



Implementing the Cloud and Internet of Thing concepts in Robots

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ABSTRACT: Using Cloud technology we can able to retrieve data anywhere. By connecting everything to internet gave more accessibility of data from one type system to another type of system. Implementation of these concepts in Robotics led us efficient production process, better understanding of problem solving skills to robots and efficient system design .The Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

This paper describes about a new methodology to create robots with the integration of Cloud and Internet of Things (IoT). This method is applicable for almost all type robots. But it works efficiently in the system design where large number of function implemented in robots. It has the aim to solve the problem which arises when we develop the robotic systems.

KEYWORDS: Cloud Computing; Internet of Things (IoT); Robots; High functional Robots; Industrial Robots; Artificial Intelligence (AI)

I. INTRODUCTION

Robotics is one of now fast growing field. Using robots we can reduce the work flow process and also the efficient of manufacturing process could be increase. Artificial intelligence enables us to make robots to act smart for any given situation. The programming of artificial intelligence is too difficult. Also the robot needs to analyse and store more data in the learning process. So, the memory capacity of robot should be greater than any other programming system (because of implementing learning function).

The Internet of things and Cloud are two comparative challenging technologies are been merged together to change not only current and future of the Internet working services. As Internet of Things has limited capabilities of processing power and storage also consequential issues such as performance, security, reliability, privacy, integration of Internet of Things with Cloud is more beneficial for undergoing unlimited capabilities like Storage, and Processing power. Cloud can even benefit from the Internet of things that it can extend its limits with real world things in more dynamic and distributed manner, and deliver massive number of services in real time.[1] Cloud application has realized the business process of industry application, which can be used as a part of the cloud platform, and can also integrate third-party industry applications, such as traffic logistics, health monitoring and agriculture monitoring.[2]

Fig. 1 refers to connecting robotic system into Internet we can access that robotic system anywhere (i.e. we can gave command to the robot anywhere). The development of mobile robots was driven by the desire to automate transportation in production processes and autonomous transport systems. The former lead to driver-less transport systems used on factory floors to move objects to different points in the production process in the late seventies. New forms of mobile robots have been constructed lately like inspected robots with many legs modelled after examples nature gave us or autonomous robots for underwater usage. This method is a kind of development of our proposed method previously [3,4].

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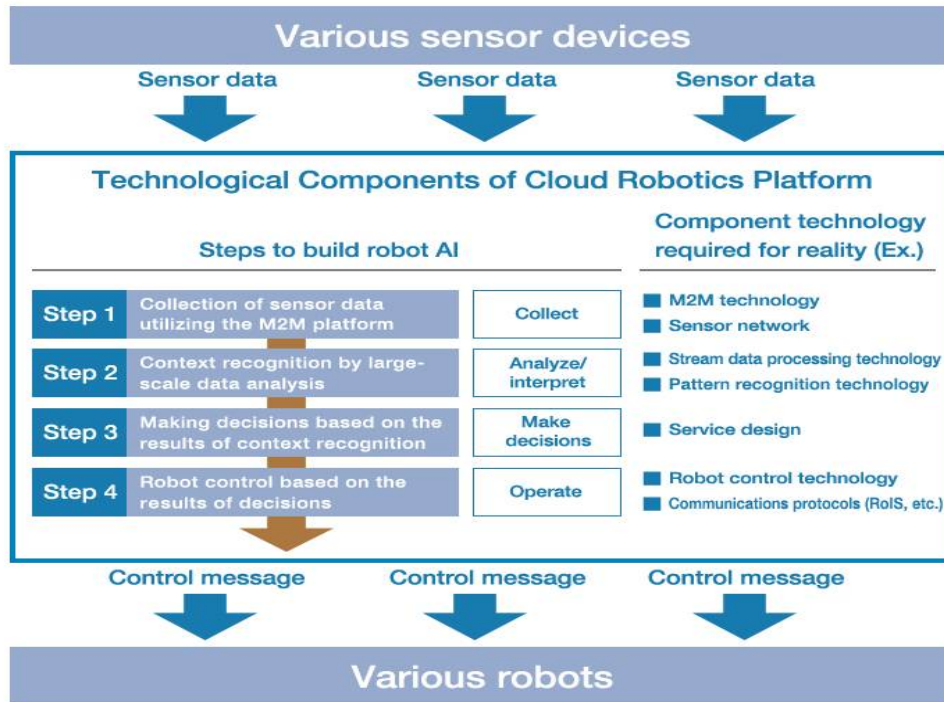


Fig. 1. Components of Cloud Robotics Platform

II. RELATED WORK

In [2] authors used Machines as intelligent as humans should be able to do most of the things humans can do. Flexible automation schemes and systems are quickly gaining acceptance and are being increasingly applied in industry. Now a day, they are use robots for manufacturing process. Applications of Artificial Intelligence to medicine have been increasing in recent years. Artificial Intelligence employed in the medical field mainly to perform a rational analysis of the data available from clinical examination (such as Computerized Tomography, Nuclear Magnetic Resonance(NMR), Digital Angiography, etc.) in order to get a reliable diagnosis of the patient's disease and a suitable decision support. Also lot of robots invented to work in home. Robots also invented to play chess, soccer etc. Robots can think well when we implement artificial intelligent concept to it.

All hardware parts of the robots connected and the programs also written in the sensors and other parts. [3]. Authors used the general concepts to make the robot as a given tasks is the second step in this method. The concepts are involving the sensors which are used to make a robot according to given tasks. Programming the robot also considered as a general concept. So, programming the sensors and other parts (like microprocessor, some chip sets etc.) are also including in this concept. For example, to make a robot which can take a thing. The sensors need to make the robot and programming the dimension of that thing has been taken general concepts to make a robot. In [4] The Internet of Things (IoT) paradigm is based on intelligent and self configuring nodes (things) interconnected in a dynamic and global network infrastructure. It represents one of the most disruptive technologies, enabling ubiquitous and pervasive computing scenarios. IoT is generally characterized by real world and small things with limited storage and processing capacity, and consequential issues regarding reliability, performance, security, and privacy. On the other hand, Cloud computing has virtually unlimited capabilities in terms of storage and processing power, is a much more mature technology, and has most of the IoT issues at least partially solved. Thus, a novel IT paradigm in which Cloud and IoT are two complementary technologies merged together is expected to disrupt both current and future Internet.

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III. PROPOSED SYSTEM

A. ARTIFICIAL INTELLIGENCE:

The field of artificial intelligence, attempts to understand intelligent entities. Thus, one reason to study it is to learn more about ourselves. But unlike philosophy and psychology, which also concerned with intelligence, artificial intelligence strives to build intelligent entities as well as understand them. Another reason to study artificial intelligence is that these constructed intelligent entities are somewhat interesting and useful in their own right. Artificial intelligence has produced many significant and impressive products even at its early stage in its development. [5]. The first work of AI was done by Warren McCulloch and Walter Pitts (1943)

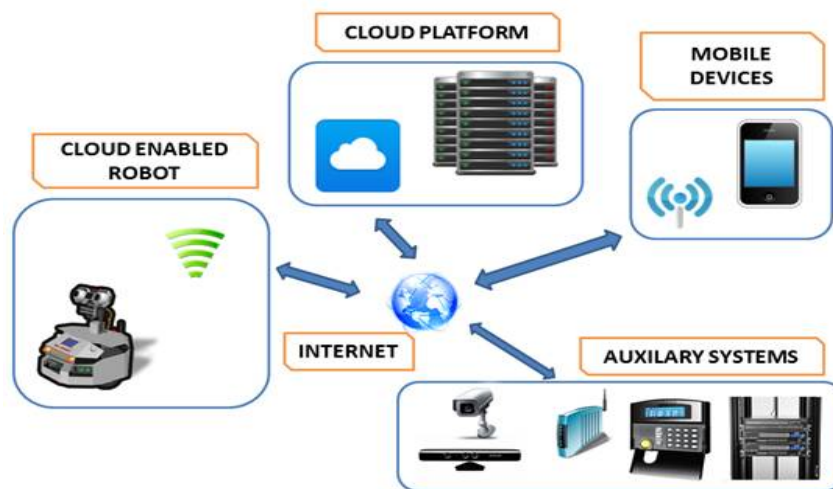


Fig. 2. Cloud Enabled Robot using IoT

B. ROBOTS:

Robotics is concerned with the study of those machines that can replace human beings in the execution of a task, as regards both physical activity and decision making[7]. Robots can be defined as programmed machines or computers that can able to do some (physical) work. Robots have become incorporated into human life over the last half century: what was once only science fiction has now become a reality.[8] Also there is some biblical passage (Luke 19:37- 40 and Matthew 3:9)[9] that said like non-living thing can speak and Almighty God can make stones to human like thing[10].

C. CLOUD COMPUTING:

Fig. 3. refers to NIST[11]Cloud computing is a model for enabling ubiquitous, convenient, on- demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. Also Cloud computing can be defined as the paradigm for enabling network access to a scalable and elastic pool of shareable physical or virtual resources with self-service provisioning and administration on-demand[12].

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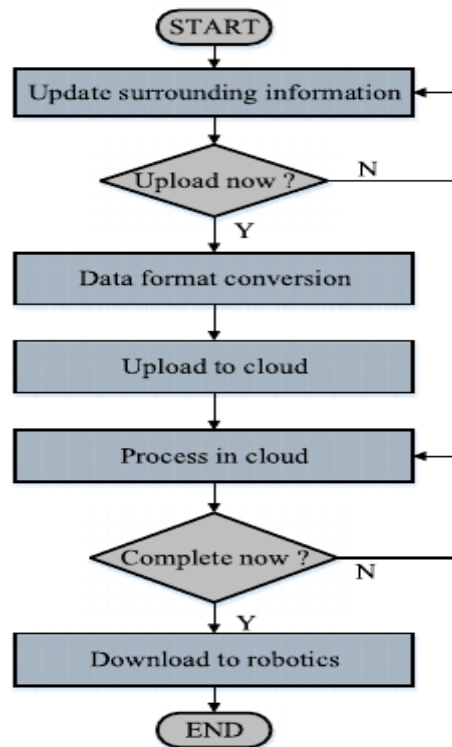


Fig. 3. Step by Step Implementation of Robotics in Cloud

D. INTERNET OF THINGS (IOT):

Connecting almost all type of things (like car, home appliances, watch etc.) into Internet known as Internet of things. The Internet of Things refers to uniquely identifiable objects (things) and their virtual representations in an Internet-like structure. Fig .2. Refers to everyday objects, that are readable, recognizable, locatable, addressable, and/or controllable via the Internet using either RFID, wireless LAN, wide-area network, or other means.[13]

IV. PROPOSED METHODS AND IMPLEMENTATION

STEP 1: ANALYSING TASKS

First of all the tasks which need to implement to our robot or a robotic system is pointed out. It may be listed separately.

STEP 2: CONCEPT TO MAKE ROBOT

Listing the general concepts to make the robot according to the tasks listed in previous step is the next process in this method. It means when we make a robot to take a ball is one of the task of the robot, the dimension of the ball and the corresponding sensor requirement are assumed as a general concept. Also in non-humanoid robots like in car industries two robots are fit the two sides of the door and then another robot screwed it. Here that robots hand like machine, Screwdriver, screws etc are considered in this process. If we implement some sensors programming the sensors and other parts (like microprocessor, some chip sets etc.) are also considered in this process.

STEP 3: CONCEPT-ARTIFICIAL INTELLIGENCE

The artificial intelligence concepts (or term) make a robot to learn and think like a human being. Concepts which involve making a robot artificial intelligence in each task are finding out in this process. All the additional hardware like sensors, ICs etc. and the programming like to think and learn are analysed and took necessary steps to implement those tasks to that robot. To explain it take a previous example (taking a ball by a robot), if the ball was in the box(may



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be transparent), the robot must think that box need to open and took the ball. This is known as artificial intelligent thinking. Likely in non-humanoid robots as in previous example (to make door of a car), When other side of the door cannot be in the place(i.e. not taken by the robot), the other robot also just screwed the one side without knowing it. Here if the two robots have or haven't the door side must be known by the other robot by using any appropriate sensors. And also learning from day to day from its environments is necessary to work efficiently.

STEP 4: RECHECKING THE CONCEPTS

Rechecking whether the concept doesn't violate another concept (i.e. one task doesn't violate another task) In practical we could be able to find some contradiction. These things need to correct in this step.

STEP 5: IMPLEMENTING CLOUD

Uploading the software to a cloud server and checking the programs and check whether it will work correctly considered in this process. In other words, it will connect to a cloud. Because of this the size of the robotic system also reduced. So, learning by the robot and transferring one system to other is easy. Consider a robot 'A' learn from a person 'X'. When the person 'X' need to go other place (like foreign country). Person 'X' has no need to take a robot from his/her own place to another place. 'X' can use the other similar type robot by using the password or access key using the data stored in the cloud server. So it is another advantage when we implement programs to the cloud.

Also Cloud computing technology combines parallel computing, distributed computing and grid computing. The developing of the Internet of things depends upon high efficient storage and computing power, which is the advantage of cloud computing technology. So it is the basic of the internet of things.[14]

STEP 6: MAKE A ROBOT

Assemble all the hardware parts and install all the programs to make a robot.

STEP 7: MAKE IT TO CONNECT WITH OTHER SYSTEMS OR ROBOTS

Connection between two systems can be made wired or wireless. For wired we can use Metallic cables, Optical Fiber cables etc. For short distance accessing we can use Zig-bee , Wi-Fi, UWB, blue-tooth, the extension of broadband network and some integrated communication module, etc. But in the case of long distance we can use internet or Optical fibre cable to access the robotic system.

STEP 8: SECURITY CHECK

We need to check the security of the system in order to prevent malfunctioning and attacks. Because when we connect robot to a internet probably the risk of data threatening is increase. So may be some another person can change the configuration or gave command to our robotic system. So high en security is needed before we using the robotic system.

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Robots and automation systems are no longer limited by onboard resources in computation, memory, or software.



Fig.4. Cloud Robotics and Automation

Fig.4. refers "Cloud Robotics and Automation" is a new paradigm where robots and automation systems share data and code and perform computation via networks building on emerging research in cloud computing. Consider Google's autonomous car. It uses the network to index maps, images, and data on prior driving trajectories, weather, and traffic to determine spatial localization and make decisions. Data from each car is shared via the network for statistical optimization and machine learning performed by grid computing in the Cloud. Cloud Robot and Automation systems can be broadly defined as any robot or automation system that relies on data or code from a network to support its operation, i.e., where not all sensing, computation, and memory is integrated into a single standalone system. Cloud computing has virtually unlimited capabilities in terms of storage and processing power, is a much more mature technology, and has most of the IoT issues at least partially solved. Thus, a novel IT paradigm in which Cloud and IoT are two complementary technologies merged together is expected to disrupt both current and future Internet.

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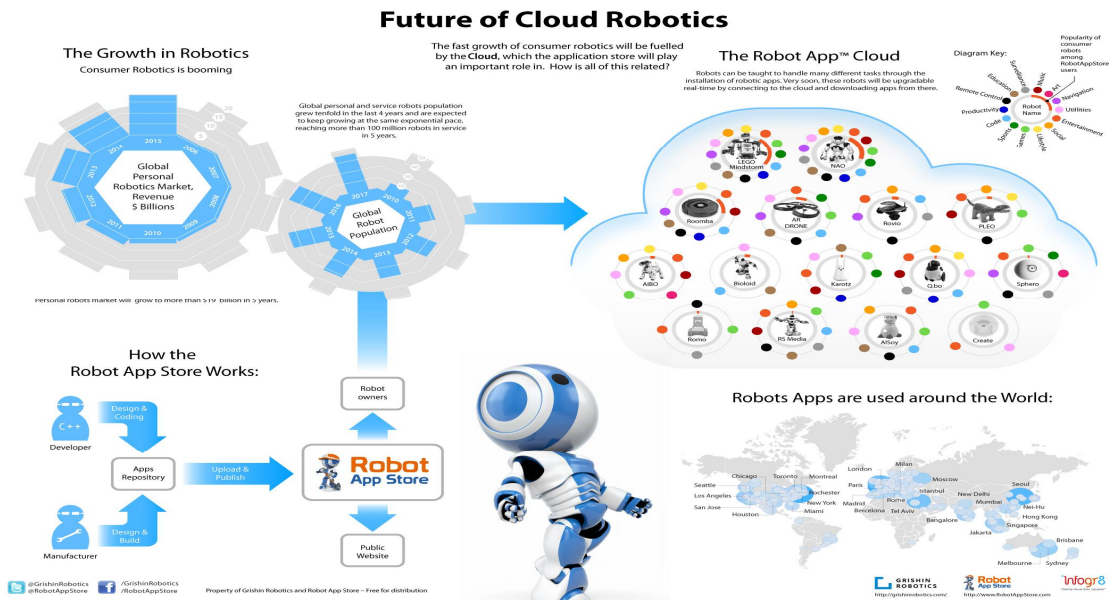


Fig.5. Future of Cloud Robotics

Fig. 5 refers at least four potential advantages to using the Cloud: 1) Big Data: access to updated libraries of images, maps, and object/product data, 2) Cloud Computing: access to parallel grid computing on demand for statistical analysis, learning, and motion planning, 3) Collective Learning: robots and systems sharing trajectories, control policies, and outcomes, and 4) Human Computation: use of crowd sourcing to tap human skills for analysing images and video, classification, learning, and error recovery. The Cloud can also provide access to a) datasets, publications, models, benchmarks, and simulation tools, b) open competitions for designs and systems, and c) open-source software. It is important to recognize that Cloud Robotics and Automation raises critical new questions related to network latency, quality of service, privacy, and security.

V. CONCLUSION AND FUTURE WORK

By using Cloud and Internet of Things we can make a robot capable of learning and doing work efficiently. In implementing these concepts and commercialization security plays a vital role. Researches going on to gave better security over cloud and internet of thing to implement it. Also using these concepts Surgery robots can be made with higher productivity [15]. M2M [Machine to Machine] communication can be possible in this method (by using cloud)[16]. Industry, medical, army, research etc. need robots to perform jobs quickly and efficiently. These methods simplify the process of thinking and making the robot.

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