

ABSTRAK

RANCANG BANGUN TONGKAT TUNANETRA DENGAN PENERAPAN METODE FUZZY SUGENO MENGGUNAKAN SENSOR *TIME-OF-FLIGHT* DAN *WATER LEVEL* DENGAN OUTPUT SUARA

(Nadhifa Nur Sahla 2026 : 179)

Penyandang tunanetra menghadapi kendala dalam mendeteksi hambatan dan genangan air saat bermobilitas karena tongkat konvensional hanya dapat mendeteksi rintangan setelah terjadi kontak fisik. Penelitian ini bertujuan merancang dan membangun tongkat tunanetra berbasis Sensor *Time-of-Flight* VL53L0X dan sensor *Water Level* dengan metode Fuzzy Sugeno untuk mendeteksi hambatan dan genangan air serta memberikan peringatan suara kepada pengguna. Sistem menggunakan mikrokontroler ESP32 sebagai pengendali utama, sensor *Time-of-Flight* VL53L0X sebagai pendeteksi jarak, sensor *Water Level* sebagai pendeteksi genangan air, serta DFPlayer Mini dan speaker sebagai keluaran suara. Data dari kedua sensor diproses melalui tahapan fuzzifikasi, inferensi, dan defuzzifikasi menggunakan metode Fuzzy Sugeno untuk menghasilkan empat kategori keputusan, yaitu Aman, Ada Halangan di Depan, Terdapat Genangan Air, dan Bahaya di Depan. Hasil pengujian menunjukkan bahwa sensor *Time-of-Flight* memiliki rata-rata error sebesar 0,52%, sensor *Water Level* mampu menghasilkan data yang konsisten sebagai masukan sistem fuzzy, dan seluruh komponen sistem bekerja secara terintegrasi serta real-time. Berdasarkan hasil pengujian, alat yang dirancang mampu mendeteksi hambatan dan genangan air serta memberikan peringatan suara yang sesuai sehingga dapat membantu meningkatkan keamanan dan kemandirian penyandang tunanetra dalam beraktivitas sehari-hari.

Kata Kunci: Tongkat Tunanetra, ESP32, Sensor *Time-of-Flight* , Sensor *Water Level*, Fuzzy Sugeno, Output Suara.

ABSTRACT

DESIGN AND IMPLEMENTATION OF A SMART WHITE CANE FOR VISUALLY IMPAIRED PEOPLE USING THE FUZZY SUGENO METHOD BASED ON TIME-OF-FLIGHT AND WATER LEVEL SENSORS WITH VOICE OUTPUT

(Nadhifa Nur Sahla 2026 : 179)

Visually impaired individuals face challenges in detecting obstacles and water puddles during mobility because conventional canes can only detect obstacles after physical contact occurs. This study aims to design and develop a smart cane for visually impaired individuals based on the Time-of-Flight VL53L0X sensor and Water Level sensor using the Fuzzy Sugeno method to detect obstacles and water puddles and provide voice warnings to users. The system utilizes an ESP32 microcontroller as the main controller, a Time-of-Flight VL53L0X sensor for distance detection, a Water Level sensor for water puddle detection, and a DFPlayer Mini and speaker as audio output devices. Data from both sensors are processed through fuzzification, inference, and defuzzification stages using the Fuzzy Sugeno method to produce four decision categories, namely Safe, Obstacle Ahead, Water Puddle Detected, and Danger Ahead. The testing results show that the Time-of-Flight sensor has an average error of 0.52%, the Water Level sensor is capable of producing consistent data as input for the fuzzy system, and all system components operate in an integrated and real-time manner. Based on the testing results, the designed device is capable of detecting obstacles and water puddles and providing appropriate voice warnings, thereby helping to improve the safety and independence of visually impaired individuals in their daily activities.

Keywords: *Smart Cane for the Visually Impaired, ESP32, Time-of-Flight (Time-of-Flight) Sensor, Water Level Sensor, Fuzzy Sugeno, Voice Output.*