

# Internet of Robotics Things (IoRT) Based Integration of Robotic Applications for Advanced Research

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**ABSTRACT:** IoT and robotics industries are united to create the Internet of Robotics Things (IoRT). IoRT is the idea of intelligent machines monitoring the environment around them and using local and distributed intelligence to decide on courses of action and making decisions accordingly. IOT is a network of devices that are connected to the internet, including devices and equipment connected by sensors. These elements are essential for businesses trying to drive customer facing innovation, data-driven decisions, new applications, digital transformation, business models and revenue streams. Robots need to maintain great flexibility to react to unexpected conditions. AI helps these robots to deal with any unforeseen circumstances. Robotics and Simulation are key elements in the solutions of advancing manufacturing and production. Many people often think of IoT and robotics technologies in separate fields but they have been getting increasingly close in recent years. The In this way, such processes are used to avoid the loss of human life and the automation of processes which need high performances. Robotic and simulated application have been successfully deployed to functions in real world scenarios that man will not be able to accomplish such as study of volcanoes, and space center on its own. Furthermore, the robotic implementations give robots the opportunity to efficiently and safely function in the adverse conditions without being injured physically.

**Keywords:** Internet of Things, Internet of Robotic Things, IoT integrated Robotics, Robots in IoT Environment



## 1. INTRODUCTION

Internet of Things (IoT) devices and robots rely on sensors to gather information about their surroundings, analyze this information and make decisions accordingly. Robots are more qualified to deal with unforeseen circumstances, while IoT applications are limited to handling well-defined tasks. The main distinction between the robotics community and the IoT is that robots are active and operate in the real world. It happens. Besides, focus has shifted from the cyber component of the Internet of Things to the physical one and that's where the efforts are focused now.

Thus far, the robotics and IoT communities have been somewhat dominated by various yet closely related objectives. IOT focuses on supporting services, while robotic communities focus on production action, interaction and autonomy. By combining two ideas, the value would be increased.

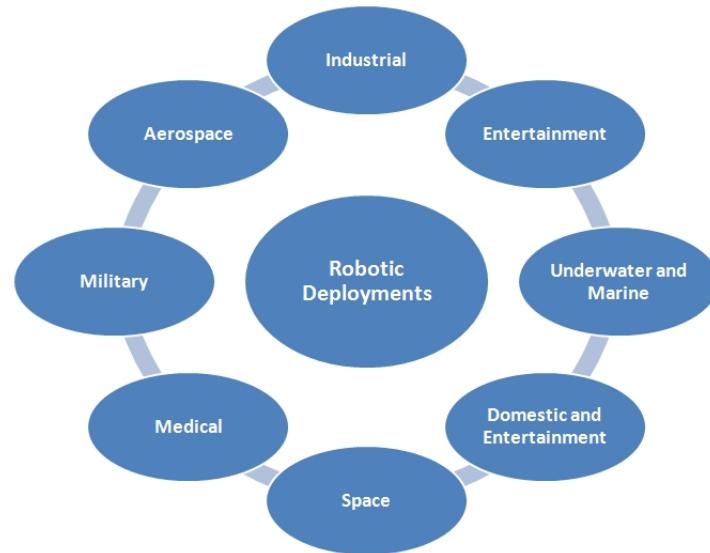
This was just how Internet of Robotic Things was conceived. Enhanced situational awareness allows robots to accomplish their task more effectively in the IoT sensor and data analytics technologies.

Automation is not a new idea, but it is becoming more popular with the rise in labor costs. By using robots in the workplace, we can boost overall productivity with the same number of workers.

As for IoT applications, they are able for both mobile and stationary applications. Some would stick to the program while others would change the program. The more sophisticated sensors that these robots have will become an important selection for both customers and manufacturers.

A number of free and open source robotic platforms and simulation libraries are available which can be used by the scientists to automate their work to fetch the predicted results. Once the results on simulations and robotic platforms are found suitable, then further actions are planned [1, 2].

The Robotic platforms provide the set of software, databases and conventions that seek to simplify the challenge of developing complex and robust robot actions across a wide range of real time industrial situations. From the robot's view, challenges that appear simple to humans also differ wildly between instances of activities and conditions. The sensitive environment where automated machines or programmable devices can be placed, such robotic systems help a lot. The scientists and data analysts can fetch the data via satellite or assorted wireless protocols while sitting at remote control room [3, 4].



**FIGURE 1. Key Dimensions of Robotic Deployments**

The typical features of robotic platforms [5, 6] include

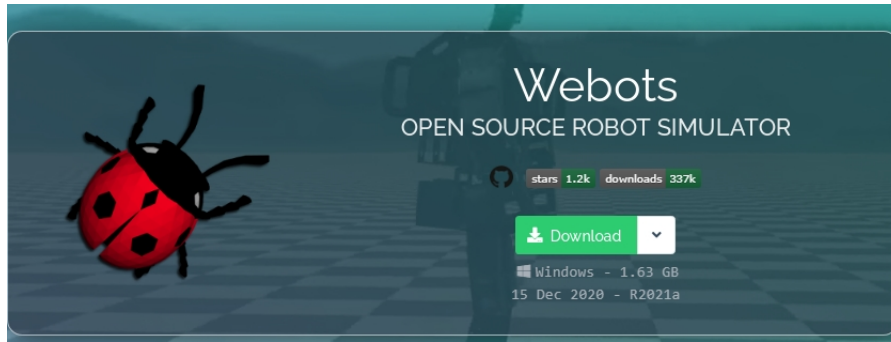
- Importing the templates from CAD for mechanical and production engineers
- Integration of OpenStreetMap and Google Maps for real time locations
- Easy interface to work
- Plugins and icons for different automations including automobile, space, drones, aerospace vehicles, volcano, underwater, marine, aircrafts and many others
- Integration with multiple programming languages for customization of features
- Exporting the results in multiple formats
- Association with multiple libraries of different engineering domains for compatibility

Following are the free and open-source robotics development frameworks which are widely used for industrial, social, corporate, military and related applications. These are programmable libraries with support to customize as per the requirements of the domain in which to implement [7–9].

## **2. WORKING WITH ROBOTIC SCENARIOS FOR INDUSTRIAL AND CORPORATE APPLICATIONS**

CoppeliaSim is a cross platform tool for simulation and industrial robotic applications. This tool makes possible to create the portable, scalable, and easy-to-maintain simulations for multiple scenarios [10–12].

This framework is having interfaces to various programming languages like C, Lua, Java, Python, Matlab and Octave. For an interactive production environment, the CoppeliaSim Robot Simulator relies on a distributed control architectural



**FIGURE 2. Official Portal of Webots**

**Table 1. Free and Open Source Platforms for Robotic Simulations**

Robotic Simulation Platform	URL
Webots	cyberbotics.com
Gazebo	gazebo.org
Robot Operating System	ros.org
Open Robot Control Software	orocos.org
Yet Another Robot Platform	yarp.it/git-master
Mobile Robot Programming Toolkit	mrpt.org
Robotarium	robotarium.gatech.edu
Poppy-Project	poppy-project.org
CoppeliaSim	coppeliarobotics.com

system in which the individual control of each object or model requires an embedded script for high performance control based applications. Such features render CoppeliaSim with extremely versatile and adaptable powers for broad range of robotic systems [13].

CoppeliaSim is used in the development of high-speed algorithms, plant modeling, rapid prototyping, validations, remote control, double-check security, automated double-checking and many others [14, 15].

Following are the key features in CoppeliaSim which makes this platform highly effective and performance based for multiple applications including engineering, military, aerospace, health sciences and many others [16, 17]

- Remote APIs
- Collision Detection
- Minimum Distance Calculation
- Dynamics / Physics
- Dynamic Particles
- Kinematics
- Proximity Sensor Simulation
- Vision Sensor Simulation
- Data Recording & Visualization
- Building Block Concept
- Path and Motion Planning
- Integrated Editing Modes for Customization
- Custom User Interfaces
- Convenient and Effective Model Browser

- High Performance Data Import / Export
- RRS Interface & Motion Library
- Full Interaction Modes in Multiple Dimensions and Coordinates

The implementations including the convergence of dynamics and physics can be achieved using CoppeliaSim with Bullet mechanics, Newton, Differential Equations and other integrations for easy and effective dynamic calculations simulating real life physical and entity encounters which include collision reaction, grabbing, collision response, grasping and many others. Multiple recordable data sources (including user-dependent) can view or combine time graphs with xy-graphs or 3D curves can be achieved effectively [18–20].

CoppeliaSim integrates features for real time automations including next to proximity sensors, vision sensors, viewable objects for dynamic environment with camera objects [21].

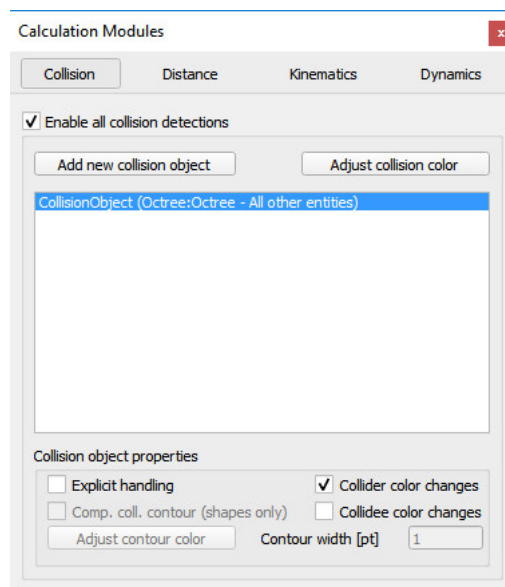
### 3. COLLISION DETECTION AND AVOIDANCE IN COPPELIASIM

Following the brief description of implementation associated with the collision detection and avoidance that is one of the key features in robots. For industrial and corporate applications, if a robot is developed, that robot should be programmed in such a way that it should not collide to other components or machinery in the industrial unit.

The collision detection and avoidance module is easy to program in CoppeliaSim so that the look-and-feel of the robotic application will be there. In Menu->Tools->Calculation the distance and collision settings can be set up effectively.



**FIGURE 3.** Collision Detection in Robotic Platform of Coppelia



**FIGURE 4.** Setting Panel to Detect Distance for Collection Avoidance

## 4. CONCLUSION

The scientists and practitioners are having huge scope to simulate their research tasks using these open source platforms for robotic applications where actual infrastructure and devices are very costly to implement. Rather than using the actual hardware and gadgets, the open source libraries and frameworks provide the ease to researchers to create, simulate and fetch the research based outcomes from their algorithms and imaginations.

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## CONFLICTS OF INTEREST

The author declares no conflict of interest.

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