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Cloud Robotics: An Evolving Research Field

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Abstract:

There are several sectors, applications and disciplines where the robotic system technology is used such as hospitals, airport defense sectors, hotels etc. The infrastructure of cloud along with the widespread set of accessible internet means which contains a capacity to offer important profits to automatons and robotics system. This robot and automation system depends on the statistics or cryptograph provided from a complex linkage to sustain their procedure. This paper converses about the four advantages of the cloud system which are huge data, cloud system computing, combined robotic learning and human calculation. This cloud system can mend and expand the robotics and the system of automation that offers access to a data base publication, models, open competition for projects, structures and any exposed software.

Keywords: *Cloud Computing, Automation system, Cloud Robotic system*

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Introduction

As the research on Robotics has completed an extensive path as the engineers as well as the scientists have exhibited a type of human being that looks like a mechanical robot in 1939 and 1940.The weight of this robot is approximately 265 pounds with a height of seven feet and termed it Elektro. Elektro has the capability to walk using commands of voice, speaks about 700 words and move his arm and head. The process of Robotics is majorly affecting or impacting the human lives for example, Robot manipulators in industrial robots are deploying in various industrial units to do monotonous and precarious tasks such as painting, packing and soldering. In Industrial set ups, the preprogrammed automatons have been efficacious because of their immense strength, rapidity and accuracy in the structured factory surroundings. In unstructured surroundings, for the purpose to enlarge the robots functional range or to deploy them, the technologies of robots are integrated with network technologies (Hu, Tay and Wen, 2012). The cloud in Cloud Robotics has the possible ability to boost a widened range of robotics and mechanization system. According to the National Institute of Standards and Technology (NIST), a cloud computing system is defined as "any model that enables universal, expedient and a mandate network access to configurable assets such as various servers, storages as well as applications of network that is released rapidly with efforts of minimal management or service provide interaction".

As according to Patil and Goldberg 2014, the cloud robot and the automation system is termed as "Any type of robot or any kind of automation system that relies on statistics or cryptogram produced from a complex linkage to supper its appropriate procedure". This automation system includes the future systems, network teleoperation, and networked groups of mobile robots. Because of the network latency and variability in the service quality, the cloud robotics and its automation processes sometimes also includes the ability of processing for low-latency responses.

In various sectors, fields and disciplines, robotics as a technology is used such as in hospitals, airport, historic places, defense and army sectors etc. (Bhardwaj and Saxena, 2016). The functions of three Robotic services are sensation, actuation and control. Intelligent artificial activities provide supports to robotic services through socially conscious behavior that should be interactive to support daily human activities (Miratabzadeh et al, 2016). A cluster of mechanical objects that are mutually associated with some kind of wired or wireless communicating network is termed as networked robotic system.

Cloud Robotics

This technology produces models of new generation of robots in which some resources such as the computing power, memory and storage is provided by the data centers which are external for e.g., the Cloud. Most of the systems of robot are basically equipped with more and more sensing units to be increasing autonomously. Actually the cloud is ubiquitous and is accessible from everywhere. The operation starts on demand and according to the requests of robot, it also provides scale economies and data sharing across users and systems (Botta et al, 2017).

As stated by Dr. Kleinrock in 2000, the computer systems still subsists in an initial stage but as they grow up, with timely advancements into the computational technologies, they tend to be far more refined and advanced. Through these techniques the computer services that are grounded on the model of service providing methods has advanced and later on controlled by two substantial concepts of construction. Amongst the two, one of them is Service Oriented Architecture (SOA) and the other one is Cloud Computing. These services are expanded that includes excessive facilities as a part of their assistances and the whole computing production has undertaken a major conversion that makes facilities voluntarily accessible on plea. Consumers are required to pay for all these services according to the usage in case they access these services.

Technologies of Cloud Computing

The process of cloud system of computing consists of three very significant models as Software: a Service (SaaS), Platform: a Service (PaaS) and Infrastructure: a Service (IaaS). The claims of software as a service (SaaS) are server about the entire network which therefore eliminates the requirement to mount and run the aforesaid application on the system of the user. The access is done remotely using a web browser and are accomplished from a consolidated position. Google Apps is the most extensively used SaaS application suit. PaaS, whereas mentions to a platform of the

computing system that is served beyond any infrastructure and it lets the designers get a methodic hold of every process and surrounding that is the basic requisite to finish up the lifecycle of the software, to check if it is progressing, checking, deploying or web application hosting. IaaS provides the infrastructure that is required as a service.

The services of all the cloud computing are used to boost the abilities of robot and such technologies provide number of benefits that possibly are useful for the need of demonstrating configuration and successively growing robot services (Das, Saikiran and Ramana, 2016).

According to Henry Schaffer, X as a service (XaaS) includes cloud computing, when X can be denoted as anything for example,

- Hardware: a service (Haas)
- Communication: a service (Caas)
- Database: a service (Daas)
- Software: a service (Saas)
- Storage: a service (Saas)
- Cloud Functionality and Robots' tasks

The robots have basically small computer architecture for the purpose of mobile that leads to insufficient capability of computing. The access of data is constrained to the distinct network storage. Some of the technologies such as wireless communication and cloud computing technologies helps in overcome all the restrictions by cloud robotics.

The tasks of robot are classified on the basis of types of the cloud system resources and a few of the robots chores are hurdle prevention, vision handling, localization, pathway scheduling and the plotting of environment. All the needless and ineffective apprehensions can be disabled by the cloud environment that is done by paradigm shifting of computer resources. The tasks are categorized as follows,

- The resources of computing devices that is distributed for each mediator.
- The assets of storage for the fruitful research activities of data analytic.
- The resources of network for swarm performing cooperative missions.

Proposed Software Architecture

The system of architecture comprises of three systems which are:

- Middleware subsystem which is the platform's main carrier.
- Background task subsystem includes the batch processing.
- A controlled subsystem is the platform's brain and intellect.

All the subsystems are arranged horizontally, whereas the computation, stowage and networking tasks are vertically administered.

As According to Miratabzadeh et al, Implementation includes,

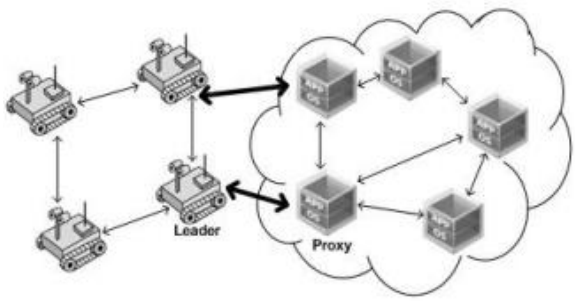
Connection of multiple agents - Robot Operating System (ROS) is basically an exposed source of software for any kind of mechanical system that mainly includes influential packages which are freely and legally accessible for the purpose of usage. The used packages output the topics of data that pertains to the negotiators such as angular velocities as well as linear velocities and camera data, and control topics. This established data is then later used to accomplish numerous tasks. Then the next and the final most step is linking each proxy to the cloud system using ROS.

Cloud Seeding and Cloud Architecture

As stated by Chifamba 2015, in his paper "A study on Cloud Robotics", that the individual field robots have their own resources i.e., computer, memory and storage. All these factors extends the capacity to the cloud using a process called offloading. As according to the Guoqiang Hu et al, three architecture systems are proposed for the purpose of construction of a cloud robotics system that includes Proxy built Model, Peer built model and Clone built model.

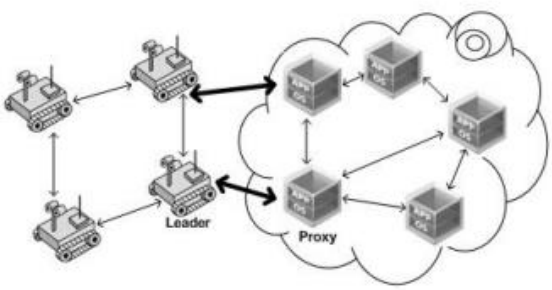
Proxy Built cloud Robotics model

In this process, a proxy is deployed that is directly communicated with a robot leader that forms a bridge between the cloud and the network of robot.



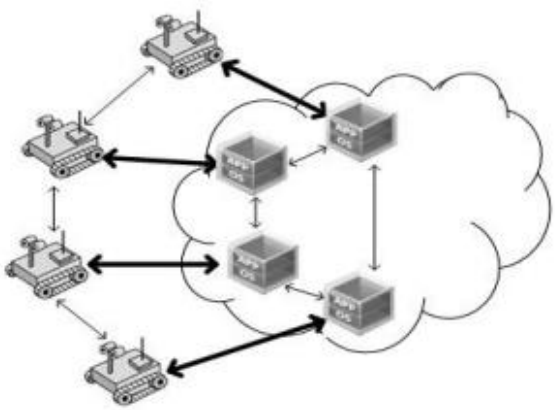
Peer Built Model

This is the connection that is a full mesh where the robot and systems made a network.



Clone Built Model

Each robot has an equivalent clone in the cloud system which tends to maintain a greater relationship between each pair (Chifamba, 2015).



Network Construct for Cloud Seeding

Every robot has the ability to directly communicate with other utilizing standards such as WiFi, Zigbee and Bluetooth for the purpose of short ranges. There is a need for procedures that relies and adapts fast in the environment. The availability of high protocols having low latency and low communication load in the network that is considered as the network center.

There are some heddles and challenges in cloud seeding which are computational, communication, power, application and operational challenges that can be overcome using different techniques.

Review of Literature

Hu, Tay and Wen 2012 discussed in his paper about the Architecture, challenges and applications of cloud robotics. The communication protocols and various elastic models of computing are proposed to handle the different type of applications. The technical challenges in communication and computation are discusses in this paper.

Burski and Garbacz 2014 stated the use of cloud computing in mobile robotics and also explained about the capability of popular platform of cloud robotics. This paper also discusses about the short descriptions of a number having cloud-based platforms that includes the DAvinCi project, Cloud Based Robot Grasping Project and RoboEarth. Kinect sensor and RoboEarth object recognition software are the simple tests which are performed in this paper.

Kehoe and Abbeel 2014, made a study of research on Cloud Robotics and Automation, and stated that the systems of robots and automation depends on data or code from a linkage that supports the procedure. This survey is systematized and is having four potential advantages of the cloud which are huge data, cloud computing system, mutual robotic learning and human computation. 150 references are included in this survey that works on results and open challenges.

Chifamba 2015 studied on cloud computing: the Ad- Hoc Cloud that the scholar discovers as on how cloud seeing can be performed correctly, which involves the security repercussions as well the networking apprehensions.

Koken 2015 described that the cloud system provides computation power that is unlimited, memory, and storage. These cloud systems enabled robots which are majorly classified into two major

classification are as standalone and networked robots. This survey is concluded in this editorial for cloud robotic platforms and on works of schmoozed robotic systems.

Bhardwaj and Saxena 2016, discusses about the cloud robotics in which they identified the analog signal through cloud facilitating robots. This paper explained that how analog signals can facilitate robotics system and this approach somewhat not only allow machine to cloud communication (M2C) but also allows machine to machine communication (M2M).M2M performs task faster in different areas at the same time.

He et al. 2016 stated in his research paper about the cloud built real time multi robot collision Evasion for Swarm Robotics Techniques. This paper discovers about the cloud based real time control availability of complex robots that are massive is performed by complicated technique and the performed by local collision avoidance algorithm. All the characteristics developed from these applications verifies that the environment of cloud computing is considered as a new platform for studying the complex robots in swarm robotics.

Manzi et al 2016 explained the cloud robotic system design for the purpose to support senior citizens and this paper explores about the procedure that is solely established on the robot called KuBo. This system depends on the assets of cloud that helps in the capability extension for the purpose of human communication and environmental detecting in order to offer services for an independent and individual living.

Miratabzadeh et al. 2016, explained the software architecture of the cloud robotics system that includes three subsystems which are the Middleware subsystem with a circumstantial task and a controlled subsystem. In this paper, the computing, the storage and the networking are the three primary jobs handled by the anticipated software design.

As according to **Quintas, Menezesb and Dias, an** approach was .proposed for the purpose of an automated system using mobile robots and a smart room that follows architecture that is service oriented and aims to undertake any kind of complex and heavy computational tasks. This approach uses the ideologies of service concerned with architecture that relies solely on cloud computing system to provide a notch of scalability to the entire set up.

Conclusion

As discussed the architecture of software in the cloud environment consists of three types of subsystems, that has been applied on an IaaS platform by the OpenStack that supplements the scalability to any particular system. By using the ROS Multimaster FKIE, the platform that is dispersed appropriately aids the heterogeneous large scale autonomous robots which having critical problems in case when one robot loses communication. When any type of robot is installed that entails the installation of related packages onto the robot and its related network. Hadoop is used for storing the data in a series of packages that allows the processing of the large amount of data that is received from the software which are robotic agents.

At the end, the software which are discussed for the purpose of cooperative robotics which is having an authentic shared data center for the purpose of communication and a platform that is required.

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