ABSTRACT

The advancement of automation technology is increasingly evident across various sectors, including service industries such as restaurants. One notable innovation that has begun to be widely implemented is the use of food delivery robots. This innovation aims to enhance efficiency and accuracy in service processes. However, deploying robots in dynamic environments like restaurants presents its own set of challenges. Changes in table positions, the movement of customers, and ever-shifting spatial conditions make navigation particularly complex. Conventional navigation systems, which rely heavily on fixed points and lack the ability to respond to real-time changes, often become major limitations.

To address these challenges, an intelligent navigation system based on Machine Learning has been developed, capable of mapping the environment in real-time. This system utilizes RPLiDAR sensors and the SLAM (Simultaneous Localization and Mapping) method to construct accurate and automated environmental maps. Data processing is handled by a Raspberry Pi, functioning as the central control unit. For path planning, the system combines the K-Nearest Neighbors (KNN) algorithm for environmental recognition and Breadth-First Search (BFS) for optimal route finding. Once the route is determined, it is refined using a smoothing technique to ensure the robot moves smoothly and avoids obstacles.

Based on testing results, the system was able to map two different environments with an accuracy of 99.55%, and achieved a localization accuracy of 99.29% through testing at 30 distinct coordinate points. The average measurement deviation was less than 5 cm, indicating precise navigation performance. The robot can determine the optimal path from the starting point to the destination efficiently and is capable of avoiding obstacles without collisions. In addition, the robot maintains a stable movement speed of approximately ±0.3 m/s, allowing for safe and responsive motion in reaction to changes in the surrounding environment. With these advantages, the navigation system has proven to enhance the reliability and effectiveness of the food delivery robot, particularly when operating in dynamic environments such as restaurants.

Keywords : *robot navigation, machine learning, SLAM, RPLiDAR, food delivery robot.*