**ABSTRACT** 

Individuals with Down Syndrome are at high risk of disorientation due to cognitive and

communication limitations. These challenges can lead to emergency situations such as getting

lost or being unable to ask for help. Based on interviews with parents of individuals with Down

Syndrome, incidents of disorientation have occurred and caused significant concern. Therefore,

a system capable of real-time movement monitoring is needed as a mitigation solution. The

main problem addressed in this study is the lack of a tracking device that can monitor the

location and physical activity of individuals with Down Syndrome securely, efficiently, and

accessibly via a mobile application.

The proposed solution is to design and develop an Internet of Things (IoT)-based tracking

system using GPS sensors, the MPU6050 accelerometer, the DHT22 temperature and humidity

sensor, and an ESP32 microcontroller. The system transmits data in real-time using the MQTT

protocol over a cellular network through the SIM7600G module, and displays the data through

a cross-platform mobile application developed with Flutter. To predict physical activity, a

Support Vector Machine (SVM) model is used, while data security is ensured with AES-GCM

encryption so that only authorized parties can access the user's information.

The developed IoT-based GPS tracker system successfully fulfilled the primary research

objective, which is to monitor the movement of individuals with Down Syndrome in real time.

The system reliably reads and transmits sensor data using the MQTT protocol, with latency

and power consumption remaining within acceptable limits for daily monitoring. The Support

Vector Machine (SVM) model with a window size of 5 achieved the highest classification

accuracy of 82.8% in activity prediction. Data security is guaranteed through AES-GCM

encryption with processing times under 0.5 milliseconds, and payloads were confirmed

unreadable in Wireshark tests. The mobile application demonstrated stable performance with

an average latency of 2 seconds, and received positive feedback from 64 respondents, scoring

above 4.8 in UI/UX evaluation. These results indicate that the system meets the technical

specifications and has been well received by end users.

Keywords: AES-GCM, Down Syndrome, IoT, MQTT, SVM

vi