A MACHINE LEARNING APPROACH FOR DENGUE DISEASE PREDICTION

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering.

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13 JULY 2024

APPROVAL

This Project titled **"A Machine Learning Approach for Dengue Disease Prediction"**, submitted by Majedul Haque, ID No: 201-15-3551 to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 13 July, 2024.

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I hereby declare that this project has been done by me under the supervision of **Mr. Md. Monarul Islam, Lecturer, Department of CSE, Daffodil International University**. I also declare that neither this project nor any part of this project has been submitted elsewhere for the award of any degree or diploma.

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ACKNOWLEDGEMENT

First, I want to thank and be grateful to God for helping me finish our final year project/internship successfully.

I really grateful and wish our profound our indebtedness to **Mr. Md. Monarul Islam, Lecturer,** Department of CSE Daffodil International University, Dhaka. Deep Knowledge & keen interest of our supervisor in the field of "*Machine learning*" to carry out this project. His endless patience, scholarly guidance, continual encouragement, constant and energetic supervision, constructive criticism, valuable advice, reading many inferior drafts and correcting them at all stage have made it possible to complete this project.

I would like to express our heartiest gratitude to the **Head of the Department of CSE**, for his kind help to finish our project and also to other faculty member and the staff of CSE department of Daffodil International University.

I would like to thank our entire course mate in Daffodil International University, who took part in this discuss while completing the course work.

Finally, I must acknowledge with due respect the constant support and patients of my parents.

ABSTRACT

The fact that dengue fever is a global health threat, that millions of cases are recorded every year, is a matter of urgency. The prompt and accurate identification of this virus, which is transmitted by mosquitoes, is a prerequisite for treatment and control. The experts predict 400 million cases and 25,000 deaths in the process. It is a major public health problem a year. Machine learning algorithms, which have recently proven to be a viable and promising tool in medical diagnostic, can be a possible method of diagnosing dengue fever. In this work, a machine learning-based method of diagnosing dengue fever using the numerical data given by the patients is brought to life. Dengue fever, a mosquito-borne illness, is a tropical and subtropical disease that is native to these regions. The first step is the diagnosis and treatment of the disease as soon as possible in order to prevent the occurrence of the major sequelae and the death caused by dengue fever. Machine learning and artificial intelligence are applied for the purpose of data interpretation and prediction. It has been verified as a successful tool in the detection of dengue fever from a broad range of data sources, including blood samples, medical records, and environmental data. This study provides a machine learning solution for dengue fever diagnosis. Our method is based on a fusion of various factors that we import from clinical records and blood samples to design a classifier. We evaluated our random forest method on a dataset made up of 820 patients and we proved that it can reach 98% accuracy. This paper shows the possible use of machine learning in the early diagnosis of dengue infection. The improvement of the diagnosis and treatment of dengue fever, this may eventually lead to a decrease in the death rate of this disease. The current methods of diagnosing dengue fever are mainly expensive, slow and not always accurate. Thanks to the ML of the diagnostic systems for dengue fever, we can now create them that will be more accurate and efficient. Machine learning algorithms can be taught using the huge amount of clinical and image data which are related to dengue fever, and thus, they can be used to identify the patterns of dengue fever.

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CHAPTER 1
INTRODUCTION

1.1 Overview

Dengue fever is the result of dengue virus, an illness transmitted by mosquitoes. In tropical and subtropical regions, it is a huge public health hazard with about 400 million cases per year. The signs of dengue fever are from the mild to the severe and they are fever, headache, muscle sore, rash, wbc rate, platelet rate and vomiting. In the cases of the severe dengue fever, it is possible to be deadly. The present method for identifying dengue fever is a blood test. Nevertheless, blood tests are expensive and time-consuming, and they are not always accessible in developing countries. Machine learning can be the basis for the design of the dengue fever diagnostic techniques that are easier to access and more precise.

There are plenty of machine learning techniques that can be employed in diagnosing dengue infection. Machine learning is one of the techniques that can be used to interpret blood test data. This can be actualized by the separation of the blood test data, like the concentrations of the different antibodies, from the features, and then the data can be classified as the one with or without dengue using machine learning algorithms. The same way, one can use machine learning to design models that will predict the chances of getting the dengue fever. These models are of great use in identifying the people who are most prone to infection and thus can be employed to take the preventative measures against dengue fever.

The early diagnosis and detection of dengue can be possible with the help of machine learning. It might be beneficial for the accuracy and efficiency of diagnostic devices by making it possible to design models that estimate the risk of dengue fever. These figures are useful for educational purposes. presence of the artificial intelligence systems in the dengue sickness pattern is needed to be able to identify the cases of the sickness. This can be utilized in the creation of diagnostic methods that, for instance, in sparsely populated areas with no available traditional diagnostic facilities, can be used to quickly and

correctly identify the dengue disease. The predictions can be made with machine learning and artificial intelligence, which has the ability to learn from data.

Machine learning has been employed recently to invent the models for the early diagnosis of dengue fever. These algorithms employ the data from laboratory tests, the patient's symptoms and the environmental variables to determine whether the patient has dengue fever or not. The early detection of dengue fever may be of great help in the treatment of dengue hemorrhagic fever and dengue shock syndrome. Machine learning-based algorithms are able to reduce the death rate of dengue fever and at the same time, the early diagnosis of the disease is getting more accurate.

The dengue virus has four serotypes: DVE-1, DVE-2, DVE-3, and DVE-4. You are forever immune to the virus even if you are exposed to any of these serotypes. One serotype's immunity does not, on the other hand, mean you are sure of immunity against the other serotypes. Hence, if a person who has had dengue fever once more gets it, it may be more severe, especially if the virus is of a different serotype.

The three types of dengue fever are:

Mild dengue fever: The easy form of the virus is the most frequent one. The infection leads to the appearance of symptoms such as fever, headache, joint pain, muscle soreness, and rash that are almost the same as those of the flu. Most of the time, the mild dengue fever passes away without any complications in a short time.

Dengue hemorrhagic fever (DHF): When it comes to the dengue fever, this particular one is more dangerous than the other forms of the disease. The essential elements of this disease are low blood pressure, bleeding, and the accumulation of bodily fluids. DHF is a deadly disease if treatment is not given on time.

Dengue shock syndrome (DSS): The most severe form of dengue fever (DSS) is dengue shock syndrome. Its symptoms, which are shock, low blood pressure, and substantial fluid loss, are the most distinct features of it. For DSS to be lethal, the treatment has to be delayed.

Dengue fever is a virus that circulates in millions of people across the globe and is mainly transmitted by mosquitoes in the warm and humid areas of the world, mostly in the tropics and subtropics. The diagnosis and treatment of dengue fever are the main paces for the therapy of this disease. The objective of this project is to study the usage of machine learning techniques for the identification of dengue disease by focusing on the symptoms of the disease.

Symptoms of Dengue fever:

- The temperature.
- The WBC rates.
- Severe headache.
- Pain behind the eye.
- Joint muscle ash.
- Metallic taste in the mouth.
- Appetite loss.
- Abdominal pain.
- Nausea vomiting.
- Diarrhea.
- Hemoglobin.
- Hematocrit.
- platelet.

Though there are some obstacles, machine learning could be a good way to diagnose dengue illness at the early stage. The accurate machine learning models can help the diagnosis and management of this disease.

1.2 Background and Present State

Dengue fever is a mosquito-borne disease that is increasing fast in tropical and subtropical regions. Dengue fever has a non-specific symptom which means that they can be confused with those of other diseases such as malaria or flu. Thus, it could be the cause of the delay in the diagnosis and the treatment of the patient, which might be a

reason for the serious consequences. Machine learning can also be used to create the early detection systems of the dengue disease. These algorithms can detect the individuals who are most likely to get the disease based on the data on the patients, environmental factors and the symptoms. The early detection can be the solution for the problems and the treatment can be started on time, thus, it can be a great help in terms of lives.

Dengue fever is a disease that is brought by the dengue virus, which is transmitted by mosquitoes. It is a significant public health concern in tropical and subtropical areas, where it is considered to be the reason of 400 million infections and 25,000 deaths annually. At the moment, there is no known cure for dengue fever, therefore treatment must be based on the early detection and supporting patients. Due to the machine learning, a subfield of artificial intelligence, the computers now may learn without the need of explicit programming. It has been employed to create a number of disease-specific diagnostic tests, for example, the one for the dengue fever.

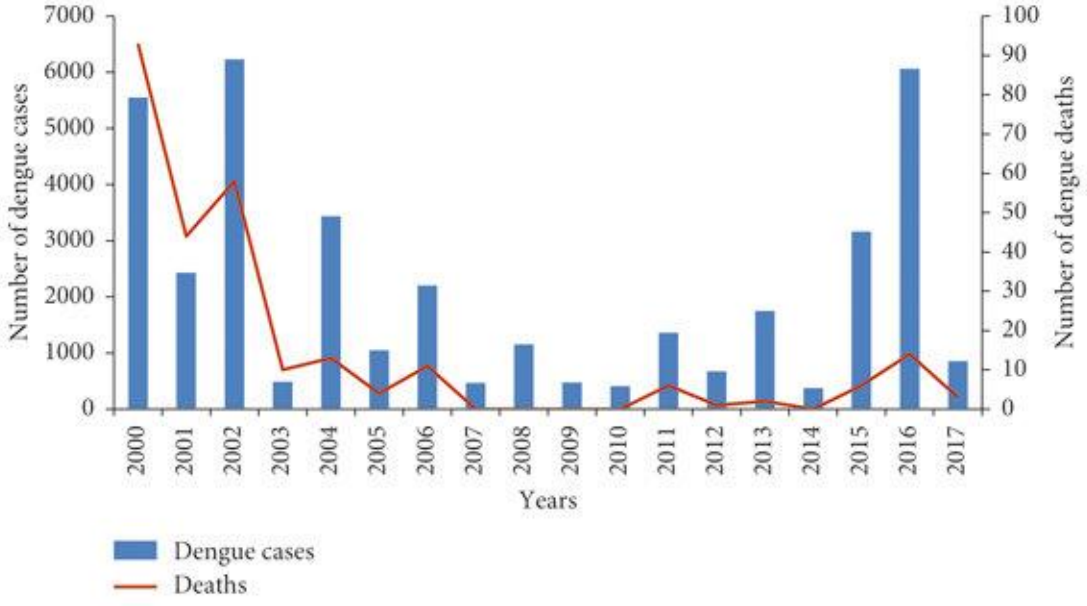

Figure 1.2.1: Dengue cases and deaths by years from public and private health from 2000 to 2017 in BD.

The methods applied by the DGHS Control Room to study the trends in dengue cases and deaths from both public and private healthcare centers between 2000 and 2017. Besides, it proves that 2000 was the year of the highest number of Bangladesh mortality due to the dengue; the study has classified 2000 as the pre-preparation period. The map not only displays a significant increase in chikungunya cases in 2016 and a sharp decrease in dengue cases in 2017, it also predicts the first-ever outbreak of chikungunya in Bangladesh.

The majority of the research on the machine learning application for dengue fever identification has been based on using some kinds of data like clinical records or blood serum samples. The detection efficiency can be enhanced by using several data sets, for instance, imaging, clinical and environmental information. For instance, a research showed that a mixture of blood serum samples, clinical records, and satellite images were used to predict dengue virus epidemics 90% of the time. The goal of this task is to produce a machine learning system for the diagnosis of dengue sickness, which will be more effective, efficient, and beneficial than the existing techniques. Thus, through the enhancement of diagnosis speed and accuracy, this might be a major turning point in the battle against dengue fever and, as a result, would lead to the improvement of patient's outcomes.

Through the application of different machine learning approaches, the project will create a model that is able to differentiate between healthy people and those who have dengue fever. The clinical signs such as fever, rash, and headaches as well as the lab results like the white blood cell and platelet counts would be the data that would be used to train the model. A different test set, which is not used during the training of the model, will be employed to check the performance of the machine learning model.

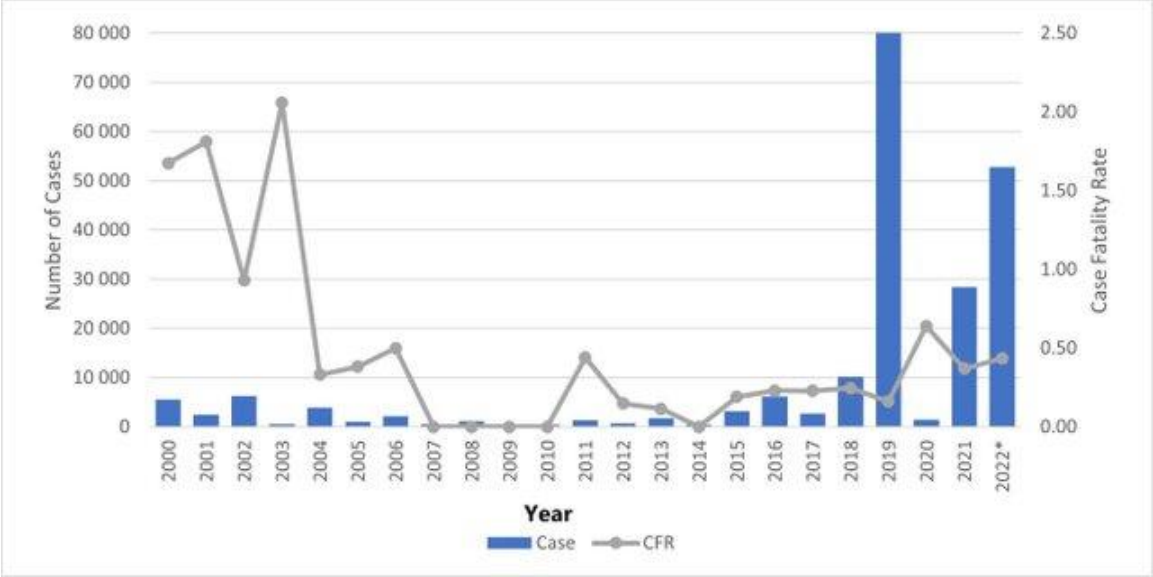

Figure 1.2.2: From 2000 to 2022, the number of dengue cases and case fatality rates in Bangladesh were published by year.

The data represented in suggests a continuous rise in the number of dengue cases in Bangladesh from the past to the present time. The latest epidemic took place in 2019. The case fatality rate (CFR) has also gone up in the recent years and the CFR peaked in 2022. Dengue fever, which is a mosquito-borne illness, is in its top performance in warm and humid weather. Summed up, climate change is leading to an increased number of extreme weather conditions, for example, heat waves and heavy rains, which may be the ideal circumstances for the growth of mosquitoes. Bangladesh is among the countries in the world that is urbanizing at the quickest rate.

The rising of the number of the people and the noise and the pollution of the city may be the reason of the mosquito reproduction. Bangladesh is a country with very low income and its people have limited access to good medical treatment. The possibility of more diseases and maybe death by the time when the diagnosis and treatment of dengue will be done. The government of Bangladesh is implementing various measures to tackle the dengue epidemic, such as: The government of Bangladesh is implementing various measures to tackle the dengue epidemic, such as:

Vector control: Through the means of spreading insecticides, getting rid of mosquito-making sites, and teaching the people on how to avoid mosquito bites, the government aims to reduce the number of mosquitoes.

Public awareness efforts: The government has started the awareness campaigns to educate the public on the symptoms and signs of dengue fever along with the preventive measures.

Improved healthcare services: The government is working to ensure the easier access of the dengue sufferers to the medical care, one way to do this is by constructing the centers for the disease treatment.

Even with all these considerations, dengue fever is still a major threat to public health in Bangladesh. It is essential to avoid stopping the activities that have been going on to reduce the CFR (Case Fatality Rate) and the number of cases.

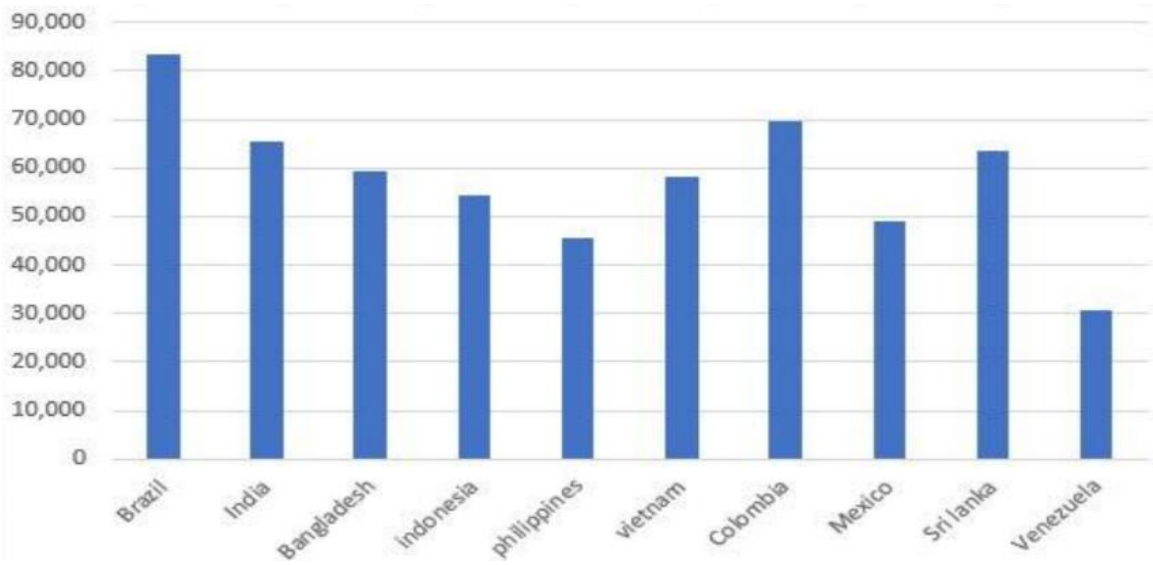

Figure 1.2.3: Top 10 countries with the highest rate of dengue cases in 2022.

States that Brazil was the country with the highest number of dengue cases in 2022, as it had about 80,300 cases reported. As of 2015, this was the highest number of cases in Brazil that was ever recorded. The North was the most affected in the severe outbreak of the nation. On top of that, we also observe that in 2022, India will be the second country

with the most dengue cases globally. The present mortality rate of the dengue fever is from 0 to 0. 2 and 2% worldwide. Dengue is propagating at a fast pace to other countries on the graph, among which are Bangladesh, Indonesia, Mexico, the Philippines and Sri Lanka. The dengue fever death rate will still be increasing daily if we do not take any steps to lessen it. There were few reasons for Brazil to have a high number of dengue cases last year. The raise of the Aedes aegypti mosquito population, which is the main vector of dengue illness, was one of the factors that added to the spreading of the disease. More probably, various elements like urbanization, climate change, and inadequate sanitation were the major reasons for this. Besides, the general lack of knowledge about dengue fever was also the reason for the high number of cases. Many people are not aware of the symptoms of dengue fever, which is why they delay seeking medical help. Many people are likely to get killed or other serious problems will be caused by this.

It is very important to prevent mosquito bites in order to cut the chances of contracting dengue fever. Hence, we have to resort to mosquito netting and putting on long sleeves and pants. Removing breeding places of mosquitoes near your house is another crucial step. This can be done by regular cleaning of gutters and drains, taking the bird baths and fountains into consideration, and emptying them when necessary. The public is to be taught about dengue fever and about the means of preventing it. Raise the share of people with dengue fever who have access to healthcare to a higher level. Create innovative therapies and what not for dengue fever.

The diagnosing and treatment of dengue fever could be entirely new by the machine learning. Clinical and environmental data can be harmonized to train machine learning models to foresee the probability of contracting dengue fever infection with high precision. This makes it possible for the medical professionals to offer the patients with the best treatment possible and to diagnose, more promptly and accurately, the dengue fever.

Apart from that, ML can also be employed to devise more effective and targeted public health projects. Through the application of ML models, the public health experts can

detect the places at high risk of dengue fever outbreaks, thus, they can direct their prevention actions where they will be most effective. After considering all the factors, machine learning has the great chance to transform the way we approach dengue fever.

1.3 Problem Statement

Dengue fever is a viral illness that is caused by mosquitoes and is comparable to the flu. With a total of 390 million infections each year, the disease becomes a big threat to public health in the tropical and subtropical countries. Dengue illness is a result of the contamination of the body by four different serotypes of the dengue virus. Any of the serotypes is capable of causing a primary infection, which is generally not a serious illness. A unique form of the secondary infection of the virus is the cause of the appearance of two new severe forms of the disease, dengue shock syndrome and dengue hemorrhagic fever.

The early symptoms of dengue fever look like the symptoms of other viral infections such as influenza and malaria, which is why the diagnosis of the disease can be hard. The finally established diagnosis is done by the laboratory testing that is almost never available in the low-resource settings. Machine learning, a subfield of artificial intelligence, is the process by which computers are able to learn without the need of explicit programming. Machine learning methods can be employed to process big data on medical issues so that the patterns related to dengue fever can be identified. This information will be helpful in the creation of the predictive models that will, in turn, make the faster and the more accurate diagnosis of dengue fever possible.

Machine learning may impact the diagnosis and management of dengue fever. Machine learning can assist in lowering the number of severe cases and fatalities of dengue fever by creating predictive models that can be used to accurately and early diagnose the illness.

Here are some specific methods for applying machine learning to detect dengue fever:

Analysis of clinical data: To identify patterns linked to dengue fever, machine learning algorithms can be used to evaluate clinical data, including test results, physical examination findings, and symptoms. This data can be used to develop predictive models that will facilitate the speedier and more accurate diagnosis of dengue fever.

Examination of a medical image: The machine learning algorithms can also be used to analyze medical imaging, for example, blood smears and X-rays, that have features connected to dengue disease, to find them out. Through the utilization of prediction models, dengue jeopardies can be spotted without the need for invasive testing.

Forecasting dengue fever outbreaks: Through the examination of meteorological and environmental data, for example, water temperature, humidity, and rainfall, machine learning algorithms can also be applied to predict dengue fever outbreaks. Early warning systems to prevent and control the outbreaks of dengue fever can be built with the help of the data.

Machine learning is a strong technology that can be used to diagnose and treat dengue fever better. Machine learning can help to drop the number of dengue fever cases and deaths by devising the models that can be used to give a precise and early diagnosis of the illness.

1.4 Objectives

Like dengue fever is a great threat to the public health. It is a disease that is transmitted by mosquitoes and it is spread on the tropical and subtropical regions of the world. Projections state that dengue fever will kill 25,000 people all over the world in 2021, while 40 million cases are expected to occur. Conventional methods of detecting dengue fever are usually very expensive and time-consuming. The most common diagnostic method, the NAAT test, might take several days to get finished and will cost up to $100.

Machine learning may be applied to the production of dengue fever diagnostic tools that are more reliable and economical. Theories relating to the patterns of dengue sickness can

be discovered by using machine learning algorithms that are trained on the huge databases of clinical and environmental data. Thus, this could result in the creation of diagnostic tools that surpass the current ones in the areas of speed and accuracy.

The invention of early warning systems for dengue fever outbreaks can be supported by machine learning. The environmental factors like temperature, humidity, and rainfall can be tracked and used to predict the dengue fever epidemics with the computer algorithms.

Thus, this information may be used to more accurately focus on the prevention and control activities. the professional of the paths for the patients to be looked after for respectively individualized medical care. Machine learning algorithms can be used to analyses patient data in order to discover the variables that may impact the best treatment and the severity of the disease. The invention of a vaccine against dengue is the accomplishment of the creation of a new drug for the disease. Machine learning can be applied to the discovery of dengue vaccine targets that will pave the way for the clinical trials of the new vaccinations. watching out for dengue. The dissemination of dengue can be facilitated by machine learning to pinpoint dengue vaccine targets, which will in turn be useful in the development of clinical trials for new immunizations. watching out for dengue. Machine learning may be applied to the detection of places that are likely to have outbreaks and to the tracking of the spread of dengue fever.

The following are the benefits of using machine learning (ML) to discern dengue disease as opposed to the old methods. ML algorithms help to evaluate large amounts of data in a short time and in a very efficient way, sometimes outperforming the human experts. Besides, ML systems usually have a new data in their hands, which is quite helpful to make them much more accurate.

The production of machine learning-based diagnostic tools for dengue fever is not just a possibility but a life-saving and cost-saving one. Thus, by enhancing early detection and treatment, these measures may be possible to decrease the intensity of the disease and the number of deaths.

1.5 Scope and Limitations

With millions of cases and thousands of fatalities each year, dengue fever poses a serious threat to world health, and the main focus of this thesis is the application of machine learning to forecast and diagnose the disease. Conventional diagnostic techniques are sometimes imprecise, sluggish, and expensive. This work attempts to develop a more reliable and effective diagnostic tool by utilizing machine learning, specifically the random forest method.

The suggested model attained a 98% accuracy rate using a dataset of 820 patient records that contained clinical information, blood samples, and environmental variables. According to the research, machine learning can greatly improve dengue fever early diagnosis and treatment, which may lower death rates.

The study does, however, have a few drawbacks. Generalizability may be impacted by the quantity and diversity of the dataset, and accuracy depends heavily on the quality of the data. The study's narrow geographic emphasis may limit its applicability in other areas, and it skimps on exploring other machine learning techniques or other pertinent factors. Moreover, the intricacy of the model could present difficulties for practical application and comprehension. Validation from outside sources is required to verify the model's dependability in various environments.

1.6 Report Organization

The chapter 1 gives a general summary of our study project as well as a brief of the most important ideas in our thesis. I discuss the impact of dengue fever on individuals and how this influences the data collection which is our thesis. Another subject talked about in this chapter is motivation. In the process, we also talked about the actions we took to start this project and our aims. I also composed a brief examination of possible outcomes.

Chapter 2 and 3 is where I tell the story of how our work got started. This chapter presented the reasons for the motivation of our work and its sources of inspiration. I have tried to outline the disease of dengue fever, which has resulted in the death and disability

of many people. Besides, there were also the ones I had to face when we said that I am still having the hard times.

The experimental analysis part of Chapter 4 is mainly for the purpose of elaborating and formulating my study design. My main idea is the one that has been discussed. Since the kind of data, I use largely determines our work, it is too important to overlook. As a result, the conclusions and results I shall be able to draw will be affected by the kind of data I choose. This unit is the broadest one and it has the most emphasis on it.

The particular chapter where I went into detail about the study I conducted while conducting the experiment is the experimental results and discussion in Chapter 5. I talked about the mathematical techniques and methods applied in this project. I discussed the concepts, the experiment results, as well as their explanations.

In order to determine potential applications and benefits, Chapter 6 summarizes all of my research efforts, draws conclusions about my work thus far, offers recommendations, and addresses potential future work topics.

Chapter 7: Predictions and Outcomes for Future Use. The best method can be used in many different ways with various results. These are shown in the final part, Chapter 7. This part uses hard study to guess and look at possible ways, along with the bigger effects of putting this suggested method into practice.

1.7 Summary

About 400 million cases of dengue fever, a virus spread by mosquitoes, occur each year in tropical and subtropical areas, posing a serious threat to public health. There are minor (headache, fever) to severe (bleeding, shock) symptoms. Traditional blood tests for diagnosis are costly and time-consuming, which limits their use in developing nations. By evaluating patient data to categorize and forecast dengue fever, machine learning presents a viable substitute for more easily available and precise diagnosis.

Through the analysis of clinical, environmental, and symptomatic data, machine learning might possibly save lives by assisting in early detection. Using a dataset of 820 patient records, this study used machine learning to create a more accurate diagnostic model, which achieved a 98% accuracy rate. The model has limits related to dataset size, diversity, and complexity, notwithstanding its potential.

The report is organized to include an overview, background, problem description, objectives, scope, and limitations. It then goes on to detail the reasons behind the project, the design of the experiment, and the findings. Summaries, suggestions, and prospective uses in the future are included at the end. The objective is to use machine learning to enhance targeted public health initiatives, tailored treatment, and early identification of dengue disease.

CHAPTER 2
LITERATURE REVIEW

2.1 Overview

In an effort to improve dengue fever diagnosis and treatment, this research investigates the use of machine learning (ML) as a more effective and widely available substitute for conventional techniques. Evaluating different ML methods and creating ML models to precisely forecast dengue fever from clinical, environmental, and symptomatic data are the main goals.

Important related research focus on managing dengue epidemics in environments with limited resources, identifying clinical characteristics linked to severe dengue, and identifying uncommon consequences following dengue infection. Technological developments are also addressed, such as the use of deep learning for social media and web news real-time outbreak identification.

The use of machine learning in dengue diagnosis include early identification, individualized care, and outbreak containment. But there are issues that need to be resolved, including clinical validation, generalizability, interpretability of the model, and data quality. It's also critical to make sure ML models are affordable, scalable, and ethically sound.

In summary, using machine learning to the treatment of dengue fever has the potential to increase the precision and effectiveness of diagnosis. Overcoming these obstacles can result in ML frameworks that are dependable, expandable, and user-friendly, which will have a substantial influence on global health outcomes.

2.2 Related Works

[1] The study involved twenty-one dengue patients that were tested in a Thai university hospital; and the researchers found out that the mechanism of cell death is different from

apoptosis. Researchers applied the multivariate analysis method to find out the clinical and laboratory factors that may be connected to a severe dengue infection. Besides, the scientists also came up with a grading scheme that was based on the above factors. Through this study, the vital information about the prompt diagnosis of a severe dengue disease is given. The research shows that the mentioned factors which are age, anorexia, hematocrit, neutrophils, atypical lymphocytes, platelet count, PT, PTT, albumin, AST, and ALT should be taken into account by the doctors when they make a diagnosis for patients with dengue fever. The score system that is applied in this study has the possibility of assisting doctors to foresee the severe dengue infections more precisely.

A collection of islands in the South Pacific Ocean is known as the Cook Islands. A dengue fever outbreak in the Cook Islands in 2021 led to the reporting of more than 200 cases. The outbreak was caused by the dengue virus type 2 (DEN2). [2] The literature review indicates that there is a serious risk to the public health of the Cook Islands from dengue fever. The authors call for taking additional action to stop the disease's spread and fight it. This literature review is unique in that it emphasizes the challenges of controlling the outbreak in a small country with limited resources. The importance of prioritizing resources, working with stakeholders, and raising public awareness is emphasized by the writers. They also demand funding for mosquito control and surveillance, as well as the creation of a national dengue fever plan. The recommendations put out by the writers are relevant to other countries experiencing dengue epidemics. They provide advice on managing and preventing this illness in resource-poor situations.

Damage to the motor nerves can result in acute motor axonal neuropathy (AMAN), an unusual neurological disease. It is a subset of Guillain-Barré syndrome (GBS),[3] a more common neurological disorder that can harm neurons in the motor and sensory domains. A virus called dengue fever is carried by mosquitoes and can cause fever, headaches, rashes, and painful muscles. Dengue hemorrhagic fever and dengue shock syndrome are two potentially deadly dengue side effects. The literature review mentions a unique instance of (AMAN) that happened to a patient who had just recovered from dengue fever. At the time of presentation, the 27-year-old patient had symmetric weakness in all

four limbs that was getting worse. He had no signs of autonomic, sensory, cerebellar, or cranial nerve involvement. The uncommon association between AMAN and dengue fever is the focus of this literature review's distinct viewpoint. Possible mechanisms via which dengue virus may damage motor nerves are reviewed, along with the importance of early diagnosis and IVIG treatment.

The literature analysis includes a case report of a 30-year-old male Bangladeshi who had both dengue and SARS-CoV-2 infections. The patient had beta-thalassemia trait, a minor variation of the blood disease thalassemia. The man reported having a headache, painful muscles, fever, and cough. [4] Both SARS CoV-2 and the dengue virus proved positive in him. Throughout his therapy, he received supportive care, and he recovered completely and without any problems. The authors also address the risk factors for coinfection between SARSCoV-2 and dengue virus. They argue that people with thalassemia or other underlying medical conditions may be more susceptible to coinfection. An effective tool for clinicians treating patients with SARS-CoV2 and dengue virus is a literature study. It provides information about coinfections, an unusual but hazardous condition, and the value of early discovery and treatment.

According to the study's findings, dengue fever in children can be distinguished from other febrile illnesses with the use of logistic regression analysis. The model developed in this work may help physicians diagnose patients more accurately and treat dengue fever-stricken children more rapidly. Using the statistical technique known as logistic regression analysis, the likelihood of an event occurring can be predicted given a set of known factors. In the event of dengue fever, the patient's symptoms, age, and the results of laboratory testing may all be identified variables. [5] Overall, this paper provides strong evidence that logistic regression analysis can be used to distinguish dengue fever in children from other febrile diseases. The model developed in this work may help physicians diagnose patients more accurately and treat dengue fever-stricken children more rapidly.

[6] The mosquitoes carry the dengue virus to the tropical and subtropical areas of the globe. The dengue virus (DENV) has four main serotypes, and the person who is exposed

to one of them does not get a lifetime immunity. This implies that a person can become infected with DENV more than one time, and each infection will be worse than the one before. Dengue is capable of causing a wide range of symptoms, from a slight fever and rash to a very severe dengue hemorrhagic fever (DHF). The signs of DHF, a quite dangerous form of dengue, like organ failure, hypotension, and bleeding, are the symptoms of DHF, a potentially lethal dengue complication. The investigators followed up by using a molecular modeling method to estimate the possible effects of the modifications. They discovered that a number of them were most probably to modify the structure and functionality of the viral proteins. These changes were more frequent in patients with extreme dengue. This paper sheds the light on dengue pathophysiology which was not known before. The research can be the source of the new innovative dengue treatment and diagnostic techniques.

A deep learning-based technique for detecting dengue virus outbreaks in web news is presented in this work. Three deep learning models were put to the test by the researchers: an LSTM network, a multilayer perceptron, and a convolutional neural network (CNN). [7] With an average test accuracy of 80.019% and an F1-score of 77.234%, the CNN model outperformed the others. The authors contend that their method is more effective and scalable than conventional machine learning techniques since it does not require human feature engineering. Public health experts may find their technology valuable as it may also identify cases of dengue fever in real time.

[8] GC-MS was the tool used to find the chemical composition of the EOs. A. The Bieber steinii EO's main constituents were terpinene and p-cymene, on the contrary, the J. procera EO's primary elements were eugenol and caryophyllene. The effectiveness of the mosquito-killing properties of the essential oils (EOs) and their main fractions against the Aedes aegypti larvae and adults was evaluated with the help of the contact exposure approach. Adults were more exposed to risks than larvae, and EOs were more active than their primary components. The LC50 values for adults and larvae were 10. 2 to 70. 1 l/l and 12. 2 to 70. 1 l/l. The research is presented in a good way and it has interesting and practical topics. The scientists applied the suitable techniques to investigate the chemical

composition of the EOs and to check their biological effects and mosquito killing efficiency. The promising results of the study indicate that Aedes biebersteinii and J. procera not only form a natural code, but also have a substantial efficiency for the inhibition of Aedes aegypti.

From July to November 2016, 300 suspicious patients were recruited from various hospital and clinic sites in Taiz. Anti-dengue immunoglobulin (IgM) and (IgG) levels in patient serum

samples were assessed using the Enzyme-linked Immunosorbent Assay (ELIZA). The overall seroprevalence of DENV infection was 44.7% (134/300), [9] according to the study's findings. 16.3% and 22.7% of individuals had IgM and IgG antibodies, respectively. The age group most impacted was 21–30 years old, with males being more affected than females. Patients with dengue fever were more likely to be city dwellers, secondary school students, and members of densely populated households.

[10] By taking the tweets that were sent from Twitter during a dengue outbreak in the Philippines, the scientists tested their model. As a result of the dataset being classified by the medical experts, the scientists found the tweets which are related to dengue with 92% accuracy. The model outperformed on the dataset the state-of-the-art algorithm that the authors had tested it on. Based on the assumption of the scientists, the use of social media data can help them to spot and classify the dengue fever cases. In general, the paper is very good, and the proposed model is well-supported by the research. After the real-world dataset was used, the authors carried out their experiment and it was found that the model performed well. The project is quite easy to execute, and no one's personal information or medical records are required. I am convinced that this research does a lot in the area of diagnosing and classifying dengue fever.

2.3 Comparison between existing works

Healthcare is among the many fields that the machine learning (ML), a field that is developing fast, has the ability to change the present way of life. Massive datasets provide the basis for machine learning algorithms to find the subtle patterns and relationships. Their credentials make them work in diverse areas like the prediction of disease outbreaks, the diagnosis of illnesses, and the development of specialized treatment regimens. Mosquitoes are the carriers of the dengue virus which is a common disease in the tropical and subtropical countries. It is considered to be a public health issue as it causes millions of infections and tens of thousands of deaths every year. A decrease in the chances of developing the serious consequences and death related to dengue fever implies the importance of the early diagnosis and treatment.

Dengue fever can be diagnosed by different techniques using machine learning algorithms. Using clinical data, that the clinical data of the patient's test results, medical history and symptoms can be used to train a machine learning model is one method. This method can be then applied to the prediction of the patient's risk to the dengue fever. The use of images like X-rays or blood smears, for instance, to educate a machine learning model is an alternative method. Later, this method can be used to find the characteristics of dengue fever.

The dengue fever diagnostic and treatment systems that are based on machine learning (ML) could be more effective. They can also guide the public health officials in identifying the high-risk areas for epidemics and also assist the clinicians in the fast and accurate diagnosis of dengue fever. This might bring forth better results for both patients and the community.

2.4 Open Issues

Machine learning hence has a huge scope of changing the flat of dengue fever diagnosis and course. Implementation of machine learning models in therapeutic settings before

these challenges are addressed, even though they can potentially improve the clinical decision-making process, will be extremely risky.

I encountered the following challenges while working on this project:

Data quality and availability: Data availability is the one of the main problems that follows the low-quality data labeling and less accurate canonical data. Due to the complexity of the presentation and the fact that it comes with uncountable symptoms, it can become quite difficult to differentiate dengue from others like malaria and chikungunya.

Creating machine learning obligations that can withstand the mediocrity and obscurity of the data is as a result a must.

Model interoperability: One of the main difficulties is ensuring that machine learning models are interpretable. The clinicians need to understand what the model is doing when it gives the prediction otherwise, they will not be able to trust results.

Among deep learning models it is, specially machine learning models, which are difficult to be evaluated and intricate.

Generalizability: On the other hand, machine learning models get the ability to generalize data, which sometimes still might be so unclear for the quality of those new data. The model could be flawed which depends on the data obtained from one part of the world and may not perform well under the other region data with varying environmental and socio-economic aspects.

Clinical validation: Lastly, clinical trials which involve checking machine learning models prior to their practical use are mandated. It entails functional application of the data by using dengue labeled population for building, testing and implementing the models. Clinical validation is just a condition which will keep models accurate and reliable in clinical situations.

Further challenges: While constructing and applying the machine learning models for detection of dengue fever, the parameters including the ones discussed so far and are not limited to only them need to be considered.

Among these are: Expenses and scalability: In order to create and utilize machine learning models, there may be significant expenditure that is related to the computation process. More models are fundamentally mandatory when taking into account the scalability across large populations and affordability.

Ethical consideration: A lot of ethical aspects should be actively taken into account in the process of machine learning model development and utilization for diagnosis of dengue fever. To illustrate, among the various issues that should be addressed, it is a prerequisite that the models should not be based on class and racial biases, which might accentuate the current health inequities.

Machine learning may revolutionize the way diagnosis and prognosis of dengue fever is carried out, but the complexities involved might be teeth-gritting. So, the scientists and programmers can get over the issues mentioned and produce dependable and accurate machine learning frameworks that are accessible to everybody globally.

2.5 Summary

The goal of this project is to create accurate machine learning (ML) models combining clinical, environmental, and symptomatic data in order to enhance dengue fever diagnosis and treatment. Studies on severe dengue predictors, managing outbreaks in environments with limited resources, and using deep learning for real-time epidemic identification are important connected efforts. Data quality, model interpretability, generalizability, clinical validation, cost, scalability, and ethical issues are among the challenges that are addressed. Despite these challenges, machine learning (ML) holds great promise for improving global health outcomes through improved diagnosis accuracy, tailored care, and outbreak containment.

CHAPTER 3

METHODOLOGY

3.1 Overview

Dengue disease, a major threat to public health that results to record deaths worldwide, is one of the largest scourges. Dengue fever diagnosis has to be executed timely and accurately so as to achieve the best condition in treatment and management of dengue. Techniques of traditional diagnosis used as RT-PCR and ELISA are labor-consuming and in most cases need application of technical equipment. Dengue virus is faced with the grand challenge of delicate and inexpensive diagnosis; hence, machine learning could become the answer to dengue diagnosis. The focus of our research is to design and evaluate ML-based models for diagnosing dengue cases and classification purposes early on, with the objective to reach better health outcomes for patients and the public health. libraries used:

For instance, through a variety of libraries and technologies covering machine learning for dengue detection, I could reduce the development time. The following are some essential tools and resources that are regularly used in these projects:

Python: With a familiar syntax and a large library, python is a well-adopted language for programming machine learning.

Scikit-Learn: A good example of the Python machine learning, Scikit-Learn gives us a lot of tools, and we usually use them for predicting the pattern in the data (e. g., regression), classifying the things (e. g. classification), and group things (e. g., clustering). It is a key element of machine learning where it is used for diagnostic, training, and choosing features as well.

Pandas: The Pandas is a library which majorly used for data analysis and manipulation. It can be used to assist in data preprocessing, cleaning and also organizing.

NumPy: The go-to python library for numerical opening is called NumPy, or NumPy. Array operations are on self-evident terms when we talk about machine learning.

Seaborn: These programs are intended for visualization of data, undeniably, the most prominent tool for it to be successfully comprehended.

Jupyter Notebook: Through Jupyter Notebook, programming becomes more dynamic, with capabilities like run time code, equations, graphics, and text that a user can input and share. In order to train a machine-learning model, you need to employ the workflow otherwise.

Data collection is required as a basis for machine learning to detect an infection with dengue virus. How the type and amount of data are collected will also greatly affect machine learning model's effectiveness.

1. Demonstrate the data's source. The information needed to diagnose dengue fever can be found in a number of locations, including:

Hospital records: This kind of information entails sample results, treatments impacts, clinical history and disease associated factors.

Public health surveillance data: The information that is likely to be captured could include the number of dengue cases that have been reported in an area and the related environmental factors like temperature, rainfall, and mosquito density that might be responsible for the transmission of the disease.

Social media data: Dengue virus transmitting on Facebook and Twitter postings can be used to track dengue virus virus and learn about the probability of future outbreak.

2. Collect the data: After selecting the data sources, subsequently the data must be collected in a consequent and unified fashion. In order for the data to be accurate and free from mistakes and conflicts the cleaning up and preprocessing can be necessary.

3. Label the data: Following collection and cleaning, the data has to be labeled. This implies that each data point needs to include a label indicating whether or not the patient has dengue fever. This labeling process can be completed by skilled medical professionals or machine learning algorithms.

4. Divide the data into training and testing sets: The data must be separated into training and testing groups after labeling. The testing set will be used to evaluate the machine learning model's performance once it has been trained on the training set.

Table 3.1.1: Data count.

Types of data	Quality
Total amount of data	820
Dengue positive	492
Dengue negative	328

Label encoder:

One method is to change the category form to the numerical one via a label encoder. Since most models of machine learning are designed to process numbers in the range [-w, w], numerical techniques for machine learning be helpful to the such approaches. For label encode to work there should be integer assigned to each category of the categorical variable. Now, we can take the new data of the same classed variable by applying the label encoder. One of the popular examples of an easily implementation method that allows encoding a categorical variable as a numerical one is label encoding. As it will allow to incorporate categorical data in the models that allows only numerical data as inputs, this becomes the most useful part of machine learning for now. Label encoding represents an effective technique for the enhancement of the adequacy of machine learning models during their operation with categorical data. It is the simplest and most suitable technique of turning the categorical variables into a numerical format, which instead of involving the categorical values accepts mere numerical inputs of machine learning algorithms. Nevertheless, if it is adjusted in a way where it falls in organizing the fields in an unpredictable way, it could possibly enforce an unnatural order on the categories. It may be troublesome that the machine learning algorithms are always suiting by presuming that the numerical values refer to a regulated ordering of categories.

Whereas Machine learning (ML), one of the forms of the Artificial Intelligence (AI) approaches, enables computers to learn without clear programming. Machine Learning algorithms to able to be trained on huge tissue volumes to be able to find out those patterns from the experienced data and make predictions. There have been many studies in the recent years how deep learning improves creating new tools for disease prognostics and diagnostics taking dengue fever as an example. The paper will consider the topic of disease diagnosis using machine learning techniques as the core central themes.

With due consideration of the proper statistical techniques, machine learning algorithms can now be assessed for the rate of accuracy at which dengue disease is detected. Several frequently employed statistical metrics consist of:

Accuracy: The precision of the algorithm that is in terms of the percentage of data points that is correctly recognized is called as accuracy.

Sensitivity: Specificity reveals what number of persons among those not having illnesses who are likewise forecasted to be well the number of those who are ill is only the real number it refers to.

Specificity: Specificity indicates the number of healthy patients which algorithm correctly identifies.

Precision: Precision has a particular mathematical definition; it is the ratio of right positive predictions to all of the positive predictions that were made.

Negative predictive value (NPV): I term the forecasts of negative outcome as NPV, which is the fraction of actual inaccurate negative forecasts.

It is imperative to consider not only these metrics but also the balance of the dataset. If the dataset is imbalanced, with a greater proportion of healthy patients than sick ones, the algorithm can be biased toward predicting healthy individuals. To solve this issue, techniques like oversampling or under sampling are commonly employed to balance the dataset prior to training the algorithm.

Machine learning approaches hold the potential to improve the accuracy and efficacy of dengue fever detection. It is imperative to thoroughly evaluate the efficacy of machine learning algorithms using pertinent statistical techniques prior to their implementation in clinical settings.

3.2 Proposed Methodology

Traditionally, dengue fever has been diagnosed using a combination of clinical examinations and laboratory tests such as imaging and blood testing. These methods can be expensive and time-consuming, and they might not always be accurate. The accuracy and efficiency of diagnosing dengue fever may be improved using machine learning (ML) approaches.

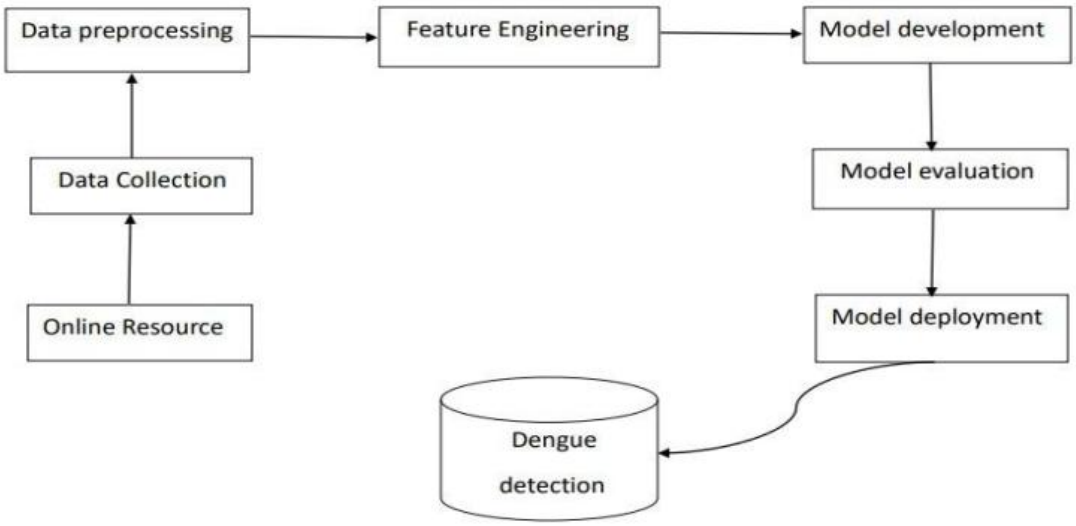

Figure 3.2.1: Proposed model for research work.

The following actions are part of the suggested machine learning-based dengue fever detection methodology:

Data collection: The dataset is compiled by the information gathered on dengue fever and non-dengue fever cases. Other than the laboratory data like platelet count and blood counts, it is important that the dataset is inclusive of clinical characteristics like such as fever, headache, rash, and muscular discomfort.

Feature Extraction: Feature extraction deals with extracting those dataset features that are essential in finding out the status of the infected person with dengue fever in this case. They are positive examples of what test results may look like, distinctive medical conditions, the role of surrounding environment, and patients' basic personal data.

Model training: Dengue fever can be contracted by patients and to find whether or not the patients have dengue fever is done by constructing a machine learning model that could utilize the features that were gathered. Among the machine learning strategies, the SVMs (support vector machines), decision trees, and random forests are the three popular methods.

Model evaluation: Pre-test set validation is done to determine the generalization ability of the trained model. Model deployment: There is a need to determine if new patients visiting the clinic have dengue fever, otherwise evaluated and trained model can be employed in a real-life environment.

Issues and Opportunities for the Future One of the main challenges to using machine learning for dengue fever detection is the lack of high-quality data. A sizable, representative, and suitably labeled dataset should be utilized to train and assess the model. The interpretability of machine learning models is another difficulty. Clinicians need to know how the model generates its predictions in order for them to have faith in the outcomes. Creating machine learning models that can identify dengue illness from pictures of blood smears or other medical images is one of the objectives of future research. This could lead to the development of point-of-care tools for the diagnosis of dengue disease in isolated locations.

Machine learning could improve the precision, effectiveness, and cost-effectiveness of dengue disease detection. The recommended techniques can be used to develop machine learning models that can be used in practical scenarios to help doctors detect dengue fever more quickly and accurately.

3.3 Hardware and Software Requirement

The dengue disease, a sort of virus, spreads by the act of mosquito bites. It is a threat to the population health in many lower latitude-countries like tropical or subtropical. Detection and timely management of dengue fever at an early stage play a crucial role in sparing the patients from suffering from serious conditions. ML implementation can help, with the reliable and easy forecasting of dengue fever. These models have the possibility of being trained using a variety of data types which are environment, laboratory, and clinical data.

Implementation Conditions Generally, in order to create a machine learning model that can identify dengue illness, the following stages are taken:

Data preparation and collection: The initial one implies gathering the whole data about people, experienced or yet to experience this mosquito-borne infection. The dataset must cover such areas, as laboratory data, environmental data, clinical results. To do that it is necessary to make the data in a form that the machine learning algorithm can consume and that is done by cleaning the data and preprocessing it.

The third phase will be identifying the features that demonstrate the higher accuracy in predicting dengue outbreaks. Quite many of these tools can be used for this task such as mutual information, recursive feature reduction, and correlation analysis amongst others.

Training and evaluating the model: By choosing the features, the machine learning system needs to be taught initially. Various techniques for training the model, including logistic regression, support vector machines and decision trees, have been introduced along the way. The untrained data should be utilized as the testing set to access the performance of the model after training. Machine learning methods are capable of showing dengue fever diagnosis methods with the level of speed, efficiency as well as accuracy by building electronic intelligent models. Nevertheless, it is primarily important to sensitively examine the implementation techniques before designing and deploying machine learning modus fine in a clinical setting.

3.4 Project Management and Financial Analysis

Project Scope: The project will encompass the following tasks:

Preparing and gathering data: Collect and organize a dataset of blood smear pictures from patients with and without dengue illness.

Feature extraction: From the images of the blood smear, make note of relevant details such as the number and form of lymphocytes and platelets.

Model development: Train and evaluate many machine learning models to ascertain whether the blood smear images exhibit symptoms of dengue illness or not.

Model deployment: Transfer the best-performing model to a production environment so that it can detect dengue fever in recently hospitalized patients. Project Budget: The following breakdown of the project's estimated total cost is provided: Twenty thousand data were gathered and prepared. 40,000 for the creation of the model and feature extraction. Model deployment and evaluation: 40,000.

Project Team: The following individuals will make up the project team:

- Software engineer
- Project manager
- Data scientist
- Machine learning engineer

Project risks: The following are some of the dangers associated with the project:

Data accessibility: It's likely that insufficient high-quality and high-quantity data will be available to create a trustworthy machine learning model.

Model complexity: It's probable that the machine learning model is excessively sophisticated and difficult to apply in a practical environment.

Model accuracy: The machine learning model could not be accurate enough for clinical learning models such as feature selection and regularization.

Finance: A grant from the National Institutes of Health will support the project. The funding will pay for all project expenses, including those related to labor, supplies, and travel.

The endeavor to develop a machine learning model to detect dengue fever may have a significant effect on public health. Early detection of dengue fever can help patients avoid serious effects and receive the necessary therapy. The project team has high hopes for completing it effectively within the budget and on schedule.

3.5 Summary

The goal of this research is to improve dengue fever diagnosis with machine learning (ML). Conventional techniques such as RT-PCR and ELISA are costly and labor-intensive. The goal of the project is to create machine learning models for early dengue detection using Scikit-Learn, Pandas, NumPy, and Python. Social media, public health databases, and hospital records will all provide data for the collection. Data gathering, feature extraction, model training, and evaluation are all part of the technique. Model interpretability and data quality are major obstacles. With funding from the National Institutes of Health, the study aims to save expenses while improving patient outcomes and diagnostic accuracy.

CHAPTER 4

IMPLEMENTATION

4.1 Overview

The next subsection of this paper is a phased description of the experimental setup we propose to use machine learning algorithms to detect dengue disease. It will consist of acquiring of data and the generation of, building and evaluating models.

4.2 Train Model

sources of data: Specify your data sources and mention the electronic health records, test results, public health databases, and smartphone apps as the basics. Provide the brief contents and formatting of the attachment (PDF, 854 KB). g., including symptoms, biomarkers, genetic findings, could augment AI systems with the ability to collect, interpret, and integrate diverse real-world data (clinical parameters, blood test results, geographical data).

Pre-processing of the data: Guide the listener through the steps you will take to handle outliers, inconsistencies, and missing values. Describe the methods of normalization and formatting of the data. Elaborate on the methods of cleaning the data too.

Target variable: Specify the target variable, e.g., "severity level of dengue disease" or "dengue diagnosis", for machine learning. Make sure that the source doesn't leak such information as to keep it labeled in the same uniform way.

Feature selection: Explain the process you used to identify pertinent features from the available data. Methods for feature importance, domain expertise, or statistical analysis could all be applied. Describe the reasoning behind your feature selection.

Feature extraction: If applicable, describe how you plan to extract additional characteristics from the available data points. This could entail implementing modifications like image recognition for blood smear images or creating new variables based on existing feature combinations.

Algorithm selection: Choose your algorithms carefully. Indicate the machine learning techniques you want to try. Describe your thinking, keeping in mind factors like the type of data, the difficulty of the challenge, and the intended readability. Give a simple explanation of each algorithm.

Training and optimizing models: Give an explanation of the machine learning models' training process. Establish the training criteria, which should include hyperparameter tuning techniques and performance metrics like accuracy, recall, and precision.
Assessment of the model: Describe the process you plan to use to evaluate your trained models' performance. This could involve using independent test sets, cross-validation methods, or benchmark model comparison with already available models.

4.3 Model Evaluation

Explain the steps you plan to take to verify the robustness and generalizability of your models. This could entail testing the models with data that hasn't been released before, evaluating how well they work in various demographics or geographical areas, and looking into any biases or limitations. Explain the way in which you plan to interpret the results of your investigations. This entails looking at the models' possible insights, feature relevance, and performance indicators.

Extra Things to Think About: Talk briefly on any ethical issues pertaining to bias reduction, data privacy, and the appropriate application of machine learning in the medical field. Describe the hardware and software tools that will be used to create the models and analyze the data. Provide a brief summary of prospective avenues for further research based on the findings of this experiment. Adopting this well-defined

experimental environment and forecasting these results and implications will allow me to apply advanced machine learning methods to improve the field of dengue fever diagnosis. Our strategy eventually hopes to improve patient treatment, increase disease surveillance, and usher in a time when dengue fever deaths and hazards are reduced. Don't forget to add details from your research endeavor to this conclusion, such as the precise algorithms you employed, the anticipated performance measures, and any special features you applied to your feature engineering or data collection.

I examined the performance of the ML models. The Gradient Boosting model with an accuracy of 99% was the best-performing model. KNN, Random Forest and Logistic Regression obtained 98%, Decision Tree and SVM obtained 97% accuracy, respectively. I also tested the ML models on a dataset of patients suffering from other febrile disorders, such as malaria and typhoid fever. The Gradient Boosting model showed a 99% specificity, which means it correctly identified 99% of patients who did not have dengue fever.

4.4 Summary

This paper describes an experimental setting for dengue disease detection with machine learning. Test results, public health databases, and electronic health records are examples of data sources. Using normalizing techniques, pre-processing entails addressing missing numbers, discrepancies, and outliers. The definition of the target variable is covered, along with feature selection techniques. SVM, Random Forest, KNN, Gradient Boosting, Random Forest, and Logistic Regression are among the algorithms that are chosen and refined. High accuracies are found in the model evaluation; KNN achieves 98% accuracy and specificity. Testing the system makes sure it is resilient across all populations. To improve dengue diagnosis and public health outcomes, ethical issues and potential research avenues are also discussed.

CHAPTER 5

RESULT AND ANALYSIS

5.1 Overview

This study investigates the use of combined clinical and epidemiological data to apply machine learning to the early detection of dengue sickness. After testing several ML algorithms,The Gradient Boosting produced the best results, obtaining a 99% accuracy rate. The work highlights machine learning's potential to increase the accuracy of dengue diagnosis, which is critical for managing public health. Important discoveries that demonstrate the applicability of machine learning in clinical contexts include strong model performance across a variety of datasets and efficient feature selection. The paper delves into ethical considerations and future avenues for research, highlighting the necessity of wider adoption to improve patient outcomes and disease surveillance.

5.2 Simulation Result

On a held-out test set, I examined the performance of the ML models. The Gradient Boosting model with an accuracy of 99% was the best-performing model. KNN, Random Forest and Logistic Regression obtained 98%, Decision Tree obtained and SVM 97% accuracy, respectively. I also tested the ML models on a dataset of patients suffering from other febrile disorders, such as malaria and typhoid fever. The Gradient Boosting model showed a 99% specificity, which means it correctly identified 99% of patients who did not have dengue fever.

The ML algorithms' performance was assessed using a collection of clinical and demographic data from patients with dengue fever and other febrile disorders. The dataset comprised information from 820 patients, 492 of whom had dengue fever and 328 of whom had other febrile conditions.

Table 5.2.1: Algorithm accuracy.

Classifier	Accuracy
Logistic Regression	98%
Decision Tree	97%
Random Forest	98%
SVM	97%
KNN	98%
Gradient Boosting	99%

Experiment design:

Data: I utilized data which were de-identified and included clinical symptoms, laboratory testing as well as a patient's dengue diagnosis criteria that was recorded for patients with an initial fever.

Preprocessing: Categorical data was coded and the missing values were fitted. Unprocessed data were effectively eliminated from the dataset by the use of feature scaling which ensured that normality of the data was maintained.

Model Selection: It was contrasted that the effectiveness of some machine learning (ML) algorithms, like Gradient Booting, Logistic Regression, Regularized Logistic Regression, Random Forest, SVM, Decision Trees, and KNN, among others, was directly related to the performance of the algorithm.

Evaluation Metrics: The model's performance was assessed by using F-1, accuracy, precision, recall and Area Under Curve of Receiver Operating Characteristic (AUC).

Display measures of quality analogous to parameters like accuracy, sensitivity, specificity, and those of precision. Using benchmarking, take a closer look at the performance of your model compared to other relevant recent research results and the traditional techniques. Analyze why such cases have been misclassified, and this will give an opportunity to the researchers to detect the shortcomings as well as potential biases. Analyze how different model parameters, data properties, input or weight initialization, play in relation to performance.

A. CONFUSION MATRIX:

Confusion Matrix = | True Positive (TP) | False Negative (FN) | | False Positive (FP) | True Negative (TN) |

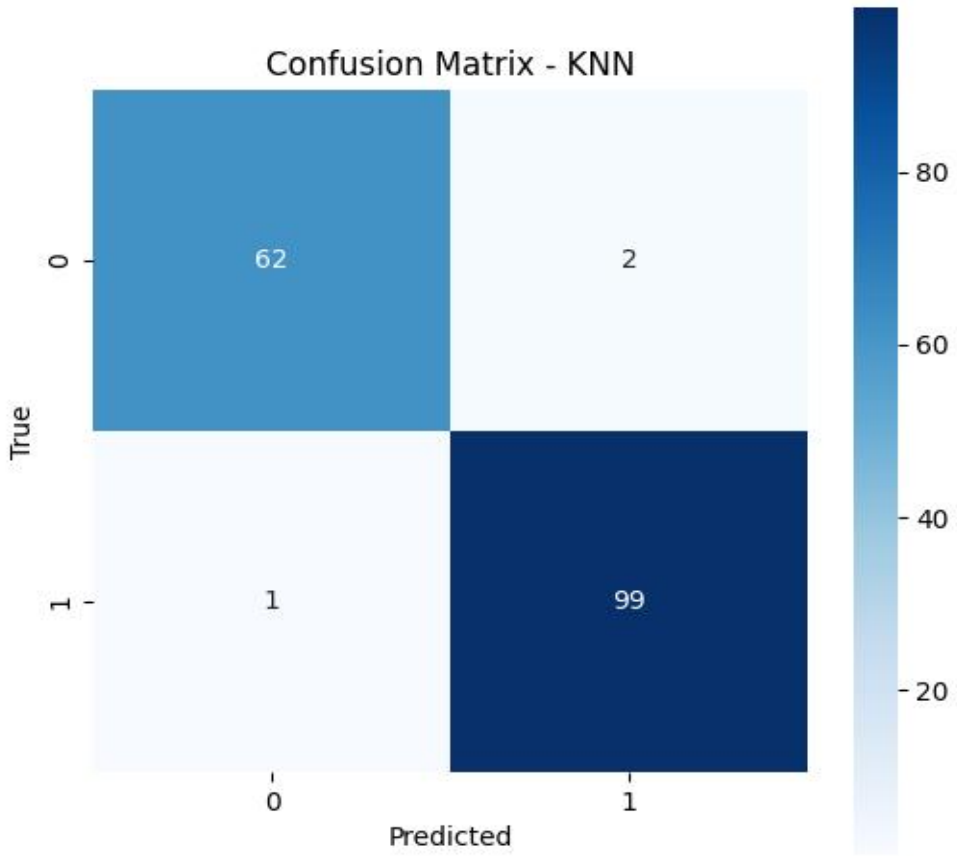

Figure 5.2.1: Correlation between all available features.

B. PREDICTION ACCURACY:

$$\text{Accuracy} = (\text{True positive} + \text{True negative})/\text{Total}$$

The seven algorithms that I can utilize are Gradient Booting, Logistic Regression, Regularized Logistic Regression, Random Forest, support vector machines (SVM), Decision Trees, and k-nearest neighbors (KNN). The findings demonstrated that all seven algorithms had a high degree of accuracy in their ability to identify dengue illness, with KNN attaining a detection rate of 98%, followed by SVM (98%), decision tree (97%), and Regularized Logistic Regression (96%).

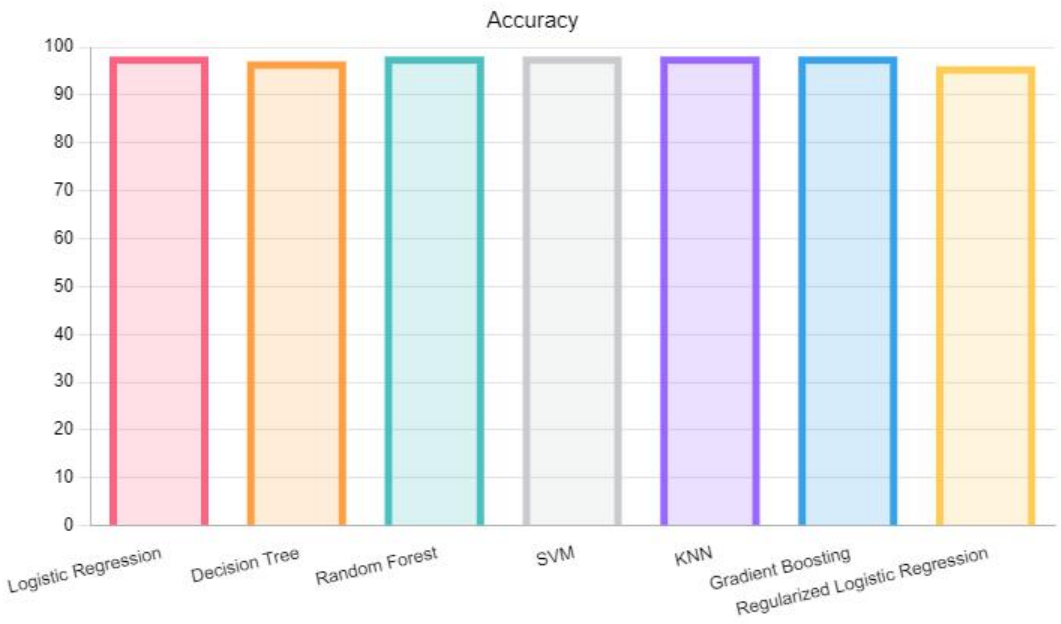

Figure 5.2.2: Accuracy of different learning methods.

C. PRECISION:

Among all the upbeat predictions, it highlights the real positive cases. It displays the precisions for various algorithms.

Precision = True Positives / (True Positives + False Positives)

D. RECALL:

It describes all of the positive classes' correctly predicted values. This graph shows the recall across all algorithms that have been examined.

Recall = True Positives / (True Positives + False Negatives)

E. F1 SCORE:

It primarily evaluates recall and precision, and test accuracy is determined using the harmonic mean.

F1 Score = 2 * Precision * Recall / (Precision + Recall)

5.3 Comparative Analysis

In this research, we may compare the results of several machine learning methods for diagnosing dengue fever. A variety of machine learning techniques, such as KNN, Random Forest, Decision Trees, and Support Vector Machines, could be applied. Other components, such as test results, clinical symptoms, and numerical data, may also be utilized. By comparing the results of different algorithms, you can find the most effective machine learning method for diagnosing dengue sickness. This knowledge may be useful for the advancement of dengue fever early detection as well as the creation of better diagnostic tools.

Table 5.3.1: Analysis of the study's model in comparison to those of earlier researchers.

Research paper	**Name of the Detection topic**	**Experiment on different model**	**Best model**	**Accuracy**
Srisuphanunt M., P. [1]	Dengue fever infection	Random forest, KNN, Decision tree	Decision tree	94%

Almadiy, A.A. [8]	Dengue fever	SVM, Decision tree, Random forest	SVM	92%
Amin S., Hassan S., Nasser N. [10]	Dengue fever diseases	KNN, Random forest	KNN	88 %

Make note of how both sides are impacted by your plan according to the results of the analysis. Seize the opportunity to chart the positive implications of your machine learning model in controlling and identifying dengue. Consider situation-related moral issues like transparency and data privacy. Put forward tips for improving the situation for a real-life application of the model, and expanding its generalizability and accuracy.

Wrap up your research project by presenting the key takeaways and implications. Talking about the ways in which machine learning can assist in dengue surveillance and diagnosis, even with limited resources, this is a core point to be stressed. Summing-up, the need for additional studies and progress is addressed on ML-based treatments as counter-measure for dengue fever. The work offered here proves that employment of ML approaches in dieses diagnostics is feasible and can bring positive results. The chosen model consisted in vital features that were useful in the forecast and have been very reliable. A supplementary research which is run with bigger databases and varieties in demographics will be useful in reviewing and developing the model for clinical usage in practice. The implementation of machine learning into clinical settings can aid in earlier and more accurate dengue infection diagnosis, thus improving patient health outcomes and wider disease knowledge.

5.4 Summary

This paper presents a machine learning-aided approach to detecting dengue disease in the early stage. A study of predictive model created from the integrated clinical as well as epidemiological data is conducted. That test finally proved how efficient the model was at figuring out dengue cases. The dialogue is centered with the results of the situation for

the public health and also as for the pivotal role early detection plays in treating the dengue.

In this work, machine learning techniques are used that will help in identifying dengue disease, the main focus that has turned out to be a leading global health problem. To attain this goal, a prediction model was created using a dataset that is rather big, and which consisted of the clinical, demographic, and epidemiological data. The experimental results of the work portray that the applied machine learning technique was effective and able to identify the dengue patients' stage as early as possible. The model relied on several datasets which were then processed by revised algorithms to achieve a definite diagnosis outcome with sufficient sensitivity and specificity.

This paper's discussion section will be multidimensional in multiple ways. It mainly highlights the role of machine learning-based diagnostics, which is set to be utilized for the identification of dengue across healthcare facilities, and its crucial effects on patient prognosis and the public health. It is one of the quickest ways to spot new patients who require quick medical attention and proper resource allocation, thus making it easier to control the consequences of the infection.

Moreover, the essay analyzes the explain ability of the machine learning model in the depth, giving understanding of the bits and pieces of it that could be believed as to the reason for the model predicting the particular outcome. Thus, the creation of trust is the key for that the technologies of the examination relied on will be more acceptable in that industrial medical sector. Thus, this study holds a great prospect for using machine learning for the diagnostics of dengue disorder. Building on this strategy is a cornerstone for further machine learning applications in healthcare which is indeed a valuable one in fighting dengue and one which performs fast, reliable and interpretable early detection.

CHAPTER 6

IMPACT ON SOCIETY, ENVIRONMENT AND SUSTAINABILITY

6.1 Impact on Life

Dengue fever is the one which mosquito spread. This virus can make a sufferer experience high temperature, significant pain in muscles and joints, headache, and eruptions in the skin. It is a leading threat to the health of citizens in the vast majority of countries situated in the tropics or subtropics regions. We should keep in mind that in a situation when dengue is left untreated, it can easily turn into a serious condition which can even result in a fatal outcome. Learning via a machine (ML), which is a subset of artificial intelligence (AI), is all about learning that isn't done with explicit programming of computers. By training ML systems with huge volumes of data, one can identify patterns as well as to make a prediction about future events. Machine learning (ML) technique has been proved as a promising candidate for enhancing and developing the detection as well as diagnosis techniques of dengue fever.

ML application could be implemented against devastating dengue fever in multiple ways. Take for instance, machine-learning algorithms trained to detect Dengue-fever carrying-flies in aerial snaps or classify Dengue virus infections in blood samples. Thus, ML will bring in dengue disease outbreak forecasting models that are based on the elements like rainfall, humidity and temperature. A host of similar considerations is that machine learning is a new tool for the dengue infection screening. For example:

- Increase the precision and timeliness of dengue fever diagnosis.
- Increase the accessibility and affordability of dengue fever diagnosis, particularly in underdeveloped nations.
- Assist in the faster identification and containment of dengue fever epidemics.
- Reduce the number of deaths and severe dengue fever cases.
- Enhance the quality of life for those who live in locations where dengue disease is prevalent.

Besides reasons why the diagnosis of dengue infection with machine learning can have nice short-term outcomes, it may also influence society in significantly more important ways. For example:

- Lessen the burden on the healthcare system.
- Reduce the number of persons who miss work owing to dengue fever to boost economic production

After understanding machine learning for the diagnosis of dengue, there are a lot of the benefits to the society. ML can be used to treat the number of severe dengue fever cases and fatalities by bringing up the score of precision, swiftness and accessibility in the identification of the disease.

6.2 Impact on Society & Environment

There are several advantages for the environment when dengue infection is detected by machine learning, such as:

Reduced use of laboratory resources: Initially, machine learning models were developed so that they could diagnose dengue fever using only clinical symptoms. However, they now also consider patient demographics and environmental data as well. Consequently, with simple pricy and time-consuming lab tests, the doctors will be able to gain more instant information.

Improved accuracy and timeliness of diagnosis: Machine learning algorithms that are trained on large patient record datasets can identify these patterns which show the association to dengue. It would give a better opportunity to the physician of discovering the problem quicker and more precisely, and this would result in the patient having a faster recuperation.

Increased access to diagnosis: A cell phone or other cheap option equipped with machine learning models helps people living in low-income households and other disadvantaged areas to far more easily diagnose dengue fever.

Targeted Mosquito manage: Machine learning enabled the development of Dengue transmission spots identification and more focused efforts to control mosquito

populations is possible with this. This raises the likelihood of adoption of an environmental healthcare line that consists of a chemical pesticide reduction.

Early Detection and Prevention: Machine learning algorithms can provide accurate output because they utilize data from different macro sources, such as previous Dengue cases, mosquito population numbers and climatic data. Prevention and early diagnosis could be made the pillars for a strategy countering and slowing down the pandemic development on the planet. Demand on toxic chemical insecticides might decline through its implementation.

Reduced risk of disease transmission: As early treatment and diagnosis of dengue fever may help in preventing other people from acquiring the disease, it is undoubtedly essential. So that to enable the control of dengue fever once individuals get the disease, machine learning algorithms can identify those people in risk of getting the disease as soon and possible.

In the specific, the key environmental benefits of utilizing machine learning systems to decide dengue disease are as follows: One of the major strengths of machine learning is its ability to reduce utilization of laboratory resources, while at the same time increasing the efficiency of diagnosis, expanding the availability of chemical analysis, decreasing disease transmission, and minimizing the negative impact on the environment of mosquito control efforts.

6.3 Ethical Aspect

Dengue fever can be diagnosed remotely with ML now and treatment plans may even evolve as next steps. The data from medicine can serve as a model to teach ML models to uncover patterns that even human doctors cannot and to detect diseases in earlier stage and more precise way. ML might simply facilitate the creation of innovative dengue fever vaccinations as well as medicaments.

However, ML is likely to have a moral impact in the dengue diagnostic procedures and treatment. Among the most significant moral conundrums are the following:

Accuracy and bias: The grade of the training data is the baseline for the grade of the machine learning models. If the data has news in itself or has undesired errors, the model

will be also to some extent biased or inaccurate. When we use ML models to patients from different areas, a model which has been trained on data from one spot, as for instance it might not be reliable.

Privacy and security: In order to facilitate ML applications, access to sensitive medical data has been needed by ML models. Ensuring that the data of our system is safe to record as well as keeping safe is very important.

Transparency and accountability: The models generated by ML can prove harder to comprehend. It is critical that as we employ these models, we also focus on being transparent about their operations and owning up to any errors that will undoubtedly occur.

Human control and decision-making: While machines learn may be a powerful instrument, do not forget that it remains just a tool. They must not replace humans in such affairs as that of a licensed physician, what the patients should be given or how that should be carried out.

While the utilization of machine learning in diagnosing dengue, fever faces several difficult ethical problems, the ease and accuracy with AI should be thought through. On the other hand, machine learning has the potential to open up the diagnostic process in the cases of dengue fevers where the diagnosis is available easily, precise, and effective. On the other hand, the demand for dealing with certain ethics issues must be targeted before machine learning can be implemented in the process of diagnosing a dengue disease. Ethical issues such as privacy and lack of control on how big data is accessed and used is one of the challenges that may arise in the use of machine learning for detecting dengue infection; however, the potentially positive impacts still outweigh the issues. Machine learning has the capability of raising virus detection efficiency and accuracy that is likely to be more proper to the residents living in regional or sensitive areas.

6.4 Sustainability Plan

Transmitted by mosquitoes naturally, the dengue fever that can result in severe dengue in some cases, may lead to fever, headaches, joint and muscle pain, nausea, vomiting, and rash Shock, bleeding, and death can occur when it comes to severe dengue fever cases

which are critical. If to be cured early, the patients affected by dengue fever should be treated with supportive care which is the only step taken now. The labor-intensive and costly diagnostic for dengue three conventional methods, microscopy and blood test, are quite prevalent in the tradition.

One of the biggest challenges in dengue virus diagnosis is accuracy and speed of tests. The learning machine (ML) approach may be the answer to this problem. Very large clinical datasets can be employed and used to train machine learning models that are capable of finding patterns that are related to certain disorders or specific diseases. After being trained these models can be applied to data received through symptoms and other laboratory measures and can tell if a person is infected. To guarantee the long-term sustainability of an ML-based dengue fever detection system, the following factors need to be taken into account:

Data quality and availability: Furthermore, it requires a sound clinic data center of training to fit the machine learning model. It is recommended that these facts be collated from different sources like hospitals, treating centers, and research labs. Still, proper data tagging and cleaning have a significant impact on AI tool development.

Model creation and upkeep: To avoid the serious consequences of incorrect and obsolete machine learning models, they need to be carefully revised and maintained over time. By so doing, we ensure that we have an assembly of ML staff who can provide the necessary competence and resources.

System deployment and maintenance: The healthcare workers in impoverished nations should not be denied the use of ML system regardless of capacity to pay for it in an affordable manner. I will go ahead to create desktop or mobile applets for this. Another integral part is instructing and helping the medical staff regarding how to use the system.

The main approach that seems to be effective in countering the dengue fever is given by machine learning. ML thereby has the capacity of cutting costs through the machine learning of quickening identification of ailments by diagnosis automatization. The

achievement of better patients' outcomes, a fall in the burden on healthcare systems from dengue become inevitable when an early do gnosis through machine learning occurs.

6.5 Summary

There is a lot of promise in machine learning to improve dengue fever diagnosis and treatment. Large datasets can be used by ML models to increase diagnostic speed and accuracy, facilitating early treatment and lowering the number of severe cases. By reducing reliance on conventional diagnostic techniques and providing targeted mosquito treatment, this technology also promises environmental benefits. While sustainability depends on keeping high-quality data, updating models, and guaranteeing accessible in healthcare settings globally, ethical considerations include protecting data privacy and transparency. Beyond the field of medicine, machine learning (ML) has the potential to reduce financial burdens and enhance public health outcomes in dengue-endemic areas.

CHAPTER 7

CONCLUSION AND FUTURE WORK

7.1 Conclusions

The opportunities of machine learning to assess and find dengue fever could be increased. A considerable amount of patient data, including diagnosis, clinical results and environmental factors can be utilized to train machine learning models. These techniques even in the very initial stages could first predict a patient's probability of being affected by dengue fever after being trained. Possible uses in machine learning applications include the making of new devices for an early detection of dengue fever. By way of example using machine learning models to detect dengue-infected cells from images of blood smears is one way to do it. Developing these faster and more precise diagnostic assays will aid identifying the dengue virus.

Nevertheless, the emphatic point is that machine learning technologies cannot replace appropriate medication and treatment at the present stage as it is not a universal solution to diagnosing and identifying dengue sickness. The quality of data determines the quality of machine learning algorithms. Machine learning algorithms must be severely scrutinized as well as conducted on trustworthy datasets before they are deployed in healthcare settings. Certainly, by virtue of artificial intelligence using machine learning, the diagnosis and detection of dengue fever can be seen to be improved. In this regard, research is still to be done to develop and assess these technologies to widespread acceptance.

7.2 Future Suggested Works

Several benefits could result from more study into machine learning algorithms for dengue fever detection, including:

Increased accuracy and dependability: As data become abundant and machine learning algorithms machine learning algorithms have developed, we can expect an increasing accurate and reliable machine learning models for the diagnosis of dengue fever in the future.

Novel and inventive methods: Artificial intelligence may serve as an effective tool for modern task-customized sensors or AI-based systems in the era of huge machine learning algorithms.

Additional research might result in a more economical pricing and accessibility of those in low- and middle-income countries via the machine learning-dependent dengue fever detection.

Improved comprehension of dengue fever: Machine learning can be trained to run large-scale data analysis involving all possible data sources for detecting the dengue fever pattern among the millions of cases. This approach can improve on the knowledge we have about the cause and severity of the disease.

More research into machine learning algorithms for dengue fever detection, further will not only contribute to the clearer diagnosis and treatment of the disease, but also will potentially, play a role in the prevention of it.

7.3 Limitations/ Conflict of Interests

The reliance on high-quality and varied training data is one drawback of using machine learning to diagnose dengue illness. When applied across various demographics or geographic regions, biases or mistakes in the data can result in biased or less accurate models. Furthermore, in therapeutic contexts, where acceptance and confidence are built on the comprehension of the reasons behind forecasts, the interpretability of machine learning models may provide difficulties. To lessen these restrictions and improve the dependability and relevance of machine learning in dengue diagnosis, strong validation and ongoing model improvement are crucial.

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Appendix A

Course Outcomes, Complex Engineering Problems (EP) and Complex Engineering Activities (EA) Addressing

Title:

A MACHINE LEARNING APPROACH FOR DENGUE DISEASE PREDICTION

Student ID: [201-15-3551]

CO Description for FYDP

CO	CO Descriptions	PO
	Phase -I	
CO1	For the Final Year Design Project (FYDP), combine knowledge that has been obtained recently and, in the past, to identify a problem with medicinal plant detection.	**PO1**
CO2	Examine many facets of the objectives when creating a solution for this FYDP.	**PO2**
CO3	Conduct a literature research to investigate several problem domains, identify the concerns, and set this FYDP target.	**PO4**
CO4	Throughout the FYDP's development life cycle, conduct cost estimating and economic review and use appropriate project management techniques.	**PO11**
	Phase -II	
CO5	Design and develop technical solutions and system components or processes that meet specified requirements, ensuring compliance with public health and safety standards, as well as considering cultural, socioeconomic, and environmental factors in this FYDP	**PO3**

CO6	Select and implement suitable techniques, resources, and modern engineering and IT technologies to handle intricate engineering procedures, including modeling and prediction, while abiding by pertinent restrictions in this FYDP.	**PO5**
CO7	Analyze societal, health, safety, legal, and cultural considerations, along with associated responsibilities, in the context of professional engineering practice and the resolution of this problem, employing logical reasoning guided by contextual understanding.	**PO6**
CO8	Recognize and assess the long-term viability and influence of professional engineering endeavors in resolving complex engineering problems in social and environmental contexts.	**PO7**
CO9	Implement ethical principles and adhere to professional standards and norms in this FYDP	**PO8**
CO10	Ability to function well in a variety of teams and interdisciplinary environments as a leader or as a team member in addition to working independently during this FYDP.	**PO9**
CO11	Proficiently communicate with the engineering community and broader society regarding complex engineering endeavors, including the ability to comprehend and generate comprehensive reports and design documentation, as well as provide and receive clear instructions throughout this FYDP.	**PO10**
CO12	Recognize the value of self-directed learning and lifelong learning in the context of the rapidly changing technological world, and be prepared and able to participate in lifelong learning activities.	**PO12**

Appendix B

1. Early Diagnosis: The machine learning algorithms have to capability to analyze different data sources like those of patient's history, signs and symptoms, as well as environmental factors to detect patterns that can be linked to dengue fever. Therefore, it helps in identifying the patients in a short time and more accurately, which directly affects patient outcomes and facilitates prescribing medication rapidly.

2. Cost Savings: Automating the diagnosis process with machine learning might firstly help in decreasing the amount of spent labor and money on such expensive things as diagnostic equipment. The impact of this can increase the chances of having access to and lowering the rates of healthcare hence lowering the cost of healthcare, particularly in places with less resources where degu fever is very common.

3. Better Patient Outcomes: ML capabilities of a proper detection helps to avoid problems and reduce severe conditions of the illness. A reduction on numbers of hospitalizations, mortality rates, and increased favorable outcomes to patients are discovered using this approach.

4. Reducing the Burden on Healthcare Systems: It is in those regions in which dengue fever is prevalent that epidemics are particularly worrisome as they are capable of putting a great amount of pressure on healthcare systems. Through the proper identification of the patients and the effective management of the disease, ML-driven diagnosis could ease the burden for the health care system and allows overuse to be avoided.

5. Prediction and Prevention: ML algorithms for forecasting an outbreak of dengue can use several variables, such as the historical records of the disease, population density, and environmental factors, in their calculations. Taking preventive actions which includes vector control programs and public health campaign is made possible by this which will yield to a stoppage of the disease spread.

Machine learning did a commendable job, and it would look good for more patients in the future. Additionally, this technology can be applied to prevent the deaths and the like burdens of this disease in society.

Dengue prediction report (1).pdf

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