ABSTRAK

Flatfoot merupakan kondisi penurunan lengkungan telapak kaki yang dapat memengaruhi distribusi tekanan pada telapak kaki saat berdiri maupun berjalan. Identifikasi kondisi *flatfoot* secara dini diperlukan untuk membantu proses pemantauan dan evaluasi kondisi telapak kaki. Penelitian ini bertujuan merancang dan mengimplementasikan sistem *smart insole* berbasis *Internet* of *Things* (IoT) yang memanfaatkan sensor *Force Sensitive Resistor* (FSR) dan algoritma *decision tree* untuk memantau distribusi tekanan telapak kaki serta mengklasifikasikan kondisi *flatfoot* secara otomatis. Sistem menggunakan empat sensor FSR yang ditempatkan pada area *heel*, metatarsal kiri, metatarsal kanan, dan *midfoot*. Data tekanan dibaca oleh mikrokontroler ESP32, diolah menjadi persentase distribusi tekanan, kemudian dikirim menggunakan protokol MQTT. Selanjutnya, data diproses menggunakan algoritma *decision tree* untuk mengklasifikasikan kondisi telapak kaki ke dalam kategori Normal atau *Flatfoot*. Hasil klasifikasi dan data sensor disimpan pada database MongoDB serta ditampilkan melalui *dashboard* berbasis Flask secara *real-time*. Hasil pengujian menunjukkan bahwa sensor FSR mampu mengukur distribusi tekanan pada setiap titik pengukuran dengan baik. Model *decision tree* memperoleh nilai *accuracy*, *precision*, *recall*, dan *F1-score* sebesar 100%, sedangkan pengujian terhadap 10 data uji menunjukkan tingkat kesesuaian klasifikasi sebesar 100%. Pengujian *usability* menggunakan *System Usability Scale* (SUS) memperoleh skor rata-rata 72 yang termasuk kategori "*Good"* dengan tingkat penerimaan *Acceptable*. Pengujian fungsional juga menunjukkan seluruh fitur sistem, komunikasi MQTT, penyimpanan MongoDB, dan *dashboard* Flask berjalan sesuai rancangan. Berdasarkan hasil tersebut, sistem *smart insole* berbasis IoT yang dikembangkan mampu memantau distribusi tekanan telapak kaki dan mendeteksi kondisi *flatfoot* secara *real-time*.

Kata kunci**:** *Smart Insole*, *Flatfoot*, *Force Sensitive Resistor*, *Internet of Things*, *Decision tree*, ESP32, MQTT, MongoDB, Flask.

ABSTRACT

*Flatfoot is a condition of decreased arch of the foot that can affect the distribution of pressure on the sole of the foot when standing and walking. Early identification of flatfoot is necessary to assist the process of monitoring and evaluating the condition of the sole of the foot. This research aims to design and implement an Internet of Things (*IoT*)-based Smart insole system that utilizes Force Sensitive Resistor (*FSR*) sensors and Decision Tree algorithms to monitor the distribution of pressure on the sole of the foot and classify flatfoot conditions automatically. The system uses four* FSR *sensors placed on the heel, left metatarsal, right metatarsal, and midfoot areas. Pressure data is read by an* ESP32 *microcontroller, processed into a percentage of pressure distribution, and then sent using the MQTT protocol. Next, the data is processed using a Decision Tree algorithm to classify the condition of the sole of the foot into the Normal or Flatfoot category. The classification results and sensor data are stored in a MongoDB database and displayed through a Flask-based web dashboard in real-time. Test results show that the* FSR *sensor is able to measure pressure distribution at each measurement point well. The Decision Tree model achieved 100% accuracy, precision, recall, and F1-score, while testing on 10 test data showed a classification suitability level of 100%. Usability testing using the System Usability Scale (SUS) obtained an average score of 72, which is included in the "Good" category with an Acceptable acceptance level. Functional testing also showed that all system features, MQTT communication, MongoDB storage, and the Flask dashboard run as designed. Based on these results, the developed* IoT*-based Smart insole system is able to monitor the distribution of foot pressure and detect flatfoot conditions in real-time.*

Keywords**:** *Smart Insole, Flatfoot, Force Sensitive Resistor, Internet of Things, Decision tree,* ESP32*,* MQTT*, MongoDB, Flask*.