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Cloud Robotics: Its Industrial Automation Implementation And Challenges

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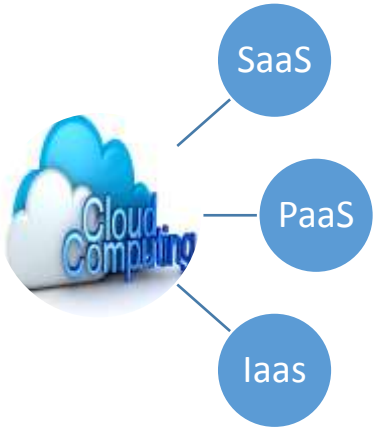
Abstract:
Since the cloud computing is easily and widely available and robots along with its automation system have been at the front of research with majority of systems still operating on the basis of onboard computation and memory management , it is wise to develop a system which allows integration of robotic services with cloud services.
The cloud robotic architecture leverages the combination of a cloud formed by machine to machine (M-2-M) communication among participating robots and an infrastructure cloud enabled by machine to cloud communications(M-2-C).
Success in cloud robotics implementation will also help in future robotics application to evolve more as one of the standard service accessible through the cloud similar to the applications of other domain which were based on cloud computing.
The aim of this paper is to provide a better understanding and implementation of cloud robotics in industries using parallel grid computing and cloud architecture.
Keywords: Big data, Cloud remote brain , Cloud Robotics , IAAS , PAAS , Robot Operating System(ROS) , SAAS , Service Oriented Architecture (SOA),

1 Introduction

Cloud computing is widely available, the power behind the cloud be harnessed. This means there would be absolutely no need to have a powerful computer onboard, but the brain of the robot could be in the cloud.
The National Institute of Standards and Technology (NIST) defines the Cloud as "a model for enabling ubiquitous, convenient, ondemand network access to a shared pool of configurable resources that can be rapidly provisioned and released with minimal management effort or service provider interaction".
The concept of centralized cloud has been applied here which means that the memory for robot is now nearly infinite and is easily and instantly accessible so the process of exchanging knowledge and information can be simplified. This will help in upgrading the robots regardless of their hardware.
Cloud computing as we know consists of three fundamental models:



SaaS application is basically Software As A Service model and is served over the internet, thus eliminating the need to install and run the application on the users system . They are managed from a centralized location and accessed remotely by a web browser or a mobile client. Google Apps is the most widely used SaaS application suit.

PaaS application is basically Platform As a Service model and is served by the cloud platform and it allows the developers to get a hold of all

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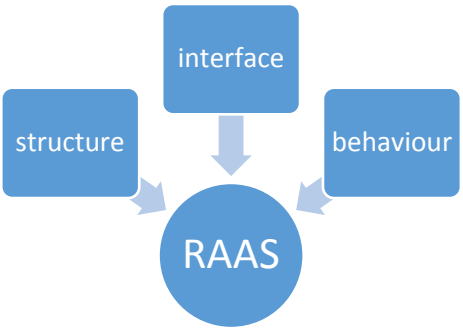
systems and environments by the required life cycle of the software.

IaaS is defined as Infrastructure As A Service model . In this model, the client need not purchase the servers , data centres and network resources. This is basically a pay as you go model . The most common examples of IaaS are Microsoft ,Apple ,Amazon,

2 Collective Robot Learning



3 Implementation Of Different Types Of Robotics And Their Challenges

To implement the concepts of cloud robotics in practical scenario and industries, there should be a proper human to machine interface.

Robotic systems deployed in factories have brought a major socioeconomic change in our lives. Their implementation in industries have made them various tedious and dangerous tasks in a repetitive loop without a saturation.

The pre-programmed robots have been very successful due to their high speed, endurance and precision in factory environments but on the other hand, they cannot work in unstructured and pliable environments.

To extend their functional aspects in unstructured environments, the robotic technologies are integrated with network technologies for the emergence of networked robotics.

3.1 Networked Robotic System

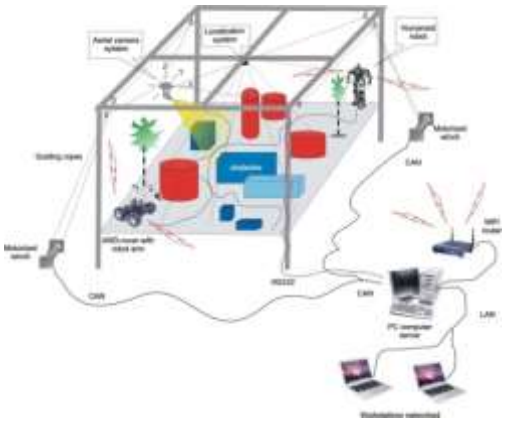
A networked robotic system refers to the group of robotic devices connected via wires or wirelessly to a communication network A human operator controls and/or manages the robot by sending command through a

The centralized cloud acts as a brain for all robotic units working at an industrial level.

It facilitates the sharing of data for robot learning by collecting data from the physical trails and environment.

The concept of ROBOTS AS A SERVICE refers to robots that can dynamically combine to give support to an existing application

RaaS has three aspects as a system



communication network Networked robotics is similar to standalone robots, faces inherent physical constraints as all computations are conducted onboard the robots, which have limited computing capabilities Information access is also restricted to the collective storage of network

3.2 Challenges

In networking robotics, groups of tasks such as sensing , actuating is distributed among various participating robots.

The advancement and upgradation of networked robotics is restricted by resource constraints, communication constraints, and information and learning constraints.

Networked robotics can be considered as an evolutionary step towards cloud robotics which leverages combining cloud computing technologies to transformed network devices. The design objective is to overcome the limitations of networked robotics with elastic resources offered by a ubiquitous cloud infrastructure.

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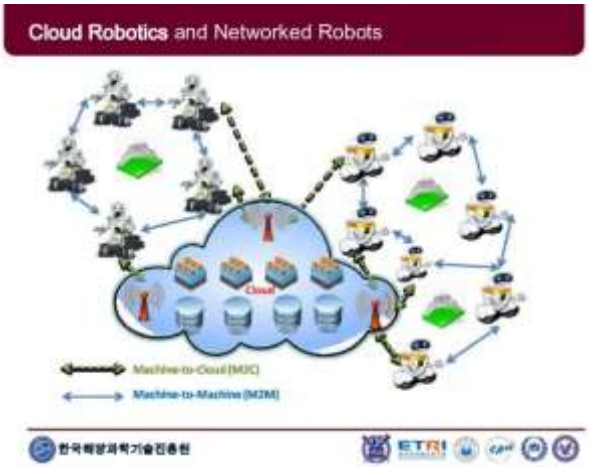
4 Cloud Robotics And Its Industrial Application

Cloud robotics provides the resources to extend the capabilities of networked robotics

Cloud robotics is based on 2 keys ie system to system communication along with system to machine communication.



The service robots used in cloud robotics concepts are of 2 types

personal service robots

- are frequently used by lay people for domestic purposes — typical examples being home and family servants, pet companions, and mobility assistants.

professional service robots

- are often managed by qualified operators and perform commercial tasks such as serving customers,manufacturing, etc.

The robotic cloud can play two different roles. The first role is to act as a virtualization middleware, where service-oriented technologies are used to build virtual environments of robotic ecosystem through Web services, which allow the users to access the robots through Web browsers and Internet utilities. The virtualization of robotic ecosystem through Web services contributed to offering the Robot as a Service (RaaS) model . This make the robot easily accessible and upgradable as whole group of robot need not be upgraded or changes separately but a centralized cloud controls them.

In this process , along with the upgradation , the maintenance and the memory management of robot can be done easily just by maintaining the cloud.

The developer or the user can program fleet of robots altogether just through the cloud.

The centralized brain concept also provides infinite memory to all robots as each module has very less computation power and memory management.

The second role that the robotic cloud plays is computations offloading, which consists in migrating intensive computations and processing tasks from the robot to the cloud computing infrastructure [. This is particularly interesting for mobile robots that might have low computation and energy capabilities to perform computationally-intensive tasks, such as 3D localization and mapping, image processing, object recognition, etc.

These robots can now be operated via cloud services by ROS i.e. ROBOT OPERATING SYSTEM

The robot operating system helps in manipulation of the sensor data of robot without changing each module's hardware individually

4.1 Robot Cloud Unit Design

The robot cloud unit mainly consists of two parts:

- **Infrastructure** - this consists of the hardware of a module along with its operating system and sensors along with separate device drivers as there can be different types of robots
- **WSDL**- this consists of an interface which allows the communication of individual robotic modules and with other parts of system . Application system should also be installed to enable local messaging service

The robot cloud panel in industries consists of 4 parts:

Model Panel : This panel provides the interface for user requirements. The robotic application developer simulates and optimizes its application according to user and will record and store the data in the system.

Assemble Panel : This consists of optimization of application using existing services published

Deploy Panel : this panel is responsible for deployment and updation of new services to individual robots. The autoinstaller updates all services(newly developed) to robots wirelessly.

Management Analysis Panel : consists of internal services such as robot monitor ,robot manager and simulator on individual robots.

This technique will help to solve existing problems related to automation and implementation of robotics in industries as now a number of resources can be saved

This method is cost efficient as it is comparatively efficient to maintain a cloud than individual module.

Various robots simulation softwares are easily available and can be linked to the cloud .

Now no robot needs a separate memory management module and computation capabilities as all of them can be controlled and maintained via centralized cloud

5 Conclusion

We can conclude that cloud robotics implementation can bring standardization to the existing robot service scenario

Cloud robotics is an emerging engineering discipline and researches are looking forward to implement it in various applications.

The final conclusion is to meet diverse requirements without degrading the quality of service

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