Collaborative Maze Solving and Map Development via Gestural Communication Using Multiple Ground Robots

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A single robot can explore an unknown area autonomously, but multiple robots can do it quickly and reliably. However, current implementations of multiple autonomous robots rely on wireless interfaces or radio communication to transmit data, creating a security issue due to potential data interception. The greatest use of robots to explore unknown areas is in a defense application where exploration time is often limited and data manipulation is dangerous. Here, I developed a novel script based on swarm intelligence, mimicking the natural communication process of a bee's waggle dance, to securely transmit data between robots. Two Turtlebots were configured, programmed, equipped with tags and Kinect sensors, and placed inside a large physical maze where they communicated their map information through a series of dance rotations, resulting in a merged map. Both Turtlebots had different roles once they recognized each other inside the maze. One robot was responsible for communicating the map information through the dance and one robot was responsible for watching the dance. The dance script took an average time of 5 minutes to develop a map of the maze compared to 6.5 minutes for a single robot ($p<0.0001$). The collaboration method resulted in significantly reducing the time of map development for the entire maze. Furthermore, this approach operates without any wireless communication and offers a unique approach for unknown environment exploration.

Awards Won: