A Mesh Network-Integrated Multi-Robot Team With Electronic Nose for Human Detection Under Rubble in Post-Disaster Scenarios

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Catastrophic natural phenomena like earthquakes, hurricanes, and tsunamis have caused widespread devastation, resulting in significant loss of life and property damage. In 2023, during the Turkey-Syria Earthquake and Marrakesh-Safi Earthquake, nearly 210.000 people were injured and 65.000 people lost their lives due to the inability to be detected in time under the rubble. Search and rescue teams currently use accosting listening devices and radar units. But these technologies are immobile and difficult to reach because of their high cost. We observed these issues leading to fatalities as individuals. This inspired us to work on this problem. Our project aims to develop a heterogeneous robot team that collaborates to detect people under the rubble in post-disaster scenarios. Each robot type in our team is designed to meet the harsh conditions of the wreckage. We've developed a "station robot" to move on the rubble and carry our operation robots, and smaller robots called "operation robots" to move under the rubble and detect people. Operation robots have microphones to listen to sounds and an "electronic nose" that includes sensor arrays to detect human odors and other metabolic tracers during their biological activities. We've trained a machine-learning model to detect and track these tracers. Also communication and coordination are major problems in search and rescue operations. We've used mesh network topology for continuous and long range communication between our robots. We've developed a desktop application to display data of robots and detected human information to the search and rescue teams. We've tested our project in a real-like debris field. Overall, our project offers a low-cost and innovative solution for search and rescue operations.

Awards Won:
U.S. Agency for International Development: Second Award Working in Crisis and Conflict