

# Chapter 94

## An Approach towards Survey and Analysis of Cloud Robotics

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### ABSTRACT

*This chapter highlights the total structure and capabilities of robotic systems. This chapter then discusses the invocation of cloud technology in robotics technology empowering the whole system with higher processing power and bigger storage unit which was not possible earlier in the conventional robotic system being restricted in on-board manipulation. The flexibility of handling big data, ability to perform cloud computing, crowd sourcing and collaborative robot learning using the cloud robotics technology has been discussed briefly. This chapter describes concepts of Cloud Enabled Standalone Robotic System (CeSRS), Cloud Enabled Networked Robotic System (CeNRS), Cloud Robotic Networking System (CRNS), Standalone Robotic System (SRS), Common Networked Robotic (CNRS), Infrastructure As A Service (IAAS), Multi Robot System, R/R and R/C Network, ROS, Tele Operated Robotic System, Quality of Service (QoS), Virtual Machine (VM) and Cloud Datacenter. The existing applications of the cloud robotics technology are also described. However, the chapter focuses on the problems either inherited from the parent technology or appeared in the child technology. This chapter further recommends some solutions, new future directions and research aspects of the cloud robotics technology depending on the applications.*

## **1. INTRODUCTION**

In the modern era of technological development cloud robotics has become one of the important idea that has made a great impact in terms of socioeconomic benefits. The conventional concepts of standalone robots and networked robots were efficient and economical for the static environments only. But to deal with the dynamic environment, the capabilities of robots were being restricted in on-board manipulation. Based on the demand of modern technological growth the up-gradation of these robots was evident. While the sharing of resources was the main goal, the cost effectiveness too was the prior issue to be concerned of. This requirement made to combine the two technologies naming cloud computing and robotics technology together and form the idea of “Cloud Robotics”. The robotics technology empowered by the cloud technology then became able to meet the requirements to process the data faster and share their resources on the basis of demand. The idea of cloud robotics has made the productivity more cost effective and more efficient increasing the resultant throughput. Our chapter focuses on the two-tier communication and computational architecture and working procedure of the cloud robotics. We explain the Cloud enabled Robotic System as CeSRS (Cloud enabled Standalone Robotic System) and CeNRS (Cloud enabled Networked Robotic System) and their benefits as an on demand service. We have further discussed the existing application of cloud robotics as RoboEarth, Rapyuta, and Industrial Internet etc. However, some problems like communication and computational problem, dirty data (Krishnan, Wang, Wu, Franklin, & Goldberg, 2016) and live virtual machine migration problem (Travostino et al., 2006), Multi-Robot Multi-Area management, security and privacy problems appeared which would reduce the Quality of The service of the whole technology. So we discuss the various aspects of solutions and recommendation of the discussed problem. We further extend the discussion towards the future research aspects and possibilities for improved QoS and efficiency.

## **2. BACKGROUND**

In industrial manufacturing units many repetitive jobs need to be done faster to increase the rate of production. It is a very tedious and tiring job for humans to do. Robots in this environment can perform way better than humans with much more perfection and thus increases the productivity of the manufacturing unit and also make the unit cost efficient having lesser number of employees. So robotics has become a culmination of the modern era.

### **2.1. Robotics**

A branch of modern technology that involves computer science engineering, mechanical engineering, electrical and electronics engineering to develop automatic machines to serve various tasks and takes care of their architecture, composition, functionality, operability, efficiency, applicability, processing of information and operational feedback along with the computer programmed systems necessary for their effective control is termed as Robotics. Creation of efficient automated service robots were made possible that replaced humans in various manufacturing units and factories and in risky environments like space, under ocean and war zones.

In the late 20<sup>th</sup> century ‘Unimate’ was created. It was the first fully operational, digital and programmable robot that was used to lift and arrange metal pieces from a die casting machine.

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