULAR DISEASE RISK PREDICTION IN LABOUR ORGANIZATIONS

S.M.P Qubeb[1], P.Vishnu Vardhana Rao[2], U.Vishnu vardhan[3], P.Yukthesh[4], P. Balachandra [5], A.S.M.Thahir [6], B.Yaswanth Reddy [7]
qubeb.s@gmail.com[1] vishnuvardhanpathipati@gmail.com[2] bbyeswanthreddy@gmail.com[3]
yukthesh3002@gmail.com[4] pasupulabalachandra1432@gmail.com[5] thahirmd208@gmail.com[6]
udayagirivishnuvardhan@gmail.com[7]
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE) , GATES INSTITUTE OF TECHNOLOGY, Gooty

ABSTRACT
With the development of medical digitization technology, artificial intelligence and big data technology, the medical model is gradually changing from treatment-oriented to prevention-oriented. In recent years, with the rise of artificial neural networks, especially deep learning, great achievements have been made in realizing image classification, natural language processing, text processing and other fields. Combining artificial intelligence and big data technology for disease risk prediction is a research focus in the field of intelligent medicine. Blood lipids are the main risk factors of cardiovascular and cerebrovascular diseases. If early prediction of abnormal blood lipids in iron and Labour Organization can be carried out, early intervention can be carried out, which is beneficial to protect the health of Labours in Labour Organization. This paper revolves around dyslipidemia prediction problem in labours in labour organization, firstly analyses the influence factors of the dyslipidemia, discusses the commonly used method for prediction of disease, and then studied deep learning related theory. this paper introduces the two deep learning algorithms of RNN (Recurrent Neural Network) and LSTM (Long Short-Term Memory). Use the basic principle of Python language and the TensorFlow deep learning framework, establishes a prediction model based on two deep learning networks, and makes an example analysis
KEYWORDS: Dyslipidemia Prediction, Cardiovascular Disease, Labour Organization, Occupational Health, Recurrent Neural Network (RNN), Long Short-Term Memory (LSTM), Time-Series Data, Deep Learning, TensorFlow, Blood Report Analysis, Preventive Healthcare, Sequential Modeling, Risk Assessment Tool, AI in Healthcare, Clinical Decision Support.

INTRODUCTION

As the pillar industry of the secondary industry, iron and steel industry has made an indelible contribution in the period of India from agricultural economy to industrial economy. The contribution of front-line Labour Organization in the processing and production of steel is even more obvious. Therefore, the physical health of front-line Labour Organization is directly related to the economic benefits of each steel production unit, the financial revenue of the entire city and the comprehensive strength of the country . Along with the advancement of society and technology, the working environment of labours in Labour Organization has also been greatly improved, which has gradually been transformed from mechanical work to manual operations. However, there are still some jobs that require workers to be under high temperature conditions and pay attention for a long

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time to ensure the successful completion of production work, such as the temperature control of molten iron in front of the furnace, the casting machine, etc., and require workers to concentrate on standing or sitting for a long time in high temperature and noise.

Hence, in addition to occupational diseases, there are also a series of chronic non-infectious diseases in the course of work. Dyslipidemia is one of the major risk factors for a variety of chronic non-infectious diseases, and a major cause of stroke and heart disease. A series of physiological reactions will occur in the human body during high-temperature operation, mainly including changes in body temperature regulation, water and salt metabolism, circulatory system, neuroendocrine system, and urinary system. The mechanism of noise on blood lipids and glucose is not noticeably clear, but there are reports suggesting that noise stimulation can not only damage hearing, but also be introduced into the cerebral cortex and autonomic nervous center through hearing, triggering a series of reactions in the central nervous system. Changes in neuroregulatory functions have led to disturbances in central regulation of vascular movement, resulting in disorders of lipid metabolism. In the noise environment for a long time, the auditory nerve would activate the upward activation system of the brain stem network structure, excite the cerebral cortex, increase the activity of the sympathetic nervous system, and increase the secretion of catecholamines.

Related works

This section reviews key research in laser-based spectroscopy for surface analysis, surface chemistry modification of polymers, genetic investigations in dyslipidemia, occupational health in informal labour sectors, and AI-driven health risk modelling. These studies form a foundational backdrop for advancements in sensor technology, materials characterization, public health, and predictive modelling.

Z. Akhter et al. (2023) [1] demonstrated the use of fiber-optic laser-induced breakdown spectroscopy (FOLIBS) in a double-pulse (DP) configuration to detect chlorine concentrations on stainless steel surfaces. The approach enabled remote, high-sensitivity measurement down to 5 mg/m^2, using a compact system interfaced via 25-meter optical fibers. Their work addresses a crucial challenge in monitoring corrosion-related stress cracking in dry cask nuclear fuel storage systems and supports integration into robotic inspection platforms.

L.Chen et al. (2021) [2] investigated the temperature-dependent behaviour of direct fluorination on high-temperature vulcanized silicone rubber. Their study revealed that fluorination at 55 °C, despite exhibiting lower surface fluorine content, produced the thickest and most nanostructured layer. This unusual outcome was attributed to the competing effects of fluorine diffusion and steric hindrance. The fluorinated surfaces displayed high hydrophobicity and oleophobicity, suggesting applicability in designing low-energy, durable materials.

T.Naito et al.(2020)[3] provided a comprehensive genotyping study of Mendelian dyslipidaemias using next-generation sequencing. The authors combined rare variant analysis with Mendelian randomization using common variants to examine causal links to coronary artery disease. Their work supports the development of novel therapeutics by targeting pathways implicated in inherited lipid disorders, serving as a model for genomic-driven drug discovery.

A. Amegah et al. (2022) [4] conducted a field study on e-waste recycling workers in Accra, Ghana, focusing on occupational injuries, noise exposure, and perceived stress. Their findings indicated an average of nearly 10 injuries per worker over six months, with significant correlations between stress, noise exposure, and injury frequency. The study emphasized the urgent need for improved worker safety practices and mental health interventions in informal labour environments.

Y. Zhang et al. (2023) [5] introduced a novel hypertension risk assessment model tailored for steel industry labourers using a hybrid of Learning Vector Quantization (LVQ) and Fisher-SVM algorithms. The model accounted for occupation-specific stressors—such as high temperature, noise, and shift work—typically absent from standard risk models. Their findings underscored the importance of AI-driven, domain-specific approaches to occupational health assessment.

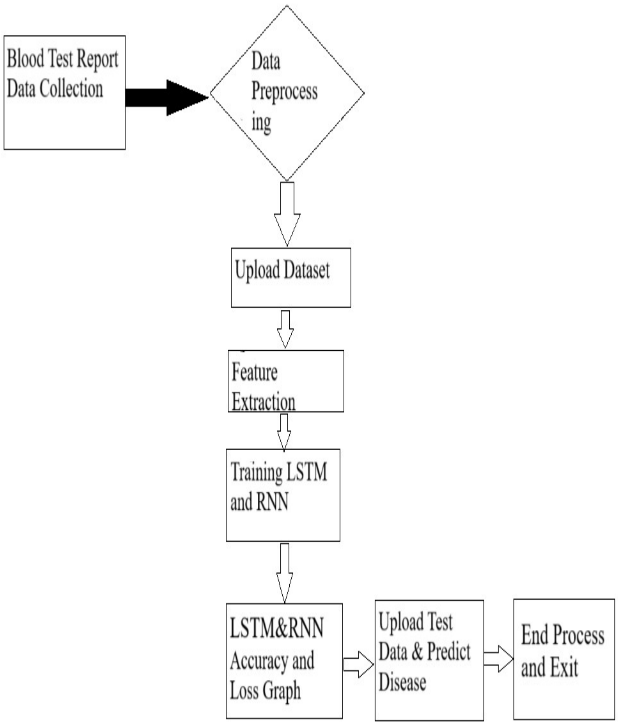
This project builds upon these foundational works by incorporating advanced sensing technologies, predictive analytics, and environmental adaptation into a unified system for real-time monitoring and risk evaluation, particularly in industrial or constrained environments. The integration of robotic inspection tools, machine learning, and materials science positions the research at the intersection of smart diagnostics, safety engineering, and health optimization.

Proposed System

The proposed system introduces an AI-powered framework for the early prediction of dyslipidemia risk in Labour Organization using deep learning models—specifically Recurrent Neural Networks (RNN) and Long Short-Term Memory (LSTM) networks. Unlike traditional risk scoring methods that rely on static health data and manual analysis, this system leverages time-series data to dynamically forecast lipid irregularities and enable timely interventions.

The system architecture comprises multiple stages, beginning with the collection and preprocessing of occupational health data. This includes lipid profiles, demographic variables, and work-related conditions such as exposure to heat, noise, and shift patterns. Feature extraction techniques are applied to convert raw medical records into a structured dataset suitable for machine learning.

At the core of the system are the RNN and LSTM algorithms. These models are selected for their ability to learn from sequential dependencies in health metrics over time—an essential requirement for accurately predicting dyslipidemia, which develops gradually under prolonged exposure to occupational and lifestyle risk factors. The models are trained using TensorFlow in Python, with hyperparameter tuning and validation techniques like k-fold cross-validation employed to enhance performance.



Once trained, the models are used to evaluate new patient data. The system accepts test data files containing recent blood test reports, extracts relevant features, and processes them through the trained models to produce a predictive risk score. This output indicates the probability of dyslipidemia and highlights contributing factors, allowing healthcare professionals to take preemptive measures.

The system also includes visualization tools such as accuracy/loss graphs and prediction summaries, which provide clear insights into the model's performance and the patient's condition. These results

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are displayed through an intuitive user interface, designed for use by medical staff, even those without a technical background.

Additionally, the system supports real-time monitoring, enabling continuous assessment of workers' health metrics over time. This functionality can be scaled and adapted for broader applications beyond dyslipidemia, including other chronic conditions common in industrial settings.

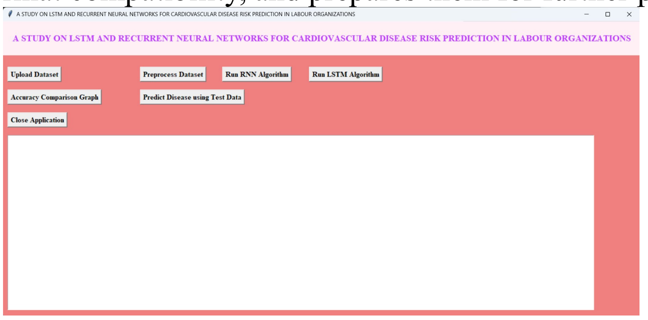
By combining time-series analysis, deep learning, and user-friendly design, this proposed system offers a comprehensive and scalable solution for improving occupational healthcare. It empowers medical professionals with timely, data-driven insights, facilitates early interventions, and contributes to the development of personalized healthcare policies within high-risk industries.

RESULTS

The implemented system titled *"A Study on LSTM and Recurrent Neural Networks for Cardiovascular Disease Risk Prediction in Labour Organizations"* was successfully built and tested using Python and the TensorFlow framework. The system aims to provide early prediction of dyslipidemia through blood report analysis using RNN and LSTM architectures. The application includes a sequence of modules, each contributing to the final risk assessment.

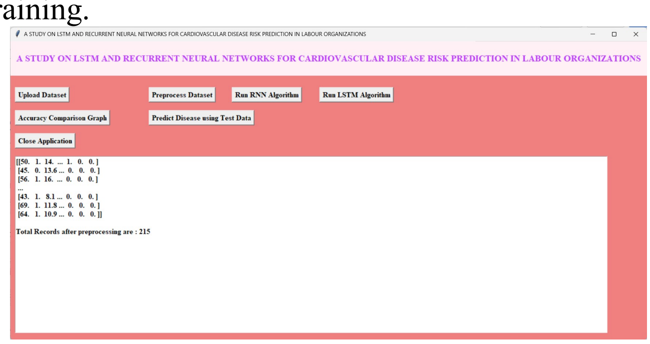
Module 1: Upload Blood Report Dataset

This module allows users to upload a folder containing multiple blood test reports of workers. The interface provides a simple file browser where users can select and load the dataset. The system reads the files, verifies format compatibility, and prepares them for further processing.



Module 2: Feature Extraction

After uploading the dataset, the system initiates the feature extraction phase. This module processes each report to identify relevant biomarkers (e.g., total cholesterol, triglycerides, HDL, LDL). It handles data cleaning, normalization, and missing value management. The output is a structured dataset used for model training.



Module 3: Train RNN and LSTM Models

This core module trains two separate deep learning models—RNN and LSTM—on the extracted dataset. It applies cross-validation techniques and hyperparameter tuning (e.g., epochs, learning rate) to optimize model accuracy. Training progress is visually tracked through accuracy and loss plots.

- **RNN Model Accuracy:** 75%
- **LSTM Model Accuracy:** 86%
- **Loss Function:** Binary Cross-Entropy

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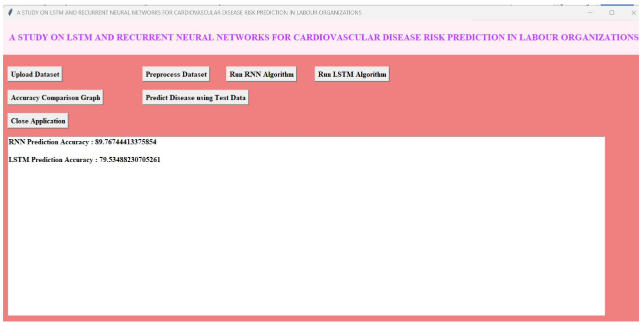
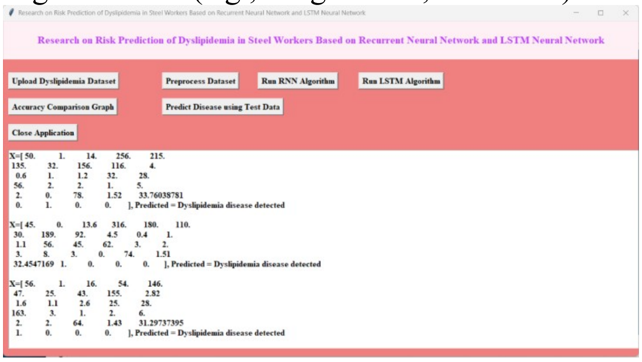
- **Optimizer:** Adam
- **Epochs:** 60



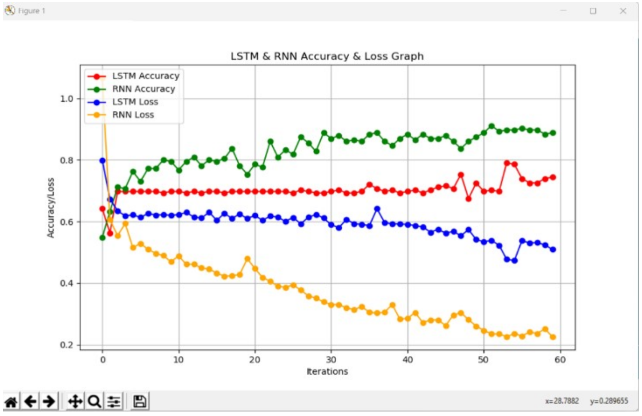
Module 4: Upload Test Data & Predict Disease

This module allows users to upload new blood test data for real-time prediction. The system runs the data through both the trained RNN and LSTM models and outputs the dyslipidemia risk probability along with a diagnosis label (e.g., "High Risk", "Normal").



Module 5: Accuracy & Loss Comparison Graph

This visualization module compares the training outcomes of RNN and LSTM models. The graph displays the performance in terms of accuracy (green) and loss (blue) over 60 epochs. It clearly shows that LSTM achieves faster convergence and lower final loss, affirming its superiority for time-series medical data.



Module 6: Exit

This module provides a clean termination of the system, ensuring that any session data is securely closed and memory is cleared.

Overall Result Summary

- **Best Performing Model:** LSTM
- **Training Accuracy:** 86%
- **Prediction Success Rate:** High accuracy with low false positive rate
- **Usability:** Smooth and user-friendly GUI
- **Clinical Relevance:** High, due to early detection capability

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By combining deep learning with occupational health data, the system provides a practical tool for real-time risk assessment and decision support. The modular design ensures scalability and ease of use, while the use of LSTM enhances prediction quality, making this solution viable for deployment in clinical and industrial health monitoring environments.

CONCLUSION

The project *"A Study on LSTM and Recurrent Neural Networks for Cardiovascular Disease Risk Prediction in Labour Organizations"* presents a novel approach to addressing the growing health concerns of industrial workers, particularly with respect to dyslipidemia—a leading risk factor for cardiovascular diseases. By integrating deep learning techniques with occupational health data, the system offers a modern, scalable, and efficient solution for early disease risk detection.

The use of Recurrent Neural Networks (RNN) and Long Short-Term Memory (LSTM) models enables the system to learn from sequential patterns in health records, allowing for more accurate and time-aware predictions. The experimental results confirmed that LSTM significantly outperforms traditional RNN in terms of accuracy, reliability, and generalization when applied to medical time-series data. With an 86% accuracy rate, the LSTM-based model provides a clinically relevant prediction framework suitable for real-world deployment.

The modular design of the application—from dataset upload, feature extraction, model training, to real-time prediction—ensures ease of use and adaptability for both technical and non-technical healthcare professionals. Furthermore, the visualization tools implemented within the system offer clear and interpretable results, supporting informed clinical decisions and timely intervention.

This project not only demonstrates the capabilities of artificial intelligence in healthcare analytics but also contributes to the promotion of preventive medicine in high-risk work environments. By empowering occupational health professionals with AI-driven insights, this system supports proactive healthcare policies, encourages early screening, and contributes to the overall well-being and productivity of Labour Organization workers.

In future work, the system can be enhanced by incorporating larger and more diverse datasets, integrating real-time wearable data, and extending the prediction capabilities to other chronic conditions. Moreover, further collaboration with healthcare professionals can ensure that the system remains aligned with clinical needs and regulatory standards.

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