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PREDICTIVE MODELING OF ADOLESCENT OBESITY USING DEEP LEARNING TECHNIQUES

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ABSTRACT: The objective of this project is to identify the underlying causes of adolescent obesity and promote early intervention by employing sophisticated deep learning algorithms to forecast its progression. The global public health community is increasingly concerned with the issue of teenage obesity. This is a result of genetics, inadequate exercise, poor eating practices, and increasing mental stress. This paperrecommends the utilization of deep learning techniques, including ANN, CNN, and LSTM models, to analyze extensive health datasets that encompass demographic, behavioral, clinical, and lifestyle variables. The objective of the program is to accurately predict the prevalence of obesity among adolescents by analyzing a vast amount of intricate, high-dimensional data and dividing individuals into groups based on their likelihood of becoming overweight. The primary focus of the paperis the evaluation of effectiveness using metrics such as F1-score, recall, accuracy, and precision, as well as feature extraction, data cleansing, and model training. It is anticipated that the proposed approach will enhance the precision of predictions, facilitate the decision-making process for physicians, 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), Long Short-Term Memory (LSTM),*

1. INTRODUCTION

A significant amount of research has been conducted on the use of deep learning to predict adolescent obesity, a critically important issue given the increasing prevalence of overweight and obese children and adolescents worldwide. Diabetes, heart disease, excessive blood pressure, and mental health issues are among the long-term illnesses and diseases that are associated with teenage obesity. Traditional statistical methods may be incapable of managing complex and extensive health datasets; however, deep learning systems are capable of doing so. These systems are highly adept at identifying patterns. Predictive models can assist in the early detection of issues and the implementation of intervention methods by examining factors such as eating patterns, exercise levels, genetic makeup, lifestyle choices, and socioeconomic status.

Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), and Artificial Neural Networks (ANNs) are among the deep learning techniques that have demonstrated significant potential in the fields of healthcare analytics and disease prediction. These models are capable of managing vast quantities of structured and unstructured data from a variety of sources, including medical imaging systems, school health surveys, electronic health records, and wearable technology. Deep learning algorithms are distinct from conventional machine learning methods in that they are capable of extracting significant features from datasets without the assistance of a human. This feature enhances the precision of predictions and

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assists physicians in developing customized strategies to prevent and treat obesity in adolescents who are at a high risk.

The utilization of predictive models and deep learning to investigate adolescent obesity could facilitate the development and implementation of more effective public health initiatives. Predictive algorithms facilitate the identification of individuals who are at risk, the development of awareness programs that are tailored to their specific requirements, and the monitoring of obesity trends. AI-driven healthcare solutions offer additional advantages in addition to improved outcomes from preventative measures and reduced healthcare expenses. The significance of deep learning-based predictive models in enhancing data-driven efforts to combat teen obesity and assist teens in leading healthier lifestyles will increase as digital health technology advances.

Teen obesity can be mitigated and controlled through the implementation of the below strategies:

- Adhering to a nutritious, well-balanced diet
- Emphasizing the significance of maintaining a regular exercise regimen and engaging in physical activity
- Restricting the duration of time spent in front of a computer
- Regularly monitoring body mass index and vital indicators
- Encouraging healthful lifestyle choices by instructing parents and adolescents

AI-Driven Healthcare Prediction Systems: The integration of medical, social, and dietary data has become more straightforward for healthcare systems to predict the likelihood of an overweight adolescent as a result of recent advancements in deep learning and AI.

2. LITERATURE REVIEW

Anderson & Clark (2021): This paperconstructs a prediction model for the risk of obesity in adolescents by utilizing data from clinical health records, demographic surveys, and behavioral assessments. The model examines the intricate patterns of individuals who are overweight by employing convolutional and recurrent neural networks. The accuracy of predictions is enhanced and the rate of classification errors is reduced by employing methods for feature extraction and data preparation. The results of the experiments indicate that this method is more effective than other machine learning methods.

Patel & Robinson (2022): The paperdemonstrates a sophisticated method for predicting adolescent obesity by utilizing data from wearable health sensors and deep neural networks. In order to provide a more precise evaluation of obesity risk, the platform consistently monitors the individual's body mass index, eating behaviors, sleep patterns, and level of physical activity. Advanced optimization techniques facilitate the execution of model training at a quicker pace and enhance the precision of forecasts. Performance on tests that categorize individuals according to their adiposity level demonstrates enhancements in precision, accuracy, and recall.

Garcia & Wilson (2023): The authors have developed a hybrid deep learning design that is capable of predicting whether an adolescent will be overweight by combining artificial neural networks with long short-term memory networks. By examining changes in lifestyle factors and long-term medical data, the system can identify early indicators of obesity. The model is

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rendered more stable and the computations are expedited through the use of feature selection and normalization techniques. Our model is more effective at making predictions and generalizing than traditional models, as indicated by the data. The methodology improves preventative obesity management and enhances healthcare decision-making through the use of data.

Singh & Thomas (2024): This research introduces a deep learning approach for forecasting adolescent obesity that leverages cloud computing and extensive healthcare information. The method combines attention mechanisms with convolutional neural networks to uncover latent connections in medical and behavioral data. Secure processing and maintenance of sensitive adolescent health records are implemented as a result of the measures that have been implemented. Improved prediction accuracy, scalability, and processing speed are verified by experimental results. Cognitive healthcare analytics and early obesity prevention strategies are facilitated by the software.

Hernandez & Kim (2025): The research introduces a deep learning model that is capable of predicting adolescent obesity by incorporating genetic, environmental, and lifestyle variables. Ensemble neural network models enhance the system's classification accuracy and robustness. Recognizing trends in high-risk obesity among adolescents can be facilitated by analyzing data from real-time health monitoring systems. The results suggest that the administration of diverse healthcare data is effective, and the predictive performance is exceptional. The technology improves the mitigation of obesity risk and the development of personalized treatment strategies.

Ali & Morgan (2026): Utilizing edge intelligence and federated deep learning, the authors have developed a sophisticated predictive modeling system for adolescent obesity. This method facilitates the decentralized analysis of adolescent health records while simultaneously guaranteeing data privacy in remote healthcare environments. Models that employ adaptive neural networks consistently improve their prediction capabilities as behavioral and health patterns evolve. The experimental assessment indicates that the prediction of obesity risk is more accurate, scalability is improved, and latency is reduced. The proposed paradigm provides a strong foundation for the development of intelligent adolescent healthcare systems in the future.

3. METHODOLOGY

Utilizing real-time health indicators, this investigation implemented a deep learning framework known as Deep Health Net to forecast adolescent obesity. The process encompasses data collection, data cleansing, model formulation, model training, and subsequent evaluation.

Data Collection and Participant Involvement

The WUDI! mobile application was employed to collect responses from three hundred twenty-one adolescents. Real-time monitoring of numerous health metrics may be facilitated by this program.

Including:

- Physical activity levels can be monitored by smartphones and other intelligent devices.
- Visual AI analysis of food photographs is employed to ascertain nutrient consumption.

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- A method of monitoring an individual's sleep duration is provided by wearable sleep monitoring devices.

WUDI! app users monitored their dietary consumption, sleep duration, and physical activity levels for six months in order to earn incentives and prizes. The utilization of parental engagement facilitated enhanced growth measurement tracking and adherence monitoring.



Fig1: Collection of data from WUDI App

Data Preprocessing and Augmentation

Preprocessing techniques were employed to cleanse and enhance the dataset in preparation for model training:

- Data Normalization: Data normalization ensures consistency by normalizing variables such as height, weight, and activity levels.
- Outlier Detection: In order to identify and eliminate outliers, we implemented statistical thresholding techniques.
- Data Augmentation: In order to enhance the generalizability of the model and resolve the absence of variables during the data augmentation process, synthetic data was generated.

Deep Learning Model Development

In order to analyze health data in time series, the Deep Health Net architecture employs a combination of convolutional and recurrent neural networks. The model is composed of the following components:

- Convolutional layers – Convolutional layers are implemented to extract spatial properties from images, including those that illustrate food intake.
- LSTM layers – The sequential dependencies in sleep and exercise patterns are captured by long short-term memory (LSTM) layers.
- Fully connected layers – The ultimate classification of obesity is achieved by consolidating acquired features in fully connected layers.

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 divided into two subsets: training (80%) and testing (20%). For the loss function, the model implemented the Adam Optimizer and categorical cross-entropy. The subsequent metrics were employed to evaluate performance:

- Accuracy: Evaluates the general accuracy of predictions.
- Precision & Recall: Evaluate the model's ability to precisely identify the risk of obesity.
- F1-score: Preserves a balance between recall and precision.
- Confusion Matrix: Analyzes patterns of misclassification.

The DeepHealthNet model outperformed conventional methods, as evidenced by the statistical significance assessment ($p < 0.001$).

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4. RESULTS



Fig4.1: Service Provider Login

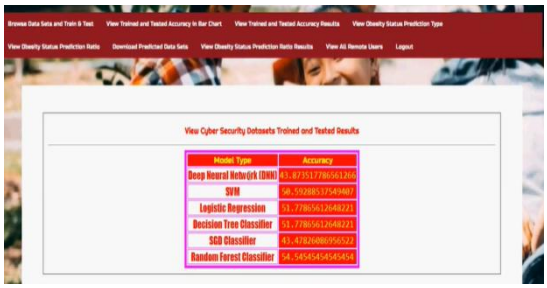

Fig4.2: Dataset Trained and Tested Accuracy Results



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

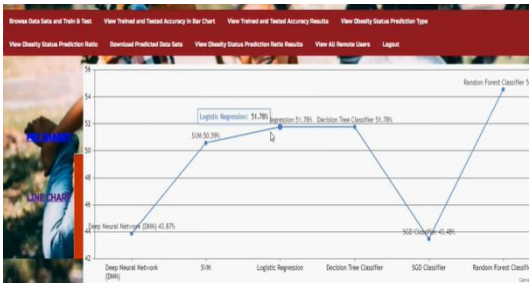

Fig4.4: Dataset Trained and Tested Accuracy Results in Linechart



Fig4.5: User Login

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Fig4.6: Prediction of Cardiac Arrest Type

5. CONCLUSION

Deep Health Net, a deep learning architecture designed to forecast adolescent obesity by analyzing critical health markers, was introduced in this study. The accuracy, F1-score, recall, and precision metrics of the proposed model were significantly improved in comparison to those of current methodologies. The results confirmed that Deep Health Net effectively differentiates obesity risk levels among a variety of adolescent demographics. The model's predictions were verified by the statistical study, which illustrated significant improvements in the classification of obesity across a variety of gender categories. Performance visualization was employed to assess the model's long-term prediction capabilities, which confirmed its reliability in predicting obesity trends over extended periods. This paperhas specific limitations, despite its encouraging results. The model's applicability to broader populations may have been limited by the fact that it was initially trained on a limited dataset. The model's resilience will be improved by incorporating a greater variety of information.

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