Chapter 10
Quantum Computing for Dengue Fever Outbreak Prediction: Machine Learning and Genetic Hybrid Algorithms Approach

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ABSTRACT

Dengue virus infection originates from the Aedes mosquito species. The authors propose a novel paradigm to revolutionize dengue fever detection and recommendation systems by leveraging the potential of quantum computing. Using meteorological data and past dengue cases, they create a prediction framework that goes beyond traditional constraints. Quantum machine learning methods are proposed for discovering hidden patterns within enormous datasets, allowing them to identify detailed relationships between environmental conditions and illness occurrences. Traditional machine learning algorithms are all part of our strategy. Quantum optimization techniques further optimize these models, enhancing predictive accuracy while minimizing resource consumption. As we navigate challenges such as data integrity, model validation, and quantum hardware constraints, interdisciplinary collaboration between epidemiologists, quantum scientists, and healthcare experts becomes paramount. The analytical results from data show improvement in more cases of dengue prediction in the various districts of Tamil Nadu.

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Table 1. Dengue affected districts

S.No.	Most Dengue affected districts	Number of Dengue Cases
1	Coimbatore	159
2	Erode	109
3	Chennai	543
4	Kanyakumari	140
5	Dharmapuri	272
6	Vellore	159
7	Kanchipuram	216
8	Thanjavur	13
9	Madurai	65
10	Tirunelveli	93

1. INTRODUCTION

Dengue, also referred to as Dengue fever or Break-bone fever stands as a prime example of the global health challenges we face. The dengue virus, carried by the Aedes mosquito, is a major reason for concern because of its fast spread and devastating effects on human health (R. Vijay Sai, S. Madhiarasi, S Keerthana, S Preethi, 2020). The world is facing a pressing need for innovative solutions, and this is where quantum computing enters the scene. In the intricate realm of disease dynamics, the four closely intertwined dengue virus strains - DEN-1, DEN-2, DEN-3, and DEN-4 - play a pivotal role in the complex interplay between the virus and its hosts. In 2013, DEN-5 emerged, adding another layer of complexity to the disease landscape. As the World Health Organization reports, every year, tens of millions of individuals are afflicted by dengue infections, a statistic that strikingly encompasses nearly half of the Earth's population. The southern Indian states are most affected, due to poor rainfall and power supply. The various districts of Tamil Nadu such as Coimbatore, Erode, Chennai, Kanyakumari, Dharmapuri, Vellore, Kanchipuram, Thanjavur, Madurai, Tirunelveli are affected due to the poor rainfall. The average number of dengue cases in most dengue-affected districts of Tamil Nadu is mentioned in the given Table 1 (P. Siriyasatien, S. Chadsuthi, K. Jampachaisri, K. Kesorn, 2018).

This quantum era brings both opportunities and challenges. Quantum computers harness the power of qubits and quantum gates to tackle problems considered intractable for classical computers. These quantum systems can analyze massive datasets with unparalleled speed, offering potential breakthroughs in disease modelling and prediction.

Dengue's vector, the Aedes mosquito, thrives in specific environmental conditions influenced by factors such as temperature, humidity, and precipitation. In the world of quantum computing, these factors can be analyzed concurrently, enabling us to discern intricate patterns that contribute to disease transmission. Quantum machine learning algorithms can unearth hidden correlations, offering insights into how climate change and human behaviour impact the disease's spread (Wu PC, Guo HR, Lung SC, Lin CY, Su HJ, 2007).