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Perspectives of Using Load Balancing for Supporting Devices in Reconfigurable Ubiquitous Environments

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ABSTRACT

The user can access data and services anytime and from any location, thanks to ubiquitous computing. As a result, device collaboration is essential. The devices and networks become overloaded as a result. As a result, the network becomes unstable, and network activity is suspended. By addressing these load-balancing issues with the new necessity of ubiquitous environments, these systems may be able to move toward greater user/device collaboration and mobility in the future. For various types of devices, this position paper shows how reconfiguration is one of the critical solutions for reducing energy usage in ubiquitous surroundings. We suggest a new way to adjust the distribution of device components as soon as high energy consumption is detected to lower and/or balance the energy consumption.

Keywords: Ubiquitous computing, load balancing, device energy consumption

I. INTRODUCTION

With context sensitivity, invisibility, and mobility capabilities, ubiquitous computing is applicable to all fields (Abbas & al., 2020 ; Abunaser & Alshqttnawi, 2013). The real benefit of these ubiquitous systems is that they are sensitive to the human environment (geo-location, the availability of communications networks, user identity, etc.). These systems enable user mobility. In other words, since the human being is the source of all information, the system must adapt to him in real-time and everywhere (Guan & al., 2011). According to this concept, ambient intelligence implementation necessitates applying technological expertise to provide services specific to consumers' demands (Stieninger & Nedbal, 2014).

When a set of devices must communicate and interact with their surroundings in a ubiquitous world, the environment and such devices must be able to recognize changes in context and let the user adapt their behavior. Communication and cooperation between many devices (sensors and actuators) are necessary for this auto-adaptation, which results in significant energy consumption (Mastelic & al., 2014).

In this article, we suggest changing how the components are distributed across the devices to decrease and balance energy usage. For various types of devices, this position paper shows how reconfiguration is one of the critical solutions for reducing energy usage in ubiquitous surroundings. The goal is to have mobile access, assure the availability of data and services at any given time, and detect high energy consumption that results from environmental objects cooperating.

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The rest of the paper is organized as follows: Section II presents a background of ubiquitous systems, reconfiguration, and load balancing. Section III details our proposal. Finally, a conclusion and perspectives are described in section IV.

II. BACKGROUND

A. Ubiquitous System

A group of technologies (hardware and/or software) known as ubiquitous computing is used in our daily lives (Abbas & al., 2020).

Ubiquitous computing is the third era of computing history. In this era, users will have mobile access to data and processing to provide the optimum service circumstances, considering their physical surroundings. The user has access to several devices. To work together and access information, these devices must be able to communicate with one another and with their surroundings. Users then can share data quickly, easily, and independently of their location and geography. The ease of access to information significantly impacts society and alters workplace practices and personal privacy.

B. Reconfuguration

Architecture of devices that can be changed have become necessary. They compromiseparticular circuits' performance and programmable solutions' adaptability (Wijtvliet, Waeijen, & Corporaa, 2016 ; Podpbas, Sano, & Matsuoka, 2020) .

Reconfigurable architectures have altered system design because of their flexibility and adaptability. If at least one of the components it defines, such as processing or communication resources, is reconfigurable, architecture can be said to be reconfigurable. To be consistent with the characteristics of these architectures, new application fields are opened.

Two different types of reconfigurations exist:

(1) Static reconfiguration. It involves altering a system after it has been shut down and could come with hazards like getting an incoherent system. This type of reconfiguration has the potential to be disastrous.

(2) Dynamic reconfiguration. It refers to changing a system while it is operating. It mainly pertains to systems that can't be changed by stopping them. As a result, it maintains some system availability by decreasing downtime.

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C. *Load Balanding*

In computing, load balancing refers to a group of methods for dividing the workload among several computers. These methods make it possible to respond to a service's heavy load by dispersing it over several servers and to lessen the possibility that this service won't be available due to a server's software or hardware failing.

Optimizing resource consumption, increasing throughput, reducing response times, and preventing resource overload are the goals of load balancing.

III. PROPOSED WORK

We intend to reconfigure various types of devices to reduce energy usage in ubiquitous surroundings. The method entails a monitoring strategy, interpretation, analysis, and reconfiguration of constantly operating systems.

A. *Position Description*

Our contribution is based on the idea of a ubiquitous network comprising nodes (devices, hosts, sensors, etc.).

Every node interacts with its neighbors and is aware of its surroundings (neighbors). The network is split up into clusters of nodes.

A controller positioned at the level of each cluster head oversees analysis, detection, and adjustment when high energy consumption is detected.

The Controller delivers a Detection agent to the user node for each node that belongs to the cluster. The Detection agent's primary task is to gather data (information) on how the system works and how much energy it uses and to evaluate and contrast the system's performance.

The Controller describes the proper measures to perform in the event of a malfunction, which could result in a change and/or overload of the device, to get out of the malfunction state and have a reconfiguration.

B. *Step Detection of Energy Overload*

Figure 1 depicts how our solution works; it has four components: the Knowledge Base, behavior, control, and action.

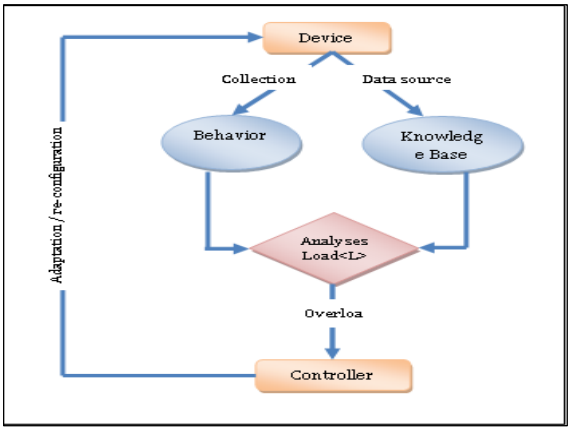

Fig. 1. Step of proposal

Knowledge bases are created using information (data) on system operations and a device's energy usage. This foundation is archived.

By gathering information (data), the user node's current behavior is developed.

A comparison of the present behavior and the device's knowledge base is made as part of an analysis and control process to find anomalies in the behavior node/energy overload.

To decrease and/or balance energy consumption, we adjust the distribution of the components on the devices when we detect high energy consumption.

a) Device. The device is designed to perform a specific function, such asa calculation. When an application (process or task) is changed, the device experiences an energy overload from the new task.

b) Detection Agent. It performs data collection and comparison with the device knowledge base. Also, it notifies the head of the controlling cluster when the device's present behavior deviates from its typical behavior.

c) Controller. The Controller manages the device's or system's adaptation to the new situation (application) by cooperation or modification.

- Cooperation. In this case, the Controller uses numerous devices in the same cluster to share processing (calculation).

- Modification. Here, the Controller modifies the quote to fit the new circumstance while enhancing the device's capacity to minimize or balance the load's energy consumption.

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IV. CONCLUSION

The main goal of this effort was to load balance devices and reconfigure them to reduce energy usage in ubiquitous contexts. We created a method for spotting high energy use, enabling you to monitor how much each node and network is used. It entails looking for abnormalities that could result in overload and acting to prevent it.

Then, after outlining our strategy, we presented a new method for building an authentication-based user knowledge base. We are interested in how a node interacts with the network.

This article is a work in progress that presents concepts that will be expanded upon in our subsequent work.

In the future, we will finish the overload detection architecture, create the reconfiguration process, and design and assess our energy-saving strategy.

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