

IMPLEMENTASI ALGORITMA SLAM PADA PEMBUATAN SISTEM NAVIGASI BERBASIS *AUGMENTED REALITY* DIDALAM RUANGAN

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ABSTRAK

Teknologi navigasi Global Positioning System (GPS) memiliki keterbatasan fundamental ketika digunakan di dalam ruangan (indoor) akibat ketidakmampuan sinyal satelit menembus struktur beton bangunan. Sebagai alternatif, metode navigasi berbasis sensor inersia (Dead Reckoning) sering digunakan, namun metode ini rentan terhadap fenomena drifting (akumulasi kesalahan posisi) yang menyebabkan penurunan akurasi seiring bertambahnya jarak tempuh. Penelitian ini bertujuan untuk mengembangkan sistem navigasi indoor berbasis *Augmented Reality* (AR) yang mengintegrasikan algoritma Simultaneous Localization and Mapping (SLAM) menggunakan *Google Cloud Anchors* API untuk mengatasi masalah drifting tersebut. Sistem dibangun menggunakan Unity Game Engine dan ARCore Extensions pada platform Android. Pengujian dilakukan di koridor Gedung A Institut Teknologi PLN menggunakan metode eksperimen komparatif pada tiga skenario jalur: Lurus (21 meter), Belokan L, dan Letter U. Hasil pengujian menunjukkan bahwa metode *Non-SLAM* (sensor inersia murni) mengalami rata-rata kesalahan posisi (*Root Mean Square Error* / RMSE) sebesar 15,87 meter pada lintasan lurus. Sebaliknya, metode *With SLAM* mampu menurunkan RMSE secara drastis menjadi 0,15 meter, yang setara dengan peningkatan akurasi sebesar 99,1%. Selain itu, metode SLAM terbukti efektif melakukan Loop Closure untuk mengenali kembali titik awal pada skenario lintasan memutar. Penelitian ini menyimpulkan bahwa integrasi fitur *Cloud Anchor* dapat menjadi solusi yang andal untuk meningkatkan stabilitas dan akurasi sistem navigasi dalam ruangan pada perangkat seluler.

Kata Kunci: *Augmented Reality, Indoor Navigation, SLAM, Google Cloud Anchor, Drifting, ARCore.*

IMPLEMENTATION OF SLAM ALGORITHM FOR THE DEVELOPMENT OF AN INDOOR AUGMENTED REALITY-BASED NAVIGATION SYSTEM

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ABSTRACT

Global Positioning System (GPS) navigation technology has fundamental limitations when used indoors due to the inability of satellite signals to penetrate building concrete structures. As an alternative, navigation methods based on inertial sensors (Dead Reckoning) are often used; however, this method is prone to the drifting phenomenon (accumulated position error), which causes a decrease in accuracy as travel distance increases. This study aims to develop an Augmented Reality (AR)-based indoor navigation system that integrates the Simultaneous Localization and Mapping (SLAM) algorithm using the Google Cloud Anchors API to address the drifting issue. The system was built using Unity Game Engine and ARCore Extensions on the Android platform. Testing was conducted in the corridor of Building A, Institut Teknologi PLN, using a comparative experimental method on three path scenarios: Straight (21 meters), L-Turn, and Letter U. The test results show that the Non-SLAM method (pure inertial sensors) experienced an average position error (Root Mean Square Error / RMSE) of 15.87 meters on the straight path. Conversely, the With SLAM method was able to drastically reduce the RMSE to 0.15 meters, equivalent to an accuracy improvement of 99.1%. Additionally, the SLAM method proved effective in performing Loop Closure to re-recognize the starting point in the turning path scenario. This study concludes that the integration of Cloud Anchor features can be a reliable solution to improve the stability and accuracy of indoor navigation systems on mobile devices.

Keywords: *Augmented Reality, Indoor Navigation, SLAM, Google Cloud Anchor, Drifting, ARCore.*