

INTISARI

Peningkatan prevalensi penyakit *diabetes mellitus* secara global berdampak pada kenaikan angka penderita komplikasi kaki diabetik dan resiko amputasi. Termografi merupakan perangkat elektronik pendeteksi suhu berbasis gelombang inframerah yang memiliki keunggulan bersifat non kontak, non invasif, non radiasi, dan pasif. Penelitian terdahulu menyatakan validitas dan akurasi yang tinggi terkait kolaborasi termografi dan kecerdasan buatan untuk sistem deteksi dini komplikasi kaki diabetik. Pada penelitian tesis ini dilakukan pengembangan algoritma *deep learning* untuk sistem deteksi dini komplikasi kaki diabetik menggunakan termografi dengan tujuan meminimalisasi jumlah parameter dengan mempertahankan kemampuan deteksi tetap tinggi yang merupakan kontribusi utama dari penelitian. Metode yang digunakan merupakan kombinasi antara *model compression* dengan konsep *teacher-student model* dan *Neural Architecture Search* (NAS) dengan model *auto-keras*. Metode *Neural Architecture Search* tersebut digunakan untuk merancang algoritma *Convolutional Neural Network* (CNN) berbasis *Multilayer Perceptron* (MLP) secara otomatis. Penelitian dilakukan untuk mencari kombinasi *teacher* dan *student model* terbaik yang mampu menghasilkan algoritma *Convolutional Neural Network* (CNN) berbasis *Multilayer Perceptron* (MLP) sebagai *student model* dengan jumlah parameter paling minimal dan parameter evaluasi tertinggi. Hasil penelitian menunjukkan algoritma *Convolutional Neural Network* berbasis *Multilayer Perceptron* dengan metode *neural architecture search* sebagai *teacher model* dan algoritma *Convolutional Neural Network* berbasis *Multilayer Perceptron* model 4 dengan metode perancangan manual (*from scratch*) sebagai *student model* merupakan kombinasi *teacher-student* terbaik yang mampu menghasilkan *student model* dengan jumlah parameter paling minimal (1.570.594 juta) dan parameter evaluasi tertinggi (100%) pada data primer. Pada data sekunder, meskipun mengalami *underfitting*, model *MobileNetV2* sebagai *teacher model* dan algoritma *Convolutional Neural Network* berbasis *Multilayer Perceptron* dengan metode perancangan manual *from scratch* (model 4) sebagai *student model* merupakan kombinasi *teacher-student model* terbaik yang mampu menghasilkan *student model* dengan jumlah parameter paling minimal (1.570.594 juta) dan parameter evaluasi tertinggi (91%). Algoritma *Convolutional Neural Network* berbasis *Multilayer Perceptron* model 4 dengan metode perancangan manual *from scratch* sebagai *student model* memiliki total 19 *layers* dengan komposisi 6 *convolutional layer*, 6 *maxpooling layer*, 2 *hidden layer*, 3 *dropout layer*, 1 *flatten layer*, dan 1 *output layer* dengan kombinasi ukuran *filter* 3x3, 2x2, dan 1x1 serta 512, 1024, dan 2 *neurons*.

Kata kunci: kaki diabetik, termografi, *model compression*, *neural architecture search*

ABSTRACT

The increasing prevalence of diabetes mellitus globally has an impact on the increase in the number of patients with diabetic foot complications and the risk of amputation. Thermography is an electronic infrared wave-based temperature detection device that has the advantages of being non-contact, non-invasive, non-radiation, and passive. Previous research stated the validity and high accuracy related to the collaboration of thermography and artificial intelligence for the early detection system of diabetic foot complications. In this thesis research, the development of a deep learning algorithm for early detection system of diabetic foot complications using thermography with the aim of minimizing the number of parameters while maintaining high detection capability is the main contribution of the research. The method used is a combination of compression model with the concept of teacher-student model and Neural Architecture Search (NAS) with auto-keras model. The Neural Architecture Search method is used to automatically design a Multilayer Perceptron (MLP) based Convolutional Neural Network (CNN) algorithm. The research was conducted to find the best combination of teacher and student model that can produce Convolutional Neural Network (CNN) algorithm based on Multilayer Perceptron (MLP) as a student model with the least number of parameters and the highest evaluation parameters. The results showed that the Convolutional Neural Network algorithm based on Multilayer Perceptron with neural architecture search method as a teacher model and Convolutional Neural Network algorithm based on Multilayer Perceptron model 4 with manual design method (from scratch) as a student model are the best teacher-student combinations that can produce student models with the least number of parameters (1,570,594 million) and the highest evaluation parameters (100%) on primary data. In secondary data, despite underfitting, the MobileNetV2 model as a teacher model and the Multilayer Perceptron-based Convolutional Neural Network algorithm with the manual design method from scratch (model 4) as a student model is the best teacher-student model combination capable of producing student models with the least number of parameters (1,570,594 million) and the highest evaluation parameters (91%). Convolutional Neural Network algorithm based on Multilayer Perceptron model 4 with manual design method from scratch as a student model has a total of 19 layers with a composition of 6 convolutional layers, 6 maxpooling layers, 2 hidden layers, 3 dropout layers, 1 flatten layer, and 1 output layer with a combination of 3x3, 2x2, and 1x1 filter sizes and 512, 1024, and 2 neurons.

Keywords: diabetic foot, termography, model compression, neural architecture search