

# Multi-agent LLM System for Robot Coordination and Communication

Vicky Lopez-Leanos, Priscilla Chau, Ellie Forness, Jonathan Granda Acaro, Paul Brenner, Charles Vardeman, The University of Notre Dame



UNIVERSITY OF  
NOTRE DAME



## Background and Motivation

The project aims to facilitate and map collaboration among large language models (LLMs) to the physical world to complete complex tasks. Specifically we utilize this mapping to streamline search and rescue operations, and reduce possible risks endangering human responders.

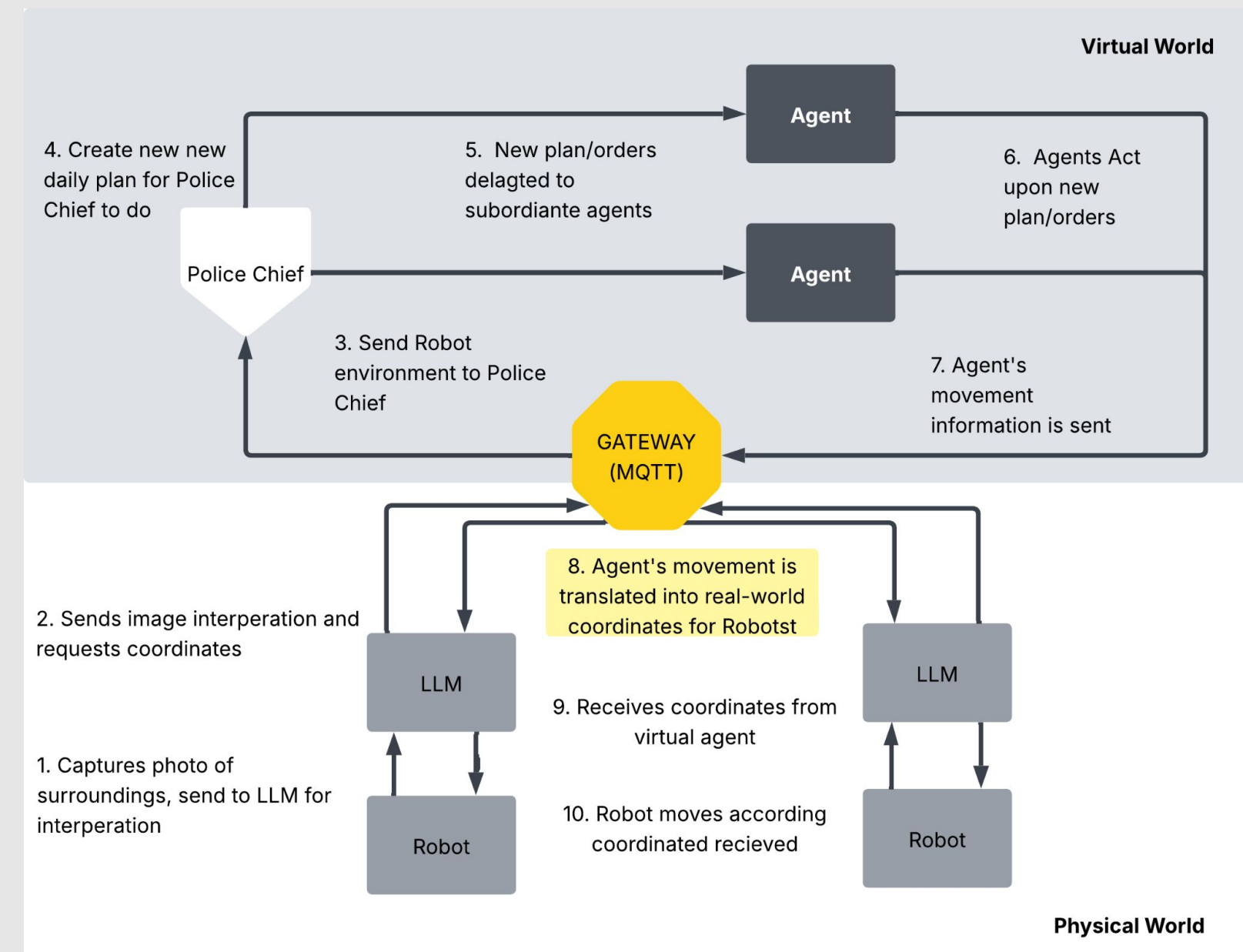
## System Design

In this research, there are two domains: the physical world and the virtual world. All robots live in the physical world and virtual-agents live on in the virtual world. Each virtual agent is a digital twin of its corresponding robot in the physical world.

Both robots and digital agents have the exact map that they perceive, but as the robots begin to move and interaction with their environments progresses, that information of the map gets reflected to the virtual world, and the virtual agents respond accordingly.

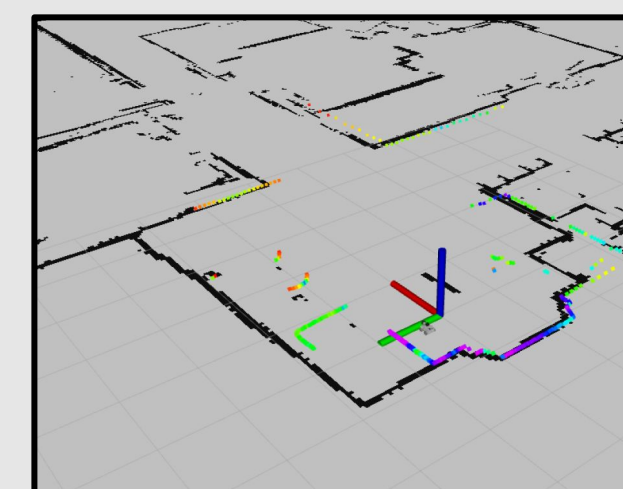
The virtual environment is built on the repository based on the paper "Generative Agents: Interactive Simulacra of Human Behavior." The physical system consists of ROS-compatible robot cars, taking advantage of their built-in ROS 2 support and the Nav2 navigation stack for robot coordination.

## Physical-Virtual World Convergence



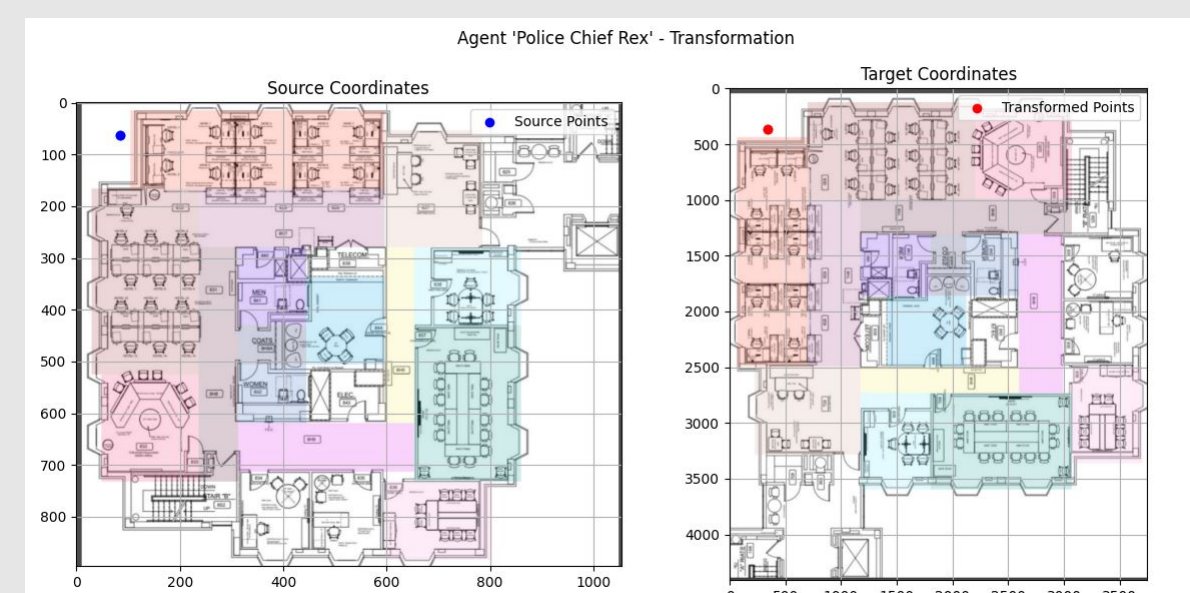
## Robot Procedure :

1. Load a prebuilt LiDAR map
2. Run live LiDAR for localization and obstacle detection
3. Navigate using the Nav2 stack
4. Send robot data via MQTT to the virtual planning system



Nav2 LiDAR Map

## Virtual world office map



## Results

This research helped prove the conventionality of using off the shelf products and tools to rapidly create and deploy custom solutions. Improved the visibility of the processes and components in the underlying systems. Compiled and centralized the system for knowledge transfer when onboarding new team-members

## Future Work

Moving forward there will be an increased emphasis on dynamic environment mapping both within the physical robots and virtual world. This shift aiming to improve real-time decision making and enhance adaptability of robot navigation through complex and changing terrain.

## Resources

### Robot functionality:

Yahboom MicroROS-Pi5 robot car

### Robot navigation:

Nav2: ROS 2 navigation framework

### LLM :

OpenAI's GPT- 4o

### Pub/Sub Server :

MQTT

