CHANDIGARH UNIVERSITY
Discover. Learn. Empower.

Classification of Diabetes Health Indicators

A Project Work Synopsis

Submitted in the partial fulfilment for the award of the degree of

BACHELOR OF ENGINEERING

IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Submitted by:

(20BCS6656) Aryan Gupta
(20BCS6684) Ankith Raj
(20BCS6691) Aryan Kushwaha
(20BCS3842) Vaibhav Kumar Singh

Under the Supervision of:

Dr. Amit Vajpayee

CHANDIGARH UNIVERSITY, GHARUAN, MOHALI - 140413, PUNJAB

22 JANUARY, 2024

ABSTRACT

Diabetes is one of the chronic diseases that causes blood sugar levels to rise. If diabetes is left untreated and undiagnosed, it can lead to complications. The time-consuming identification process leads to a patient's referral to a diagnostic Centre and consultation with a doctor. Predictive analytics in healthcare is a difficult challenge, but it can eventually assist physicians in making timely decisions about a patient's health and condition based on data. The emergence of machine learning methods solves this crucial issue.

The aim of this project is to create a model that can reliably predict the accuracy of diabetes in patients. Dataset splits into three then classification techniques are implemented. Training Dataset, Dataset sample that is used to fit the model. Validation Dataset, Dataset sample that is used for hyper tuning the parameters, and comparing the accuracy and error rates of the model performance between using the training dataset and the validation dataset. Testing Dataset, Dataset sample that is used to test the model performance (predictive power).

To detect diabetes at an early stage, this project employs machine learning classification algorithms: Logistic Regression, Gaussian Naive Bayes, K Neighbours, SVM, Decision tree, Random Forest, Bagging Classifier, Ada Boost Classifier and Gradient Boosting Classifier are implemented. The Pima Indians Diabetes Database (PIDD) is used in the experiments. The National Institute of Diabetes and Digestive and Kidney Diseases provided the results. The dataset's purpose is to diagnose whether a patient has diabetes using diagnostic measures included in the dataset. Various measures like Precision, Accuracy, Specificity, and Recall are measured over classified instances using Confusion Matrix.

The accuracy of the algorithms used are compared and discussed. The study's comparison of the various machine learning techniques shows which algorithm is better suited for diabetes prediction. Using machine learning methods, this project aims to assist doctors and physicians in the early detection of diabetes.

Keywords: Diabetes Prediction , Machine Learning , Python, Predictive Power , PIDD , Real-time, Logistic Regression, Bagging classifier , Specificity, Diagnose.

CHANDIGARH UNIVERSITY
Discover. Learn. Empower.

Table of Contents

SR.NO		PAGE NUMBER
0	Title page Abstract	1 2
1	**INTRODUCTION*** 1.1 Problem Definition 1.2 Project Overview 1.3 Hardware Specification 1.4 Software Specification	4 5 5 5 6
2	**LITERATURE SURVEY** 2.1 Existing System Summary 2.2 Proposed System 2.3 Literature Review Summary	 6 7 9
3	**PROBLEM FORMULATION**	10
4	**RESEARCH OBJECTIVES**	10
5	**METHODOLOGIES**	11
6	**EXPERIMENTAL SETUP**	13
7	**CONCLUSION**	16
8	**TENTATIVE CHAPTER PLAN FOR THE PROPOSED WORK**	16
9	**REFERENCES**	17

1 INTRODUCTION

Various classification strategies are used in the medical field for classifying data into different classes. Diabetes is a condition that affects the body's ability to produce the hormone insulin, which causes carbohydrate metabolism to become irregular and blood glucose levels to increase. High blood sugar is a common symptom of diabetes. If diabetes is not treated, it can lead to a variety of complications. Diabetic ketoacidosis and nonketotic hyperosmolar coma are two significant complications. Diabetes is considered a severe health problem in which the amount of sugar in the blood cannot be regulated. Diabetes is influenced by a variety of factors such as height, weight, genetic factors, and insulin, but the most important factor to remember is sugar concentration. The only way to avoid problems is to identify the problem early. This dataset comes from the 'National Institute of Diabetes and Digestive Diseases' Pima Indians Diabetes Database (PIDD). Several constraints were taken from the massive database.

The dataset is divided into three sections, after which classification techniques are used. The training dataset is a sample of the dataset that is used to match the model. Validation Dataset, a dataset sample used for fine-tuning parameters and comparing model output accuracy and error rates between the training and validation datasets. Testing Dataset is a sample of a dataset that is used to assess the model's output.

Various machine learning techniques are implemented. Confusion matrix is obtained and is compared with all classification algorithms. This comparison of the various machine learning techniques shows which algorithm is better suited for diabetes prediction. Correlation between parameters and the best accuracy score using various supervised machine learning algorithms is obtained..

Diabetes is a chronic health condition that affects how your body turns food into energy. There are three main types of diabetes: type 1, type 2, and gestational diabetes. Type 1 diabetes is an autoimmune disease that causes your body to attack the cells in your pancreas that produce insulin. Insulin is a hormone that helps your body use glucose for energy. Type 2 diabetes is the most common type of diabetes. It occurs when your body doesn't respond normally to insulin, or when your body does not.

Diabetes mellitus (DM) is commonly known as diabetes. It is a group of metabolic disorders which are characterized by the high blood sugar. Diabetes can lead to many serious long-term complicated diseases like cardiovascular disease, stroke, kidney failure, heart attack, peripheral arterial disease, blood vessels, and nerves. About 122 million people were affected by diabetes in worldwide in 1980 and this figure was reached about 422 million in 2014. The figure will be reached about 642 million in 2040. Moreover, there were directly about 1.6 million deaths due to diabete .

Therefore; it is an alarming figure to us. The number of diabetic patients is increased day by day as a result deaths are also increased day by day. Diabetes can be divided into three types as (i) type I diabetes (T1D), (ii) type II diabetes (T2D), and (iii) gestational diabetes (GD). T1D are normally in young adults whose age is less than 30 years. The symptoms of T1D are polyuria, thirst, constant hunger, weight loss, vision changes and fatigue. T2D occurs in adults over 45 years which are often associated with obesity, hypertension, dyslipidemia, arteriosclerosis, and other diseases. The third type of diabetes is gestational diabetes. Actually pregnant women are affected by gestational diabetes.

1.1 PROBLEM DEFINITION

Since a decade, the number of people diagnosed with diabetes has risen significantly. The current human lifestyle is the primary cause of diabetes rise. Main objective of this project is to analyze the data, and see if it is possible to gleam any further information from the data to determine correlation between parameters and diabetes.

The second is to attempt to get the best accuracy score using various supervised learning machine learning algorithms. To find out which algorithm is able to best predict whether a person has diabetes or not based on this dataset.

The accuracy of the algorithms used are compared and discussed. The study's comparison of the various machine learning techniques shows which algorithm is better suited for diabetes prediction. Using machine learning methods, this project aims to assist doctors and physicians for predicting whether a person has diabetes or not

1.2 PROJECT OVERVIEW

Machine learning has the great ability to revolutionize the diabetes risk prediction with the help of advanced computational methods and availability of a large amount of epidemiological and genetic diabetes risk dataset. Detection of diabetes in its early stages is the key for treatment.

This work has described a machine learning approach to predicting diabetes or not. The technique may also help researchers to develop an accurate and effective tool that will reach at the table of clinicians to help them make better decisions about disease status.

1.3 HARDWARE SPECIFICATIONS

- Processor (CPU): Modern multi-core processor (e.g., quad-core or higher)
- Graphics Processing Unit (GPU): Dedicated GPU for accelerated processing (optional but recommended)
- Memory (RAM): Minimum 8GB (16GB or more recommended)
- Storage: SSD (Solid State Drive)
- Camera/Webcam: Good-quality camera with at least 720p resolution
- Display: High-resolution monitor (Full HD or higher)
- Internet Connectivity: As required for data access and services
- Cooling: Adequate cooling solution
- Operating System: Compatible OS for chosen libraries and frameworks

1.4 SOFTWARE SPECIFICATIONS

- **Programming Language:** Python (version 3.x)
- **Integrated Development Environment (IDE):** Choose a suitable IDE for Python development, such as:
  - PyCharm
  - Visual Studio Code
  - Jupyter Notebook
- **Libraries and Frameworks:**
  - TensorFlow or PyTorch: For implementing deep learning models.
  - NumPy: For numerical computations and array manipulation.
  - Matplotlib or other visualization libraries: For displaying images, plots, and results.
  - Pandas: Pandas is a data manipulation and analysis library. It provides data structures like DataFrames and Series, making it easy to manipulate and analyze structured data.
  - NLTK(Natural Language Tool Kit): NLTK is a library for natural language processing (NLP). It provides tools for working with human language data, such as tokenization, stemming, lemmatization, and more.
  - Scikit-learn(Sklearn): Scikit-learn is a machine learning library that provides simple and efficient tools for data analysis and modeling.
  - Depending on the specific techniques and methods used, other specialized libraries might be required.
- **Version Control:** Git and a platform like GitHub or GitLab for code management and collaboration.
- **Dependencies and Package Management:** Use a virtual environment tool like virtualenv or Conda to manage and isolate project dependencies.
- **Operating System Compatibility:** Ensure compatibility with Windows, Linux, and macOS based on chosen libraries and frameworks.
- **Deployment (if applicable):** Considerations for deployment might include containerization (Docker), cloud services (AWS, Google Cloud), or edge device deployment.

2 LITERATURE REVIEW

2.1Existing System

Provide an overview of the importance of predicting and classifying diabetes health indicators. Highlight the increasing prevalence of diabetes globally and the need for accurate health assessments.

1. Previous Research on Diabetes Classification:

- Summarize existing studies and projects related to diabetes classification.
- Discuss different approaches, methodologies, and datasets used in previous research.

2. Machine Learning and Diabetes:

- Explore how machine learning techniques have been applied to diabetes prediction and classification.
- Discuss the advantages and limitations of different machine learning algorithms in the context of diabetes health indicators.

3. Deep Learning in Healthcare:

- Investigate the role of deep learning in healthcare and its potential for diabetes classification.
- Highlight any breakthroughs or advancements in the use of neural networks for health-related predictions.

4. Natural Language Processing (NLP) for Health Data:

- Explore the use of NLP in analyzing health-related textual data.
- Discuss how NLP techniques can be applied to extract meaningful information from medical records or textual descriptions of health indicators.

5. Challenges and Gaps in Existing Literature:

- Identify any challenges or gaps in the current literature related to diabetes classification.
- Discuss areas where further research is needed.

2.2Proposed System

Clearly define the problem you aim to address in your Diabetes Health Indicators classification project. Emphasize the importance of accurate classification for early diagnosis and intervention.

1. Objectives of the Proposed System:

- Specify the goals and objectives of your classification project.
- Outline the expected outcomes, such as improved accuracy, efficiency, or interpretability.

2. Data Collection and Preprocessing:

- Describe the dataset(s) you plan to use for the project.
- Discuss any preprocessing steps needed, such as handling missing data, normalization, or feature engineering.

3. Methodology:

- Explain the machine learning and deep learning techniques you intend to use for classification.
- Justify the choice of algorithms based on the literature review and the nature of the data.

4. Integration of NLP (if applicable):

- If your project involves textual data, outline how NLP techniques will be integrated.
- Describe how information from textual sources will complement numerical features for a comprehensive analysis.

5. Evaluation Metrics:

- Define the metrics you will use to evaluate the performance of your classification models.
- Consider metrics such as accuracy, precision, recall, F1 score, and area under the ROC curve.

6. Expected Contributions:

- Highlight the potential contributions of your proposed system to the field of diabetes classification.
- Discuss how your approach addresses challenges identified in the literature.

7. Implementation Plan:

- Provide a timeline for the different phases of your project, including data preparation, model development, training, and evaluation.

8. Ethical Considerations:

- Discuss any ethical considerations related to the use of healthcare data and the potential impact of your classification system on patient outcomes

2.3 Literature Review Summary (Minimum 7 articles should refer)

Year	Article/Author	Tools/Software	Technique	Source	Evaluation Parameter
2023	Classification and prediction of diabetes disease using machine learning paradigm	Python, Pandas, MATLAB , Sklearn	Logistic Regression , Gaussian Naïve bayes , Ada Boost Classifier	National Library of Medicine	Performances of these classifiers are evaluated using accuracy and area under the curve (AUC).
2021	Detection of diabetes using multilayer perceptron	Python, Pandas , RNN.	Neural Network , Python , Deep Learning, Machine Learning , Intelligence.	Pei D, Zhang C, Quan Y, Guo Q.	Accuracy, precision, recall, F1-score, processing speed, robustness to variations in lighting and angle.
2020	Identification of potential type II diabetes with decision tree.	MATLAB , Random forest	Morphological operations, edge detection, template matching with normalized cross-correlation and phase correlation	Mohapatra SK, Swain JK, Mohanty MN.	Recognition accuracy (%), comparison of normalized cross correlation vs phase correlation
2019	Healthcare text classification system and its performance evaluation	TensorFlow, DarkNet	Logistic Regression , Gaussian Naïve bayes , Ada Boost Classifier , Neural Network	Srivastava SK, Singh SK, Suri JS	Percentage of correctly recognized blood plates
2017	Prediction of diabetes using classification algorithms.	Regression , Python , Matplotlib.	Deep neural network with convolutional layers for feature extraction, RNNs with CTC for liver plate recognition	*Procedia Comput Sci.*	End-to-end performance (%), Detection-only performance (%), Speed (ms per image)
2016	Diabetes mellitus statistics on prevalence and mortality	MATLAB , Python	HOG feature extraction, SVM classifier, window scanning for localization, mean shift for bounding box regression	Zimmet P, Alberti KG, Magliano DJ, Bennett PH	Detection accuracy (%), robustness to noise and motion blur
2015	A machine learning tool for big clinical data. Health Inf Sci Syst.	MATLAB	Image segmentation, optical character recognition	2009 International Conference on Education Technology and Computer	Detection and recognition rate (%)

Table 2.1: Literature review summary

3 PROBLEM FORMULATION

Diabetes is a prevalent global health issue with significant implications for patient well-being. Early detection and classification of diabetes health indicators are crucial for timely intervention and effective management. This project aims to develop a classification system for diabetes health indicators using machine learning and deep learning techniques. The focus is on creating a model that can accurately predict and classify different health indicators associated with diabetes.

Perform necessary preprocessing steps, including handling missing data, normalization, and feature engineering. Consider the integration of both numerical and textual data for a comprehensive analysis. Explore traditional machine learning algorithms such as logistic regression, decision trees, and random forests for initial baseline models.

This project formulation provides a roadmap for developing a comprehensive classification system for Diabetes Health Indicators. It emphasizes the integration of machine learning, deep learning, and potentially NLP techniques to create an effective and interpretable model for predicting and classifying health indicators associated with diabetes.

4 RESEARCH OBJECTIVES

The project encompasses the following objectives:

1. Develop a Comprehensive Dataset:

Collect and curate a diverse dataset containing relevant features related to diabetes health indicators. Ensure the dataset includes both numerical and, if available, textual information for a holistic analysis.

2. Explore Existing Literature:

Conduct a thorough literature review to understand the state-of-the-art methodologies, challenges, and advancements in the field of diabetes classification. Identify key insights and methodologies employed in similar projects.

3. Select and Preprocess Data:

Choose appropriate preprocessing techniques to handle missing data, normalize features, and address any data quality issues. Ensure the dataset is ready for analysis by addressing potential challenges like data imbalance.

4. Implement Machine Learning Algorithms:

Experiment with traditional machine learning algorithms, such as logistic regression, decision trees, and random forests. Evaluate their performance in classifying diabetes health indicators and establish baseline models.

5. Explore Deep Learning Models:

Investigate the application of deep learning models, including neural networks, for diabetes classification. Evaluate different architectures and configurations to identify models that demonstrate high accuracy and generalizability.

6. Integrate Natural Language Processing (NLP):

If applicable, incorporate NLP techniques to extract meaningful information from textual health data. Assess the impact of including textual features on the overall performance of the classification models.

Evaluate Model Performance:

7. Evaluate Model Performance:

Define and implement evaluation metrics, such as accuracy, precision, recall, F1 score, and area under the ROC curve. Utilize cross-validation techniques to ensure robust assessments of model performance.

8. Address Ethical Considerations:

Develop protocols for handling healthcare data ethically and in compliance with privacy regulations. Implement measures to safeguard patient information and ensure responsible data usage throughout the project.

These research objectives provide a structured approach to guide your project, ensuring that each step contributes to the overall goal of developing an effective and interpretable classification system for Diabetes Health Indicators.

5 METHODOLOGIES

The methodology for this research project is designed as a multi-stage process to achieve the objectives laid out earlier. Each stage is critically important for the successful completion of the project. Below is a detailed description of the methodology, segmented into key phases.

Phase 1: Data Collection and Preprocessing

1. Data Sourcing: The first step involves obtaining the raw diabetes imagery. Collaborations will be established with relevant meteorological agencies to access this data.

2. Data Annotation: Each image will be annotated with existing meteorological data such as wind speed, atmospheric pressure, and other variables that traditionally serve as indicators of cyclone intensity.

3. Data Preprocessing: Techniques like normalization, cropping, and rotation will be applied to make the dataset compatible for deep learning models. Data augmentation methods will also be employed to increase the dataset size.

4. Quality Assessment: Before proceeding, a rigorous quality check will be performed to ensure that the dataset is clean, correctly annotated, and fit for training models.

Phase 2: Exploratory Data Analysis (EDA)

5. Feature Analysis: Basic statistics, distributions, and correlations among various data features will be analyzed to better understand the data characteristics.

6. Initial Visualization: Heatmaps, histograms, and scatter plots will be generated to visualize the dataset and better comprehend the relationships between image features and cyclone intensity metrics.

Phase 3: Model Selection and Development

6. **Algorithm Selection:** Different deep learning architectures like CNNs, RNNs, and hybrid models will be evaluated to determine the most suitable for the task at hand.

8. Model Architecture: The selected model's architecture will be designed, specifying layers, neurons, activation functions, and other hyperparameters.

9. Training-Validation Split: The dataset will be divided into training, validation, and test sets to train and evaluate the model.

Phase 4: Model Training

10. Hyperparameter Tuning: Techniques like grid search and random search will be employed for hyperparameter optimization.

11. Model Training: The model will be trained on a high-performance computing cluster using the annotated and preprocessed dataset.

12. Real-Time Capability: Parallel processing and other optimization techniques will be employed to enable the model to make predictions in real-time.

Phase 5: Model Evaluation

13. Performance Metrics: The model's performance will be assessed using accuracy, precision, recall, and F1-score among other metrics.

14. Comparative Analysis: The deep learning model's predictions will be compared with traditional methods to establish its relative effectiveness.

15. Sensitivity Analysis: The model will also be tested for its sensitivity to various features and conditions to understand its limitations.

Phase 6: Scalability and Deployment

16. System Architecture: Design and develop the system architecture to ensure scalability and robustness. The architecture should be capable of ingesting real-time data and providing real-time predictions.

17. API Development: An API will be developed to make the system accessible for integration

with existing meteorological and disaster management systems.

18. Testing: Before full deployment, rigorous testing will be conducted to check the system's performance under different loads and conditions.

Phase 7: Societal Impact and Documentation

19. Impact Assessment: Perform a study to evaluate the potential societal impact, specifically in the areas of disaster preparedness and response.

20. **Documentation and Reporting:** Comprehensive documentation will be prepared, covering all aspects of the research, including data collection, model architecture, evaluation metrics, and societal impact.

By meticulously planning and executing each of these phases, this research aims to develop a system that can revolutionize the field of cyclone intensity estimation, thereby substantially benefiting society in the realms of disaster preparedness and mitigation.

6 EXPERIMENTAL SETUP

Hardware Requirements:

- **Processor (CPU):** A modern multi-core CPU, preferably one with four cores or more, to effectively handle computational tasks.
- **Graphics Processing Unit (GPU):** It is optional, but Real-time processing and deep learning model training can both be greatly accelerated with a dedicated GPU.
- **Memory (RAM):** A minimum of 8GB RAM is required for data handling.
- **Storage:** A Solid State Drive (SSD) for faster data access and processing.
- **Camera/Webcam:** A good-quality camera with at least 720p resolution for capturing images/videos.
- **Operating System:** Windows/MacOS/Linux

Software Requirements:

The software tools that will be utilised in the development of this project are as follows:

Software tool used	Description	Logo
Jupyter Notebook	Jupyter Notebook is a web-based open-source application that is used for editing, creating, running, and sharing documents that contain live codes, visualisations, text, and equations. Its core supported programming languages are Julia, R, and Python. The Jupyter notebook comes with an IPython kernel that allows the programmer to write programs in Python. There are over 100 kernels other than IPython available for use.	

Atom text editor	Atom is a text and source code editor which works across all operating systems. It speeds up find-and-replace operations by an order of magnitude and improves loading performance for large, single-line files. It's a desktop application built with HTML, JavaScript, CSS, and Node.js integration.	
Visual Studio Code	Visual studio code is an open-source code editor built for Windows, Mac OS, and Linux which can be used for various programming languages like Java, JavaScript, Python, C, C++, Node.js. It contains support for multiple features like debugging, syntax highlighting, code snippets, code refactoring and git command built-in.	
Flask	Flask is a micro web framework written in Python. It is classified as microframework because it does not require particular tools or libraries. It has no database abstraction layer, formvalidation, or any other components where pre-existing third-party libraries provide common functions.	
Android Studio	The official integrated development environment (IDE) for building Android applications is called Android Studio.With capabilities including a code editor, visual layout designer, emulator for testing apps on various devices, debugging tools, and interaction with the Android Software Development Kit (SDK), Android Studio offers a user-friendly interface.. It supports a variety of programming languages, including Java and Kotlin.	

- **Libraries and Frameworks:**

  - **OpenCV**: A software library for computer vision and machine learning is called OpenCV (Open Source Computer Vision Library). For a variety of image and video processing jobs, it offers a complete set of tools, functions, and algorithms. Python is one of the many programming languages with interfaces that are supported by OpenCV, which is written in C++.

  - **NumPy**: A key component of the Python scientific computing ecosystem is NumPy (Numerical Python). It supports multidimensional arrays and matrices and offers a large selection of mathematical operations that can

be performed on these arrays. Numerous more libraries and tools in the fields of science and data analysis are built on the foundation of NumPy.

- **Matplotlib**: A popular Python library for producing static, interactive, and animated visualizations is called Matplotlib. It gives users access to a flexible and adaptable framework for creating excellent plots, charts, graphs, and other types of data visualization.

- **Tensorflow:** Google created the open-source machine learning framework known as TensorFlow. It is made to make it easier to create and use machine learning models, especially deep learning models. Building and training a variety of neural networks and other machine learning methods is made simple and adaptable by TensorFlow.

- **Tesseract:** Google created Tesseract, an open-source optical character recognition (OCR) engine. It is made to transform photos with printed or handwritten text into text data that computers can understand. Tesseract has become well-known for its precision and capacity to handle a wide range of languages and fonts. It offers options for pre-processing images to increase recognition accuracy and supports a variety of languages. Tesseract can be used for text extraction from photos, document digitalization, and making scanned documents searchable.

7 CONCLUSION

The combination of LR and RF-based classifier performs better. This combination will be very helpful for predicting diabetic patients. Machine learning has the great ability to revolutionize the diabetes prediction with the help of advanced computational methods. Detection of Diabetes in its early stage is the key for treatment.

The technique may also help researchers to develop an accurate and efficient tool that will reach at the table of clinicians to help them make better decisions about the disease. More parameters and factors would be involved in the future scope of this project.

The accuracy will increase even more when the parameters increase .Using traditional techniques and algorithms, we can enhance the accuracy by improving the data.

The "Diabetes Health Indicators Classification" project has successfully addressed its objectives, providing valuable contributions to the understanding and application of machine learning and deep learning techniques in healthcare. The findings open avenues for continued research and advancements in the field of diabetes prediction and classification.

8 TENTATIVE CHAPTER PLAN FOR THE PROPOSED WORK

CHAPTER 1: INTRODUCTION

This chapter will cover the overview of classification of diabetes health indicators.

CHAPTER 2: LITERATURE REVIEW

This chapter includes the literature available for classifcation of Diabetes Health Indicators Using Python. The findings of the researchers will be highlighted, which will become the basis of the current implementation.

CHAPTER 2: BACKGROUND OF PROPOSED METHOD

This chapter will provide an introduction to the concepts which are necessary to understand the proposed system.

CHAPTER 4: METHODOLOGY

This chapter will cover the technical details of the proposed approach.

CHAPTER 5: EXPERIMENTAL SETUP

This chapter will provide information about the subject system and tools used for the evaluationof the proposed method.

CHAPTER 6: RESULTS AND DISCUSSION

The result of the proposed technique will be discussed in this chapter.

CHAPTER 7: CONCLUSION AND FUTURE SCOPE

The major finding of the work will be presented in this chapter. Also, directions for extending the current study will be discussed.

6. REFERENCES

1. American Diabetes Association Diagnosis and classification of diabetes mellitus. Diabetes Care. 2010;33(Supplement 1):S62–S69.

2. Sarwar N, Gao P, Seshasai SR. Diabetes mellitus, fasting blood glucose concentration, and risk of vascular disease. Lancet. 2010;375(9733):2215–2222.

3. Lonappan A, Bindu G, Thomas V, Jacob J, Rajasekaran C, Mathew KT. Diagnosis of diabetes mellitus using microwaves. J Electromagn Waves Appl. 2007;21(10):1393–1401.

4. Krasteva A, Panov V, Krasteva A, Kisselova A, Krastev Z. Oral cavity and systemic diseases—diabetes mellitus. Biotechnol Biotechnol Equip. 2011;25(1):2183–2186.

5. Nathan DM. Long-term complications of diabetes mellitus. N Engl J Med. 1993;328(23):1676–1685.

6. NCD Risk Factor Collaboration (NCD-RisC) Trends in adult body-mass index in 200 countries from 1975 to 2014: a pooled analysis of 1698 population-based measurement studies with 192 million participants. Lancet. 2016;387(10026):1377–1396.

7. Zimmet P, Alberti KG, Magliano DJ, Bennett PH. Diabetes mellitus statistics on prevalence and mortality: facts and fallacies. Nat Rev Endocrinol. 2016;12(10):616.

Books:

Author1, A. A., Author2, B. B., & Author3, C. C. (Year). Title of the Book. Publisher.

Research Papers:

Lastname, F. F., & Lastname, G. G. (Year). Title of the Paper. Journal Name, Volume(Issue), Page Range. DOI or URL

Online Resources:

Organization or Author. (Year). Title of the Webpage. Website Name. URL

Software Documentation:

Scikit-learn: Machine Learning in Python. (Year). Scikit-learn: Machine Learning in Python.

Thesis or Dissertations:

Author, D. D. (Year). Title of the Thesis or Dissertation. Institution.