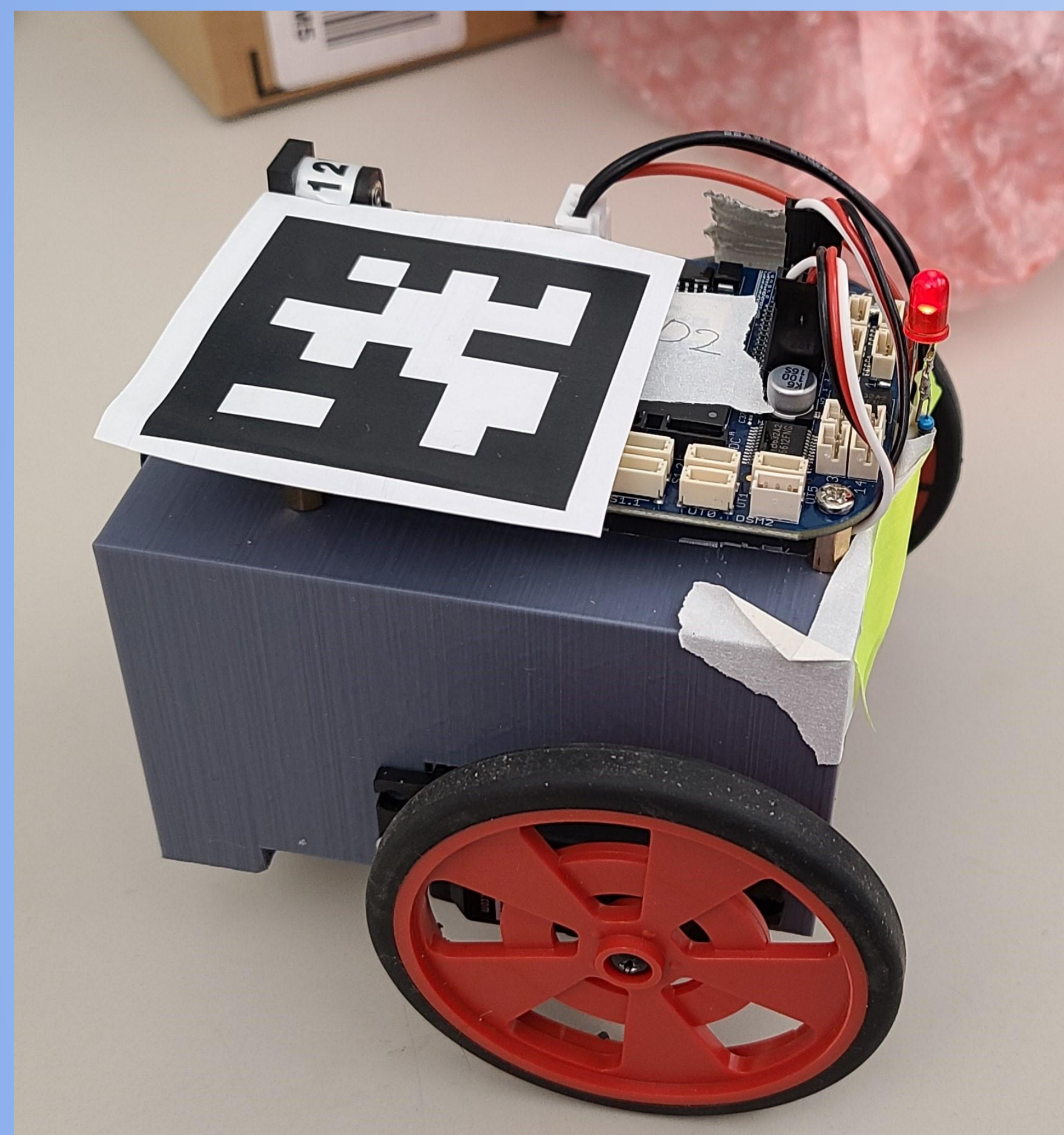


Swarm Robotics

Agents

- Beaglebone Blue
- Powered by a LiPo battery
- Custom 3D printed chassis
- MavLink UDP [1] over built-in WiFi
- Unique AprilTag ID number



One of the agents labeled with an AprilTag.

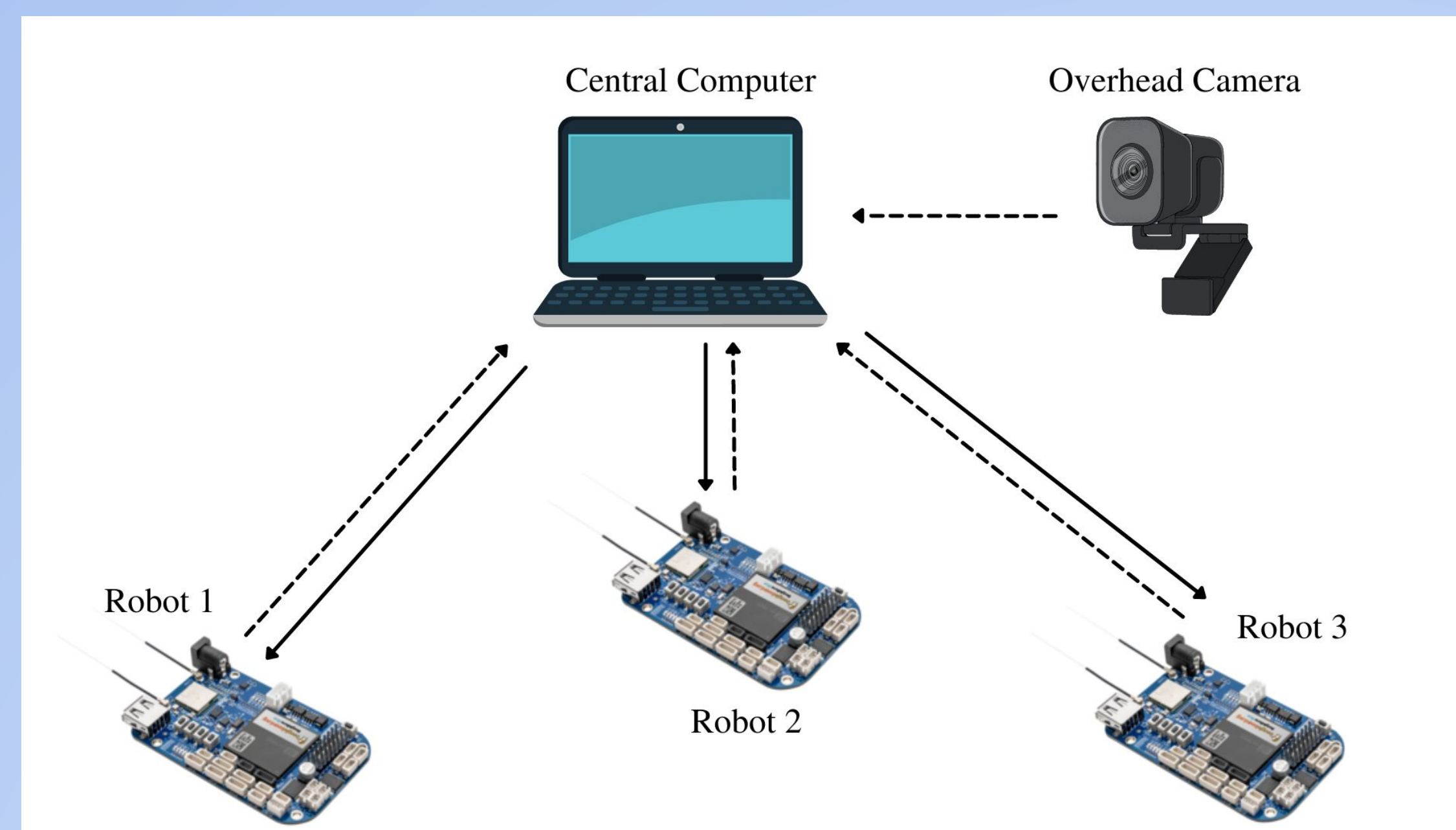
AprilTags[2]

- Similar to a QR code
- Holds a single number
- Used to locate agents in a camera feed
- Detectable regardless of rotation

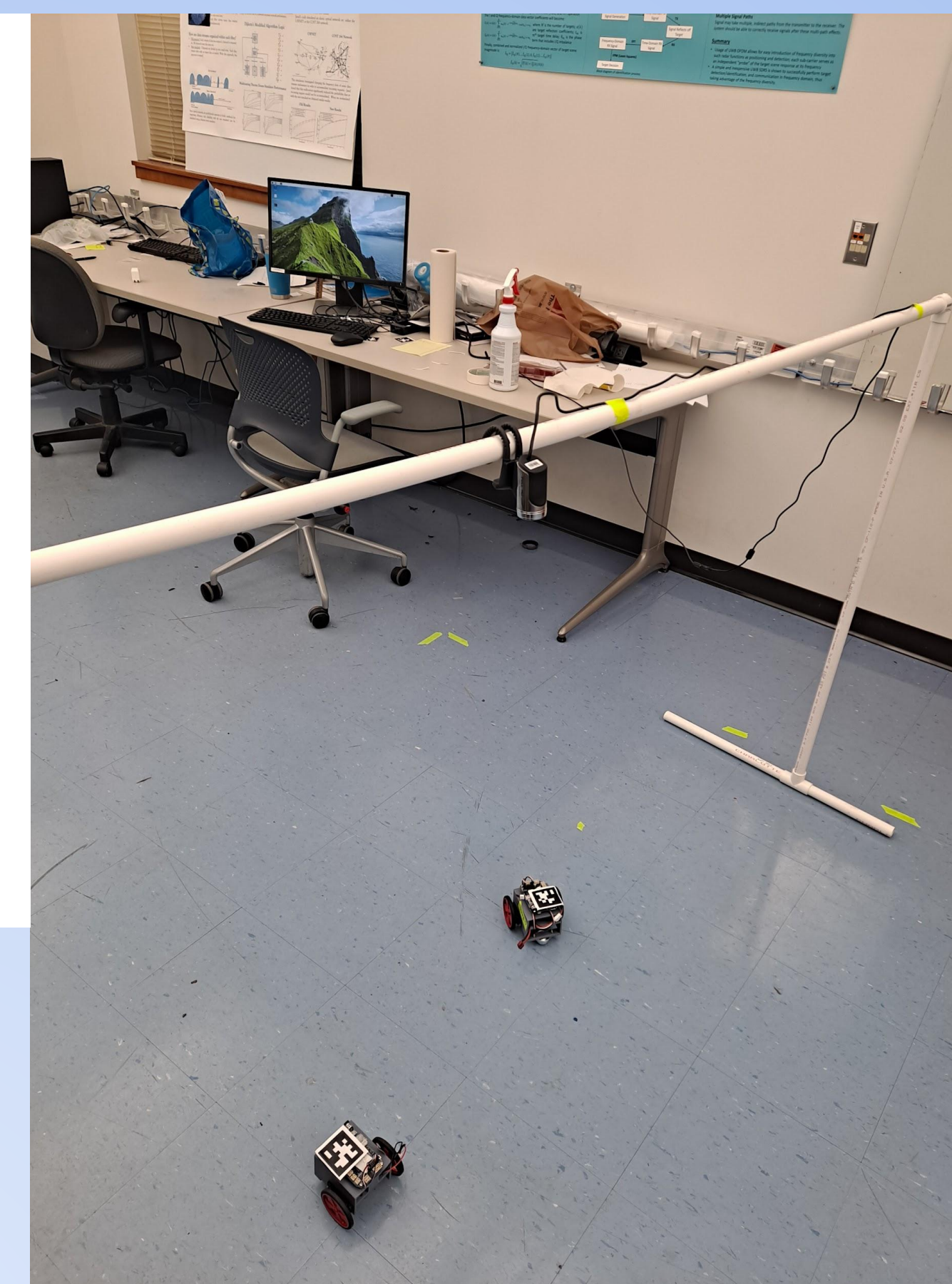


Github.com/Cole-Heng/Swarm_Robots

System Overview



(Left) Overview of how the system communicates.
(Right) The whole system setup.



Central Computer

Our central computer provides location and navigation to the agents using

- AprilTags [2]
- Wi-Fi
- Raspberry Pi 3B+
- Ausdom 12 MP 1920x1080p webcam

We conducted tests to characterize the system's ability to detect:

- A single tag at different heights
- # of tags at a fixed height with rotation
- # of tags at a fixed height without rotation

Demonstration

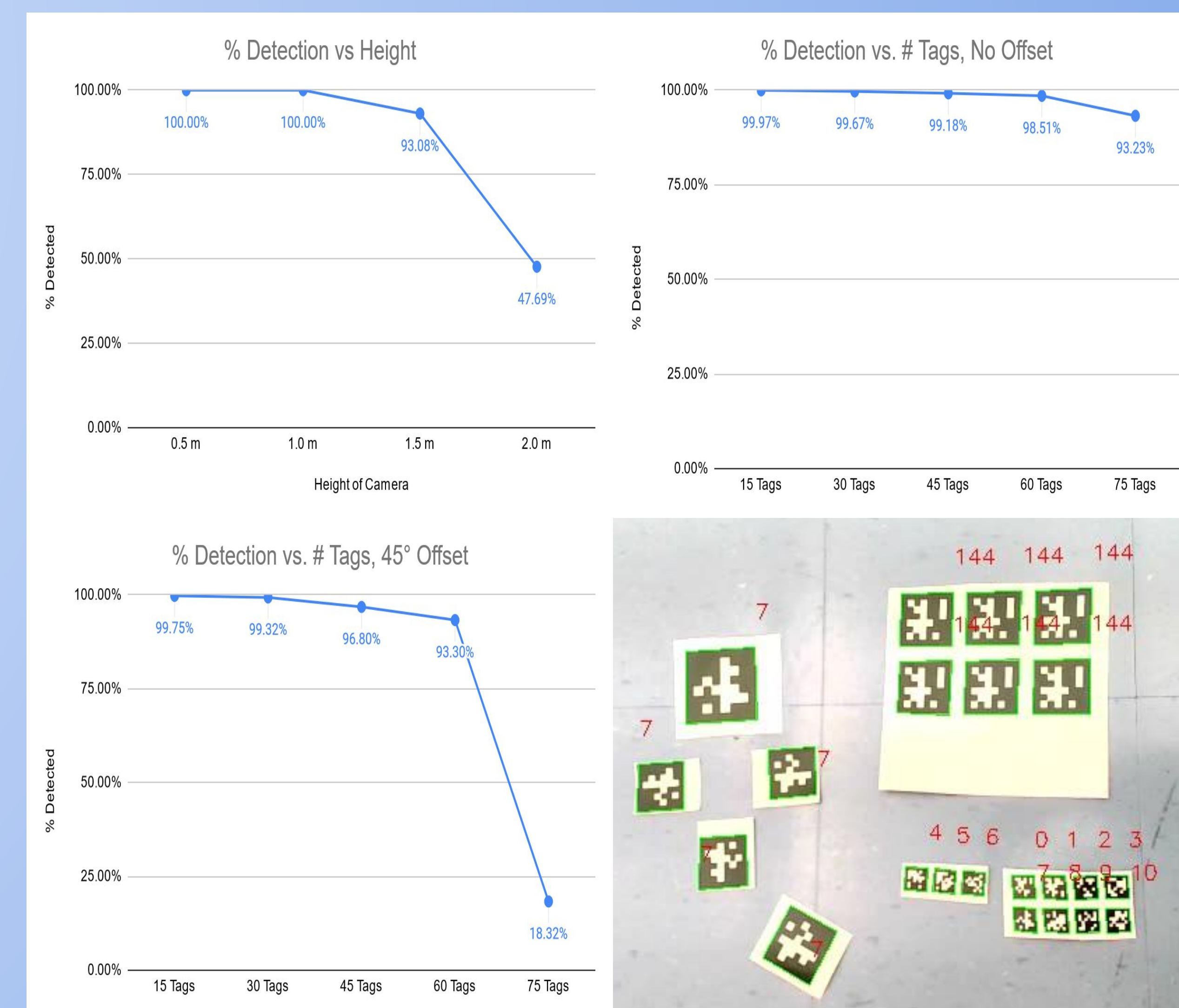
Angle offset between agent and its target
(left agent on top, right agent on bottom)



(Left) Camera's view with information overlaid.
(Right) long-exposure photo of agents moving on their path.

To demonstrate a working swarm we programmed two agents to drive in the shape of an "M" and a "U". The goals we met with this demonstration are:

- Developed the foundation of a swarm
- Utilized communications between agents and central computer
- Demonstrated independent movements of the agents
- Showed ability to control multiple agents to complete a task



Characterization of the camera and AprilTag system.
(TL) Frames detecting the tag vs height of camera. (TR) % of frames that detect all tags vs number of tags in the frame. (BL) % of frames that detect all tags vs number of tags with a 45° rotation. (BR) Demonstration of tags detected in a live camera feed.

Sources

[1] Mavlink, (2022) c_library_v2 (version 2) [Source code]. https://github.com/mavlink/c_library_v2

[2] AprilRobotics, (2022) apriltag (3.2.0) [Source code]. <https://github.com/AprilRobotics/apriltag>