# ABSTRACT

*Studies on enemy artificial intelligence in games commonly apply a single control algorithm, such as Finite State Machine (FSM) or Behavior Tree (BT), which often results in predictable and less structured Non-Player Character (NPC) behavior. In a 2D RPG game Monster Attack, a hybrid approach combining FSM and BT is applied to improve the structuring and consistency of enemy behavior control. The development process follows the Game Development Life Cycle (GDLC), consisting of initiation, pre-production, production, alpha testing, and beta testing stages. FSM is utilized to manage basic states and rapid transitions, while BT controls decision-making based on gameplay conditions. Alpha testing is conducted using Blackbox Testing to verify functional correctness and state transitions of NPC behavior. Beta testing is carried out through playtesting involving five external players based on the Nielsen–Landauer approach, using a Likert-scale questionnaire to evaluate visual appearance, control, mission clarity, NPC behavior response, gameplay enjoyment, and difficulty balance. The results show feasibility index values ranging from 68% to 96%, with an overall beta testing score of 86%, categorized as "Very Good." These results indicate that the hybrid FSM and BT approach can be implemented consistently to control NPC enemy behavior and support a positive gameplay experience in RPG games.*

*Keywords* : Behavior Tree, Finite State Machine, GDLC, NPC, RPG

# ABSTRAK

Penelitian sebelumnya mengenai kecerdasan musuh dalam game umumnya menerapkan satu algoritma pengendali perilaku, seperti Finite State Machine (FSM) atau Behavior Tree (BT), sehingga perilaku Non-Player Character (NPC) cenderung mudah diprediksi dan kurang terstruktur. Pada game RPG 2D *Monster Attack*, diterapkan kombinasi algoritma FSM dan BT untuk mengontrol perilaku NPC musuh secara lebih sistematis. Proses pengembangan game mengikuti tahapan Game Development Life Cycle (GDLC) yang meliputi inisiasi, pra-produksi, produksi, pengujian alpha, dan pengujian beta. FSM digunakan untuk mengatur state dasar dan transisi cepat perilaku musuh, sedangkan BT berperan dalam pengambilan keputusan berdasarkan kondisi permainan. Pengujian alpha dilakukan menggunakan metode Blackbox Testing untuk memverifikasi fungsionalitas mekanik permainan serta transisi state NPC. Pengujian beta dilakukan melalui playtesting dengan melibatkan lima pemain eksternal berdasarkan pendekatan Nielsen–Landauer, menggunakan kuesioner skala Likert untuk menilai aspek tampilan, kontrol, kejelasan misi, perilaku NPC, kesenangan bermain, dan keseimbangan tingkat kesulitan. Hasil pengujian menunjukkan nilai indeks kelayakan pada rentang 68%–96% dengan nilai keseluruhan sebesar 86% yang termasuk kategori "Sangat Bagus". Hasil tersebut menunjukkan bahwa kombinasi FSM dan BT dapat diterapkan secara konsisten untuk mengontrol perilaku NPC musuh pada game RPG.

**Kata kunci** : Behavior Tree, Finite State Machine, GDLC, NPC, RPG