

Cloud Computing Technology and Its Application in Robot Control

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Abstract: In recent years, with the development of science and technology, new technologies have emerged continuously, such as cloud computing, big data, etc., and cloud computing technology has been used in robot research, making the designed robot have high real-time performance and high energy efficiency, low cost and a series of advantages. Among robot technologies, controlling robots is one of the key technologies. One of the classical problems in the field of robots is the synchronous map construction and positioning (SLAM) problem. This problem is a typical computationally intensive task. In traditional robots, the implementation method is to rely on the robot's local computing resources to calculate and solve in real time. The disadvantages of this method are slow speed, low precision, and very large computational overhead. This paper aims at the current research status, based on the robot architecture and the "Software as a Service" (SaaS) idea in cloud computing, proposes a SLAM service framework based on cloud computing, and studies the control in the robot, and finally the development of cloud computing and robotics is looking into the future.

1. Introduction

When robots perform tasks, they involve techniques such as positioning, map construction, and path navigation. For traditional robots, when large amounts of data are acquired and analyzed and calculated, these data will be given to robots due to the large amount of data. To calculate the pressure and storage pressure, therefore, in the process of completion, the real-time performance is poor. In response to these problems, at the Humanoids International Conference in 2010, Dr. KUFFNE R J of Carnegie Mellon University put forward the concept of "Cloud Robotics" for the first time, which caused extensive discussion in the academic community. The core idea of the cloud robot is the combination of robot and cloud computing. Like other network terminals, the robot itself does not need to have super computing power and huge storage capacity. It can connect to the server anytime. The required knowledge and complicated calculations are completed by the cloud, capable of receiving large amounts of data and analyzing and processing the data.

After several years of development, robotics technology has gradually developed into a milestone in the development of computing technology. Compared with traditional computing services, the outstanding advantages of robots are as follows: Robots are the product of highly cross-convergence of disciplines such as mechanical engineering, artificial intelligence, materials science, bionics, etc. Robots can simply imitate human behavior, but in memory and its ability to store information has gone far beyond humanity, it's physical agent that accomplishes tasks by manipulating the physical world. The potential and advantages of cloud robots have attracted the attention of various Cayenne institutions as well as many companies, setting off an upsurge of research on cloud robots in academia and engineering.

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2. Cloud computing

At the Search Engine Conference (SES San Jose 2006) in August 2006, Google CEO Eric Schmidt put forward the concept of “cloud computing”, which was the first time the concept of “cloud computing” was proposed. After years of development, research on cloud computing has achieved a series of results. Cloud computing is based on the Internet. Computers and other devices can acquire resources from shared hardware and software resources and information as needed. It describes a service related to the Internet. It can be delivered and used on the Internet and can be dynamically expanded. It is generally a virtualized resource.

Cloud computing describes the services provided by both hardware and software, including any level of service. According to the current industry division, the services provided by cloud computing are divided into three levels: Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS). The cloud computing architecture is shown in Figure 1.

IaaS refers to consumers using the Internet to obtain services from computer infrastructure. This model is currently the mainstream model. PaaS, platform-as-a-service, refers to the software R&D platform as a service and finally presented to users in the SaaS (software as a service) model. Under the SaaS model, users no longer need to deploy and run the required software locally. Instead, they directly apply to the software service provider for their use of the software and meet their business requirements.

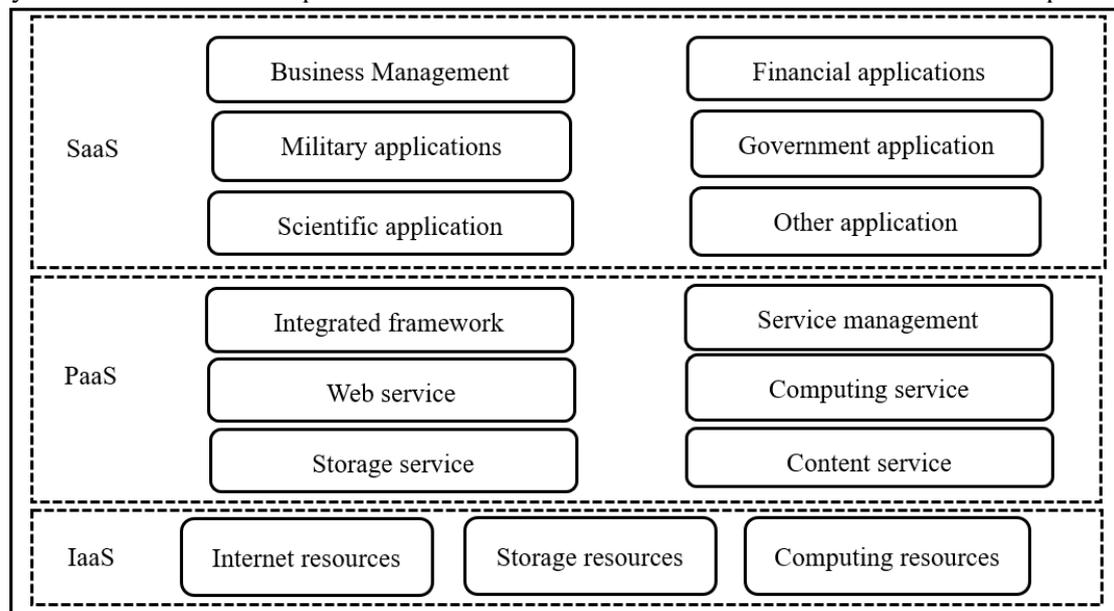


Figure 1 Three-tier architecture of cloud computing

3. Application of SLAM Service Framework in Robot Control

SLAM (SLAM, Simultaneous Localization and Mapping) is a classic computationally intensive task in the robotics field. The core of SLAM is through multiple incremental iterations of “positioning” and “composition” to enable positioning and composition. At the same time, the use of the robot is expanded to enable the robot to realize self-positioning and navigation in a mode environment and control its path. For the research of SLAM, a series of research results have been obtained so far. There are already some solutions, such as Da Vinci, Rapyuta and other architectures. The effectiveness and feasibility of "cloud+robot" collaborative SLAM has been verified in these experiments. The resources of a single robot are limited, and the calculation of SLAM is very complicated. These two are contradictory. This contradiction is also one of the major challenges of SLAM.

3.1 SLAM main research methods

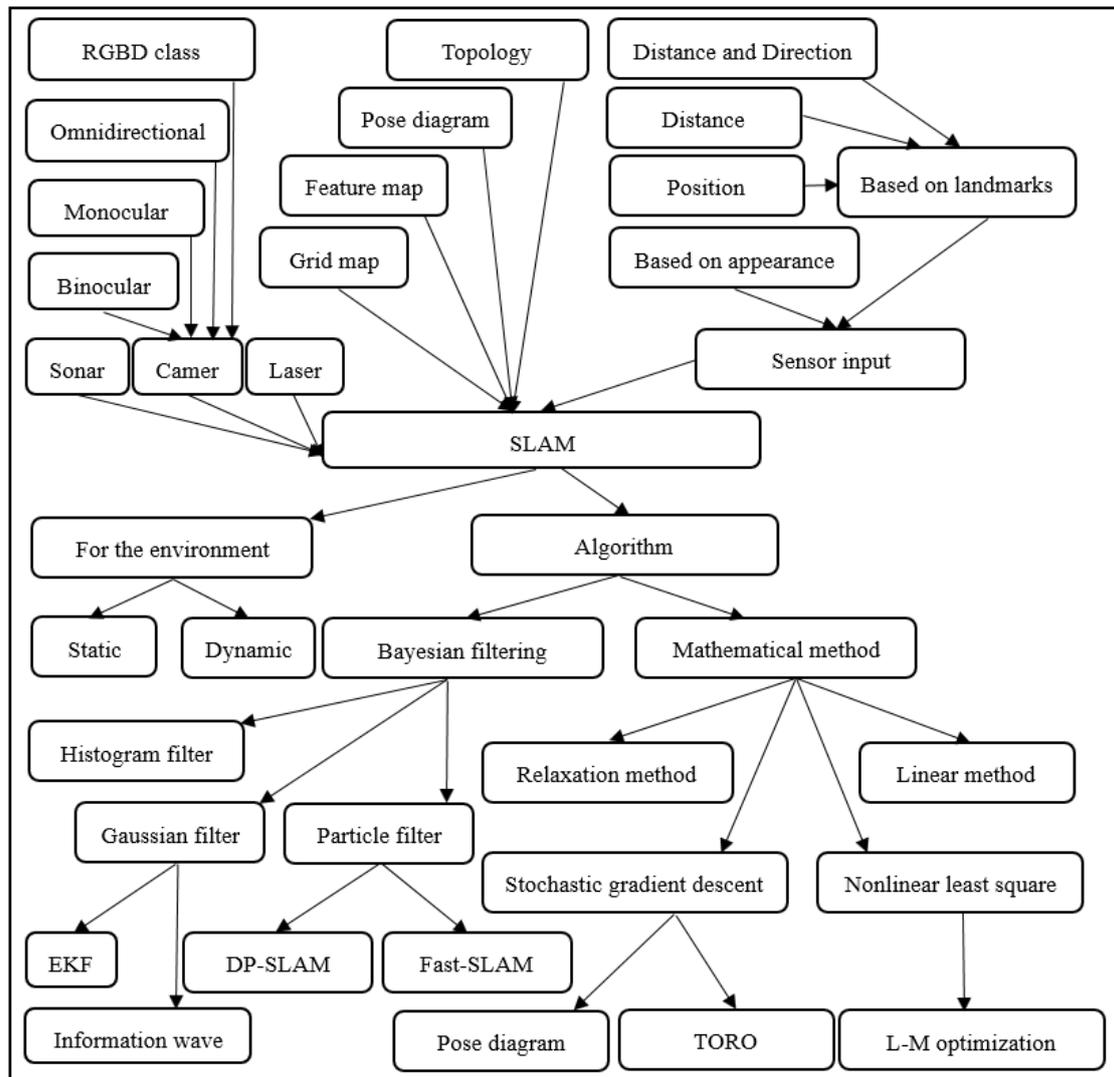


Figure 2 The main research methods of SLAM

3.2 SLA basic problem description method

The emergence of the SLAM problem was brought about by the autonomous navigation problem of the robot. In general, the SLAM problem is divided into three phases: location, map construction, and path planning. Positioning: Determine the position of the robot in its environment. The position information can be expressed by any precise measure. Map construction: Map the surroundings of the robot into a map. Path planning: Find a destination based on the current position and the constructed map. The optimal path to the land.

Therefore, under normal circumstances, the SLAM problem can be described as: When the known map is improved or a new map is created, the robot is positioned on the map, as shown in Figure 3.

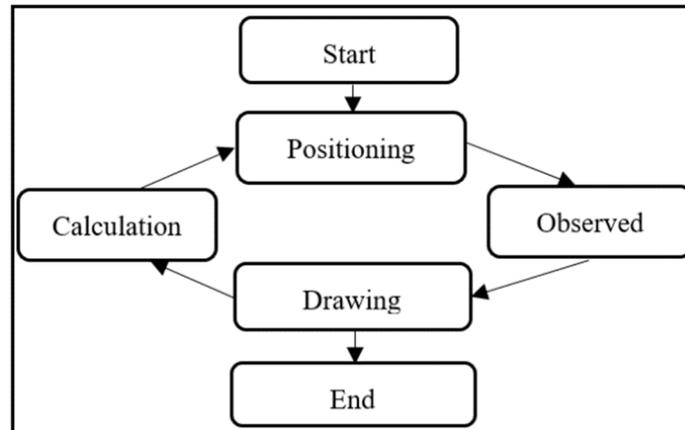


Figure 3 Basic description of the SLAM problem

3.3 Cloud-based SLAM Service Framework and Its Application in Robot Control

Based on the above description, in the cloud robot architecture, the robot "demands" to the cloud to acquire SLAM services. The "on-demand" and service-oriented means here that the robot does not need to care about how the cloud implements the algorithm. It only loads the SLAM cloud service call package and constantly inputs necessary awareness data to obtain positioning results and map construction. The real-time performance is good. The robot path can be accurately controlled; the externally exposed interfaces of the cloud service can provide efficient and personalized SLAM services for multiple robots at the same time. Based on this, this paper proposes a framework for SLAM service based on cloud robot architecture, as shown in Figure 4.

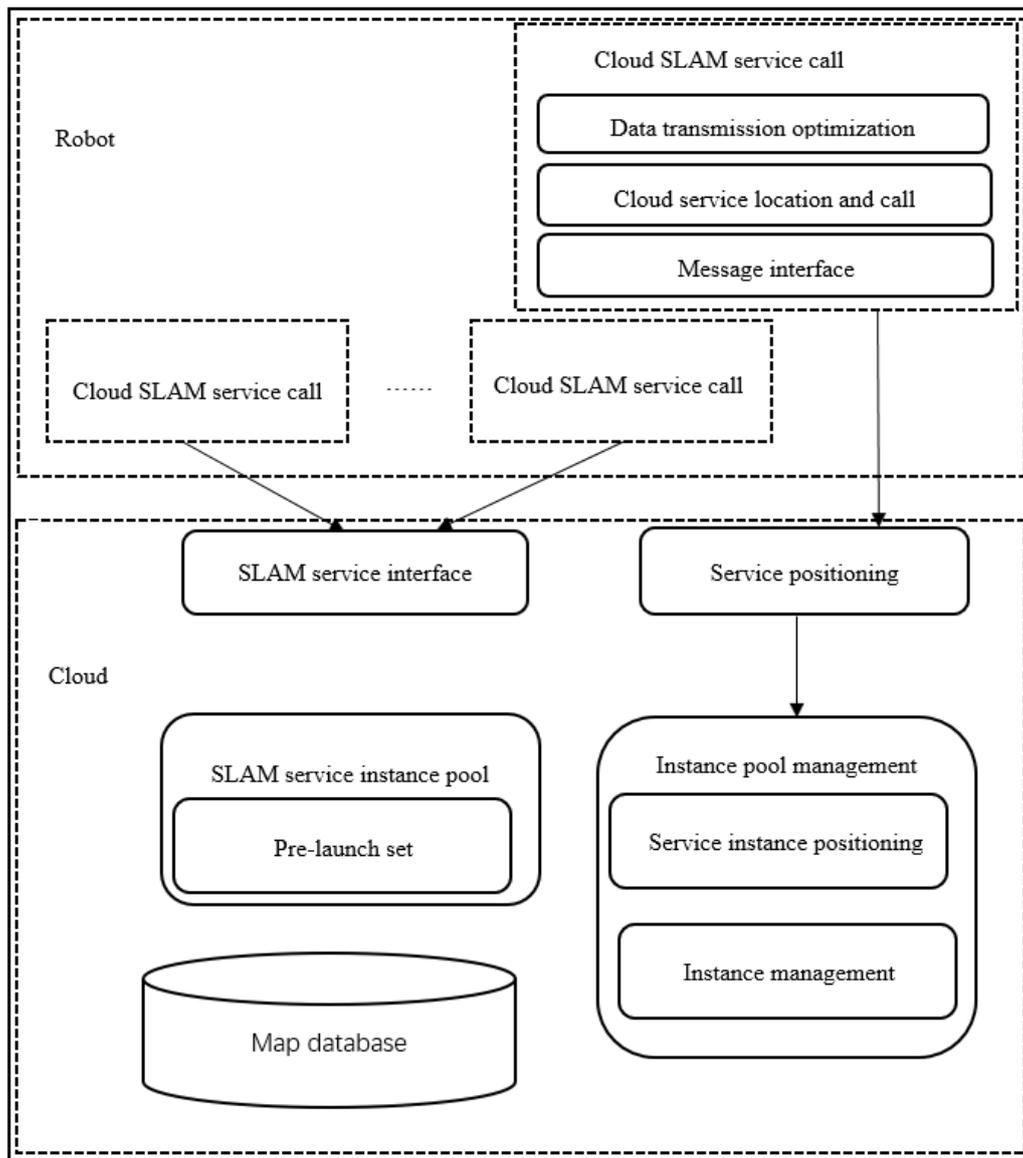


Figure 4 SLAM service framework based on cloud+robot architecture

From the figure we can see that the architecture mainly consists of two parts: the cloud part and the robot part. Next, explain the design ideas and implementation of these two parts. According to the above description, the cloud mainly provides services, namely SaaS mode and any services required by the robot are obtained from here. The main modules it contains are as follows: service entrance module, entrance module is the only module that interacts with the machine and the module accepts the robot requests and forwards it to the corresponding SLAM Execution Instance; the Instance Pool Management Module, which allocates resources for the SLAM Execution Instance. For example, when a request is received, an idle SLAM Execution Instance is found from the existing instance pool or Add a new SLAM virtual machine to the instance pool. The service instance pool module is responsible for the configuration and operation of the SLAM instance. The resource warehouse module, which is also the core module, stores all the algorithms. The robot mainly implements the service call of the SLAM and realizes the integration of the robot and the cloud computing and invokes the cloud computing service. In general, the service calling package mainly includes the following functions: starting and stopping the SLAM function; receiving sense data; current map and location of the query.

Through the analysis of cloud computing and robots, the SLAM algorithm can theoretically realize

the control of the robot path. Cloud computing has great advantages for data processing. It can locate robots and build maps in real time. We can use real-time data to the robot makes path adjustments, selects the optimal route, and reaches the destination.

4. Conclusion

Through the discussion of this article, we can see that in recent years, robotics technology has developed rapidly and has made some progress. People are increasingly demanding robots, especially their ability to perform tasks autonomously. However, due to the limited resources of the robot itself, it cannot meet the needs of complex tasks. The emergence of cloud computing can solve the problem of limited resources of the robot itself. One of the main features of cloud computing is the ability to provide various types of computing resources in the form of services. In this context, the combination of the two technologies has become a new research hotspot in academia. In the robot path control, the calculation-intensive robot SLAM task, the cloud robot architecture has great potential. In the last few years, many studies have been conducted in this area, but the current work is still at the level of feasibility verification. Therefore, this paper proposes a SLAM service architecture based on cloud robots to provide a universal SLAM solution for robots. In the future, the author of this article will continue to devote himself to the research in this area. He will continue to deeply study the integration of cloud computing and robots, and how to effectively control the robot during the execution of tasks.

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