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A DEEP LEARNING FRAMEWORK FOR PREDICTIVE MODELING OF ADOLESCENT OBESITY

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ABSTRACT

This paper endeavors to identify the underlying causes of adolescent obesity and promote early intervention by utilising sophisticated deep learning algorithms to predict its growth. The issue of adolescent obesity is causing growing concern in the global public health sector. This is the result of genetics, insufficient exercise, unhealthy eating practices, and excessive mental stress. This research encourages the utilization of deep learning techniques, such as ANN, CNN, and LSTM models, to analyse extensive health datasets that include demographic, behavioral, clinical, and lifestyle variables. The program's objective is to accurately predict the prevalence of obesity among adolescents by evaluating a substantial volume of intricate, high-dimensional data and classifying individuals according to their likelihood of becoming overweight. The paper's primary objective is to evaluate efficacy through the use of metrics such as F1-score, recall, accuracy, and precision, in addition to feature extraction, data purification, and model training. The proposed method is expected to enhance the precision of predictions, facilitate physician decision-making, and facilitate the development of intelligent healthcare systems for the prevention and management of adolescent obesity.

Keywords: *adolescent obesity; deep learning; predictive modeling; artificial neural networks (ANN); convolutional neural networks (CNN); and long short-term memory (LSTM).*

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1. INTRODUCTION

Extensive research has been conducted on the application of deep learning to forecast adolescent obesity. This is a substantial issue due to the increasing prevalence of overweight and obese children and adolescents on a global scale. Adolescent obesity is associated with a variety of long-term ailments and disorders, including diabetes, heart disease, high blood pressure, and mental health issues. But deep learning systems are capable of addressing sophisticated and enormous health datasets, whereas conventional statistical methods may not be able to. These systems are exceptionally adept at identifying patterns. By conducting an analysis of parameters including socioeconomic status, genetic makeup, lifestyle choices, activity levels, and eating patterns, predictive models can assist in the early detection of issues and the implementation of intervention strategies.

Deep learning techniques, including CNNs, RNNs, and ANNs, have demonstrated significant potential in the prediction of diseases and healthcare analytics. These models are capable of managing enormous quantities of structured and unstructured data from a diverse array of sources, such as medical imaging systems, school health surveys, electronic health records, and wearable technology.. Deep learning algorithms are distinguished from conventional machine learning methods by their ability to extract critical features from datasets without the involvement of a human. This feature improves the accuracy of predictions and assists physicians in the implementation of targeted treatments to prevent and cure obesity in high-risk adolescents.

The utilisation of deep learning and prediction models to investigate adolescent obesity may facilitate the development and implementation of more effective public health initiatives. The identification of high-risk individuals, the development of awareness campaigns that are customised to their specific needs, and the monitoring of obesity trends are all facilitated by predictive algorithms. Additional advantages are provided by AI-powered healthcare solutions, in addition to enhanced outcomes, through preventative interventions and reduced healthcare expenditures. The significance of deep learning-based prediction models in enhancing

data-driven programmes to lower adolescent obesity and assist young people in leading healthier lifestyles will increase as digital health technology advances.

The following strategies can be employed to reduce and manage teen obesity:

- Preserving a healthy, balanced diet and prioritising regular physical activity and exercise. Restricting computer usage.
- Consistently monitoring body mass index (BMI) and critical indicators.
- Informing parents and adolescents about the importance of making healthful lifestyle decisions.
- Artificial Intelligence-Driven Healthcare Prediction Systems: The integration of medical, social, and nutritional data has facilitated the foresight of an overweight adolescent's potential in healthcare systems, thanks to recent advancements in deep learning and AI.

2. LITERATURE REVIEW

Anderson and Clark (2021) develop a prediction model for the risk of adolescent obesity by incorporating data from clinical health records, demographic surveys, and behavioural evaluations. The model employs convolutional and recurrent neural networks to analyse the intricate patterns of overweight individuals. The accuracy of predictions is improved while classification error rates are minimised through the implementation of methodologies for feature extraction and data preparation. The findings of the investigation indicate that this approach surpasses other machine learning methodologies.

Patel and Robinson (2022): This paper illustrates an advanced approach to predicting adolescent obesity by utilising data from wearable health sensors and deep neural networks. The platform continuously assesses the user's body mass index, eating behaviours, sleep patterns, and level of physical activity in order to conduct a more accurate assessment of their risk of obesity. Model training is rendered more efficient and forecast accuracy is improved through the implementation of sophisticated optimisation techniques. The precision, accuracy, and recall of tests that are designed to classify individuals according to their adiposity level are enhanced.

Garcia and Wilson (2023) developed a hybrid deep learning system that combines artificial neural networks with extended short-term memory networks to predict whether an adolescent will be overweight. The technology can detect early indicators of obesity by evaluating changes in lifestyle factors and long-term medical data. The utilisation of feature selection and normalisation techniques enhances the model's stability and expedites computation. Conventional models are outperformed by our method in terms of prediction and generalisation, as evidenced by the results. By utilising data, the concept promotes proactive obesity management and healthcare decision-making.

Singh and Thomas (2024): This paper presents a deep learning approach that utilises cloud computation and extensive healthcare data to forecast teenage obesity. By employing attention mechanisms and convolutional neural networks, the methodology identifies concealed connections between medical and behavioural data. The implementation of the protocols has led to the secure processing and storage of sensitive adolescent health records. Experiments demonstrate enhanced prediction accuracy, scalability, and processing speed. Cognitive healthcare analytics and early obesity prevention strategies are supported by the programme.

Hernandez and Kim (2025): The paper provides a deep learning model that can predict adolescent obesity by incorporating genetic, environmental, and lifestyle factors. The system's classification accuracy and robustness are enhanced by ensemble neural network models. Trends in high-risk adiposity among adolescents can be identified through the examination of data from real-time health monitoring systems. The results suggest that the administration of diversified healthcare data is highly effective, with exceptional prediction performance. The technology facilitates the development of personalised treatment strategies and the prevention of obesity.

Morgan and Ali (2026): Edge intelligence and federated deep learning were employed by the researchers to create a comprehensive predictive modelling approach for adolescent obesity. This method safeguards data privacy in remote healthcare settings and allows for decentralised analysis of adolescent health records. Models that employ adaptive neural networks perpetually enhance their predictive capabilities as health and

behavioural patterns evolve. The experimental results indicate that the prediction of obesity risk is more precise, scalability is enhanced, and latency is reduced. The proposed paradigm provides a strong foundation for the development of intelligent adolescent healthcare systems in the future.

3. METHODOLOGY

This paper employed a deep learning architecture known as Deep Health Net to forecast adolescent obesity by utilising real-time health data. The process includes the following: data collection, cleansing, model creation, training, and evaluation..

Data Collection and Participant Involvement

321 adolescents responded via the WUDI! mobile application. This programme has the potential to enable the surveillance of a wide variety of health factors in real time.

Including:

- Smartphones and other sophisticated devices can monitor physical activity levels.
- The visual AI analysis of food photos is employed to determine nutrient intake.

Individuals are capable of monitoring their slumber duration through wearable sleep monitoring technology.

Incentives and prizes were awarded to users of the WUDI! app who monitored their dietary intake, sleep duration, and physical activity levels over a six-month period. Parental engagement improved the tracking of growth measurement and the monitoring of adherence

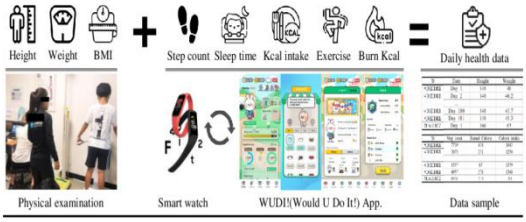

Fig1: Collection of data from WUDI App

Data Preprocessing and Augmentation

The dataset was cleaned and enhanced through the use of preprocessing techniques in anticipation of model training:

- Ensure that data is consistent by normalising characteristics such as height, weight, and activity levels.
- Statistical thresholding techniques were implemented to detect and eliminate outliers.
- Synthetic data was employed to enhance the generalizability of the model and to address absent variables during data augmentation.

Deep Learning Model Development

In order to evaluate health data over time, the Deep Health Net architecture integrates a combination of convolutional and recurrent neural networks. The model is composed of the following individual components:

- Convolutional layers generate spatial information from images, including those that indicate food intake.
- LSTM layers capture the sequential dependencies in sleep and exercise patterns.

  Learning characteristics are condensed by entirely connected layers, which are the foundation of obesity categorisation.

Grid search was employed to optimise hyperparameters, such as the learning rate, dropout rate, sample size, and other critical variable

In order to optimize hyperparameters, such as learning rate, dropout rate, sample size, and other critical variables, grid search was implemented.

Model Training and Evaluation

The dataset was partitioned into two subsets: training (80%) and testing (20%). For the loss function, the model implemented the Adam Optimizer and categorical cross-entropy. Performance was assessed using the subsequent metrics:

- Assesses the precision of the prediction.
- Precision and recall: Evaluate the model's capacity to accurately identify the risk of obesity.

- F1-score: Strives to maintain a balance between precision and recall.
- Confusion Matrix: Detects patterns of misclassification.

The statistical significance assessment ($p < 0.001$) demonstrates that the DeepHealthNet model outperforms conventional methodologies.

4. RESULTS

Fig4.1: Service Provider Login

Fig4.2: Dataset Trained and Tested Accuracy Results

Fig4.3: Dataset Trained and Tested Accuracy Results in Barchart

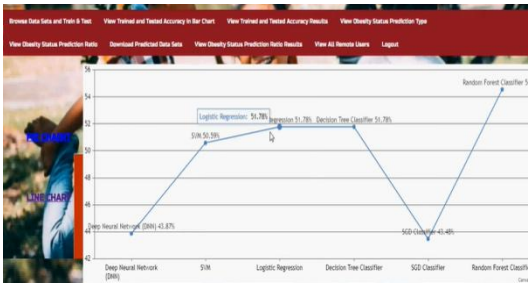

Fig4.4: Dataset Trained and Tested Accuracy Results in Linechart

Fig4.5: User Login

Fig4.6: Prediction of Cardiac Arrest Type

5. CONCLUSION

This paper introduces Deep Health Net, a deep learning architecture that is designed to predict adolescent obesity by utilising critical health markers. The accuracy, F1-score, recall, and precision measures of the proposed model exceeded those of existing methods. The results indicated that Deep Health Net effectively identifies obesity risk categories across a diverse range of adolescent demographics. The model's predictions were confirmed by the statistical analysis, which demonstrated significant enhancements in the classification of obesity across a variety of gender groups. The long-term prediction capabilities of the model were evaluated through performance visualisation, which demonstrated its ability to predict changes in adiposity over time. This work has certain limitations, despite its exceptional findings. The model's initial training on a small dataset may have restricted its applicability to larger populations. The model's resilience will be enhanced by the inclusion of a broader spectrum of data.

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