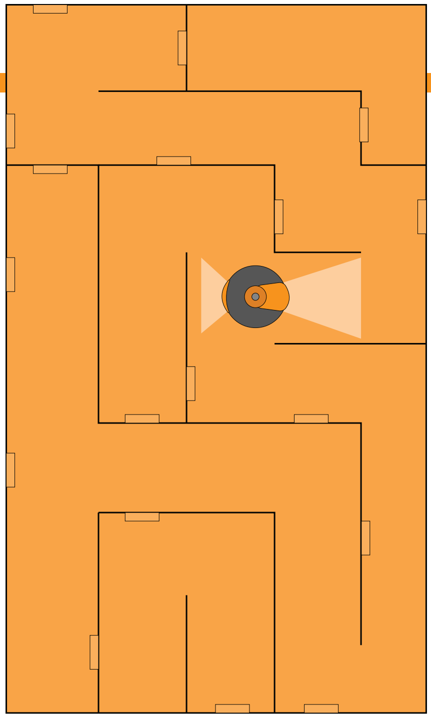
SENSORS

LOCATION/ORIENTATION

CONCEPT Robotic sensors for location and orientation are essential for enabling robots to navigate and interact with their environments effectively. These sensors provide critical information about the robot's position and orientation, allowing it to determine its location relative to other objects and navigate through complex environments. They enable robots to detect obstacles and avoid collisions, maintain their position and orientation, and perform tasks with high accuracy and precision. Without these sensors, robots would be unable to operate autonomously and would require constant human supervision, severely limiting their potential applications in areas such as manufacturing, transportation, and exploration.

BACKGROUND



Industrial robots in the 1960s used simple sensors such as limit switches and encoders to detect the position of their joints and end effectors. In the 1970s, ultrasonic sensors were developed, which used sound waves to detect the distance between the robot and surrounding objects. The 1980s saw the development of LIDAR sensors, which used lasers to create 3D maps of the robot's environment. GPS technology became widely available in the 1990s and was integrated into some robotic systems for navigation and positioning. In the 2000s, Inertial Measurement Units (IMUs) using accelerometers, gyroscopes, inclinometers and magnetometers enabled robots to accurately determine their orientation and movement in 3D space. In recent years, advances in machine learning and artificial intelligence have enabled robots to use sensor data to make more sophisticated decisions about their movements and interactions with their environment.

APPLICATION

An example of autonomous electric drones that use robotic sensors for location and orientation is Zipline. They have two different types of delivery platforms. One built for precise deliveries and the other built for long distance coverage areas. Their sensing technology has a range of over a mile which allows their drones to adapt their routes to avoid potential hazards during adverse weather both day and night.

Their fleet deconfliction software allows them to sense other drones in the area to avoid collisions and coordinate Zip traffic for strategic deconfliction (limiting congestion and optimizing movement). Coupled with their first-of-its-kind weather forecasting system, they can re-route during periods of incremental weather.

The on-board custom-built navigation components allow them to monitor current location down to a single centimeter. This allows their recovery system to “catch” the drone in mid-air and stop the aircraft in less than one second! Onboard maps help the drones navigate complex flight patterns and terrain to optimize speed and energy efficiency.

Make sure it measures up

DATA

POSITION DATA: Robot’s location in relation to a reference point or coordinate system, such as latitude and longitude or XYZ coordinates.

ORIENTATION DATA: Robot’s orientation, such as its pitch, yaw, and roll angles or its heading and bearing relative to a reference direction.

DISTANCE DATA: Distance between the robot and other objects in its environment, which may be measured using sensors such as LIDAR or ultrasonic sensors.

3D MAPPING DATA: Robot’s environment, such as its shape, size, and features, which may be created using sensors such as LIDAR, camera sensors, or depth sensors.

EXAMPLES

GPS (GLOBAL POSITIONING SYSTEM) SENSORS: These sensors use satellite signals to determine the robot’s latitude, longitude, and altitude.

LIDAR (LIGHT DETECTION AND RANGING) SENSORS: LIDAR sensors use lasers to measure the distance between the robot and surrounding objects, creating a 3D map of the environment that can be used to determine the robot’s location and orientation.

CAMERA SENSORS: Camera sensors capture images of the robot’s surroundings, which can be used to determine its position and orientation relative to known objects in the environment.