

ABSTRAK

Monitoring infus merupakan bagian penting dalam pelayanan kesehatan untuk memastikan terapi cairan intravena berjalan sesuai kebutuhan pasien. Pemantauan yang masih dilakukan secara manual berpotensi meningkatkan beban kerja tenaga medis dan menyebabkan keterlambatan dalam mendeteksi perubahan laju tetesan maupun habisnya cairan infus. Penelitian ini bertujuan merancang dan mengimplementasikan sistem monitoring infus berbasis *Internet of Things* (IoT) menggunakan metode *Decision Tree* untuk mendeteksi kondisi laju tetesan infus dan memprediksi waktu habis cairan infus secara *real-time*. Sistem dikembangkan menggunakan mikrokontroler ESP32, sensor *photoelectric infrared module* untuk mendeteksi laju tetesan infus, dan sensor *load cell* yang terhubung dengan modul HX711 untuk mengukur sisa cairan infus. Data sensor diolah menggunakan *Decision Tree Classifier* untuk mengklasifikasikan kondisi infus menjadi normal, cepat, lambat, dan macet, serta *Decision Tree Regressor* untuk memprediksi waktu habis cairan infus. Kinerja model klasifikasi dievaluasi menggunakan *5-Fold Cross Validation*, sedangkan model regresi dievaluasi menggunakan koefisien determinasi (R^2) dan *Mean Absolute Error* (MAE). Hasil pengujian menunjukkan model klasifikasi memperoleh rata-rata akurasi sebesar 90,40%, sedangkan model regresi menghasilkan nilai R^2 sebesar 97,05%. Prediksi waktu habis cairan infus memperoleh MAE sebesar 5,75 menit atau sekitar 345 detik terhadap waktu aktual. Sistem mampu menampilkan kondisi infus dan estimasi waktu habis secara *real time* melalui LCD serta mengirimkan notifikasi otomatis melalui Telegram. Hasil penelitian menunjukkan bahwa sistem yang dikembangkan mampu monitoring infus secara *real time* dengan menyediakan informasi yang akurat dan responsif bagi tenaga medis.

Kata Kunci: *Internet of Things* (IoT), monitoring infus, *Decision Tree*, ESP32, sensor inframerah, *load cell*.



ABSTRACT

Intravenous (IV) infusion monitoring is an essential aspect of healthcare services to ensure that intravenous fluid therapy is administered according to patients' needs. Manual monitoring may increase the workload of healthcare professionals and lead to delays in detecting changes in infusion drip rate or the depletion of infusion fluids. This study aims to design and implement an Internet of Things (IoT)-based infusion monitoring system using the Decision Tree method to detect infusion drip rate conditions and predict the remaining infusion time in real time. The proposed system was developed using an ESP32 microcontroller, a photoelectric infrared module to detect the infusion drip rate, and a load cell sensor integrated with an HX711 module to measure the remaining infusion fluid. Sensor data were processed using a Decision Tree Classifier to classify infusion conditions into normal, fast, slow, and blocked categories, while a Decision Tree Regressor was employed to predict the remaining infusion time. The classification model was evaluated using 5-Fold Cross Validation, whereas the regression model was assessed using the coefficient of determination (R^2) and Mean Absolute Error (MAE). Experimental results showed that the classification model achieved an average accuracy of 90.40%, while the regression model obtained an R^2 value of 97.05%. The prediction of infusion completion time achieved an MAE of 5.75 minutes, equivalent to an average prediction error of approximately 345 seconds compared with the actual completion time. The system is capable of displaying infusion status and estimated completion time in real time via an LCD and sending automatic notifications through Telegram. Overall, the proposed system improves the effectiveness of infusion monitoring by providing accurate and responsive information to healthcare professionals.

Keywords: Internet of Things (IoT), infusion monitoring, Decision Tree, ESP32, infrared sensor, load cell.

