Chapter 16
Intelligent Healthcare Provisioning in Fog Using Grey Wolf Optimization

Rajalakshmi Shenbaga Moorthy
https://orcid.org/0000-0003-3297-6123
Sri Ramachandra Institute of Higher Education and Research, India

K. S. Arikumar
VIT-AP University, India

Sahaya Beni Prathiba
Vellore Institute of Technology, Chennai, India

P. Pabitha
Anna University, India

ABSTRACT

The increasing population rate plays a vital role in bringing challenges in the provisioning of health care. The data was initially collected and kept in the cloud, where the machine learning algorithm was run on the data and decisions were then transmitted back to the client device. This incurs a significant delay for transferring the data and getting back the result. Thus, in this chapter, fog layer is introduced between device layer and cloud layer for processing the sensor data. The introduction of fog layer tends to minimize the delay incurred by the cloud, as analyzing the health data is close to the device that generates the data. For conducting the best analytics on health data received from sensors, the grey wolf optimization (GWO)-based k-nearest neighbor (K-NN) is proposed. GWO K-NN is integrated in the fog nodes, which is close to the device generating the health data, thereby providing timely decisions. The proposed GWO K-NN works on the fitness of accuracy and misclassification rate of K-NN, and it models the hunting behavior of wolves.

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INTRODUCTION

The World wide web, a marvel of human innovation, has dominated a number of industries, including enterprise, academia, governance, information science, electrical engineering, networking, and telecommunications, among many others (Chitra and Jayalakshmi, 2021). In the current technological period, the domains of computer science, electronics, and telecommunication are being integrated to create a new technical field called "Internet of Things (IoT)" (Miraz et al., 2015 and Paul et al., 2018). The Web of Things is a great advance in web 2.0 that is bringing daily fluctuations to everyone's lives, regardless of whether they're aware of it or not. The IoT makes an effort to collect and transmit data so that analytics may be performed on it and possibly produce useful insights. The development of IoT has given researchers the opportunity to come up with a workable solution for widespread healthcare applications. A person in a far-off place can haphazardly find a trustworthy solution at a reasonable price. The fast development of three sectors, including cloud technology, mobile applications, and wearables, has changed the way that health care is traditionally provided in favor of more advanced, ubiquitous health care (Arikumar et al., 2022 and Chen et al., 2017).

Smart health care system is essential as it does restrict the person to utilize the benefits of health care from anywhere particularly during pandemic conditions. Various IoT devices embedded in the human body generates data periodically thereby massive amount of data is collected which needs to be analyzed carefully for potential insights (Manogaran et al., 2017 and MA et al., 2018). Traditionally, the analytics process often happens in the centralized cloud computing that may incur delay which is crucial. As, timely decision is essential in any health care application, in this paper Fog Computing is used which can perform analytics at the edge servers thereby minimizing the delay.

Wearable device data will be analyzed by machine learning techniques to produce insights (Arikumar and Natarajan 2020). Several machine learning techniques are available for processing the data, including supervised algorithms that may process data with class labels, unsupervised algorithms that try to cluster the data, and semi-supervised algorithms that operate on a reward or penalty basis (Magoulas, 1999 and Obermeyer, 2016). The hyperparameters have a significant impact on how well the machine learning model performs. The optimal value chosen for the hyperparameter prevents the machine learning model from overfitting. Choosing optimal value for the hyperparameter is often a serious research issue. In this study, the sensitive health data are analyzed using the non-parametric technique K-Nearest Neighbor (K-NN). The value of K in K-NN has an impact on changing the true positives to true negatives which is really a serious challenge. Consequently, in order to improve the decision, it is crucial to identify the ideal value of K.

Metaheuristic algorithms are one such way of finding the optimal values for NP-Hard problems (Dietterich, 2000). Hyperparameters of machine learning algorithms can be found using metaheuristic algorithms. Particle swarm optimization, ant colony optimization, Firefly optimization technique, etc. are a few examples of metaheuristic algorithms. There is room for improvement because no algorithm is effective for all real-world challenges. Thus, in this research the authors had used Grey Wolf Optimization to find the optimal value for K in K-NN. Exploration and Exploitation are the two main factors of metaheuristic algorithms which prevents from falling in local optima. For the purpose of determining the ideal value of K, GWO makes use of the positions of the three best wolves.

Following is a list of the paper's primary contributions:

A Heuristic Meta Scheduler for Optimal Resource Utilization and Improved QoS in Cloud Computing Environment
R. Jeyaraniand N. Nagaveni (2012). *International Journal of Cloud Applications and Computing (pp. 41-52).*
www.irma-international.org/article/heuristic-meta-scheduler-optimal-resource/64634