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Evaluating the Performance of Monolithic and Microservices Architectures in an Edge Computing Environment

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ABSTRACT

Edge computing has become a popular paradigm in recent years for reducing network congestion and serving real-time IoT applications by providing services close to end-user devices. It is difficult to develop applications in an edge computing environment due to resource constraints and the diverse and distributed nature of edge computing nodes. The authors compared the performance of monolithic architecture and MicroServices Architecture (MSA) in edge computing environments to determine which architecture can better meet the diverse requirements imposed by edge computing environments. A single application has been developed using both MSA and monolithic architecture for water requirement prediction for irrigation in rice crop. In terms of peak throughput, MSA outperformed monolithic architecture by about 22%, and similarly for peak response times, MSA outperformed monolithic architecture by about 28%. The average CPU usage of MSA is about 49.26% less than the monolithic architecture.

KEYWORDS

Edge Computing, IoT, Microservices Architecture, Monolithic Architecture, Performance Evaluation

1. INTRODUCTION

The primary goal of the IoT is to bring everything online so that human participation is decreased, and the process becomes automated. IoT was initially proposed in 1999 by Kevin Ashton (Ashton, 2009), since then it has been gaining popularity and benefiting every aspect of human life. Smart cities (smart houses, smart buildings, smart surveillance) (Gharaibeh et al., 2017), smart healthcare (smart wearables, personal monitoring) (Catarinucci et al., 2015), commercial (shopping, retail), industrial automation (particularly production) (Atzori et al., 2010), and even agriculture (Elijah et al., 2018)(Brewster et al., 2017) have all benefited from the IoT in recent years. IoT is becoming increasingly important in today's digital age, resulting in a rapid increase in the number of connected

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devices (Middleton et al., 2015). Such widely distributed IoT devices at the network's edge will generate massive amounts of data. Increased bandwidth usage, delay, and network congestion are anticipated as a result of processing, analyzing, storing, and transmitting these huge amounts of data in the centralized cloud (Shi et al., 2016)(Shi & Dustdar, 2016). Furthermore, because cloud servers are located far from IoT end-user devices, cloud computing cannot meet the needs of IoT applications that demand real-time response, such as fire alarm warning systems, healthcare, and self-driving cars (Bangui et al., 2018)(Dastjerdi & Buyya, 2016).

Edge computing, which delivers services closer to IoT end-users, has become a popular paradigm in recent years for reducing network congestion. In edge computing, end-user IoT data is processed at the edge of the network as near to the originating source as possible. By providing services closer to IoT end-users, edge computing is serving real-time IoT applications without the need for high-speed Internet access (Satyanarayanan, 2017). Compared to cloud computing, edge computing offers advantages such as reduced network congestion, real-time response, and privacy. Edge computing architecture is displayed in Figure 1, which consists of three layers, namely the device layer, the edge computing layer, and the cloud computing layer.

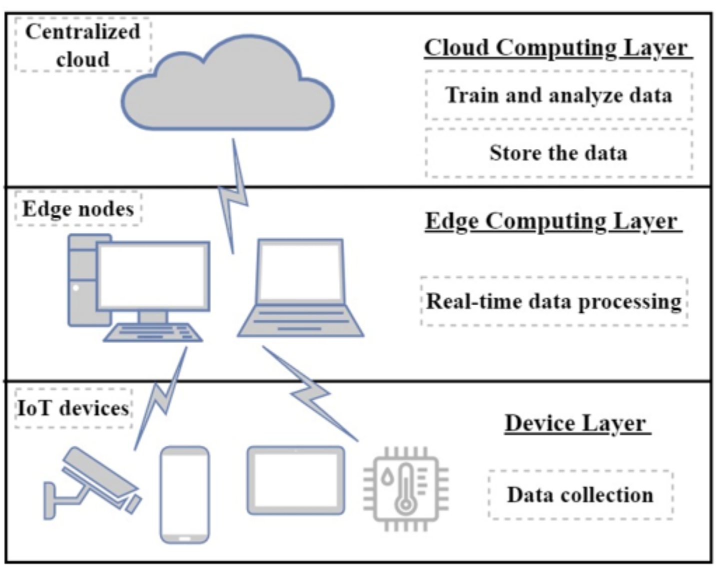
Device Layer

The device layer includes all IoT devices such as sensors and actuators, security cameras, tablets, and mobile phones etc. All connected devices at this layer have a ubiquitous presence on the Internet.

Edge Computing Layer

At this layer edge nodes such as dedicated hardware, switches, routers, and small data centers act on the raw data. Edge nodes located at the edge computing layer are devices that can direct network traffic and have limited computing power. The data produced by the device layer is no longer transferred directly to the cloud computing layer but is instead processed and analyzed locally at the edge computing layer, providing real-time feedback to the end user.

Figure 1. Edge computing architecture



Development of Community Based Intelligent Modules Using IoT to Make Cities Smarter

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