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Development of web-based collaborative framework for the simulation of embedded systems

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Abstract

Cyber Physical System (CPS) and Internet of Things (IoT) are hot objects of interest as an extension of the embedded system. These interactive products and systems contain Mobile Devices which are most popular and used most frequently. Also these have been widely used from the control of the Nuclear Power Control System (NPCS) to IoT Home Service. Information & Communication Technology (ICT) topics of trend fused-complex current Information Technology (IT) and Communication Technology (CT) are closely linked to real space and virtual space. This immediately means the arrival of the ultra-connected society. It refers to a society in which various objects surrounding the human innovation and change in the social sector are expected through the connection between the data which are to be generated. In addition, studies of Tool-kit for the design of such systems are also actively pursued. However, only increased cooperation and information sharing between the physical object consists of a variety of machinery and equipment. We have taken into consideration a number of design variables of the high barriers to entry about the product.

In this study, It has been developed a Web-based collaboration framework which can be a flexible connection between macroscopically virtual environment and the physical environment. This framework is able to verifiy and manage physical environments. Also it can resolve the bottlenecks encountered during the base expansion and development process of IoT (Internet of Things) environment.

Keywords: Web-based platform; Simulation; Internet of Things (IoT); Cyber Physical System (CPS); Embedded System

1. Introduction

Subjects of Information & Communication Technology (ICT), the Information Technology (IT) and Communication Technology (CT) fused-complex closely connected to real space and virtual space have been in in limelight recently. There has been a remarkable development of network technology, including an actuator that actually works, sensing using the sensor, the part that controls modules. As a result, the cooperation and information sharing between the physical object consisting of a variety of machinery and equipment has become closer. That is, we can obtain the necessary data from various sensors and then produce the information obtained by the extraction and analysis, finally it provides the actuator that influences the operation of the controller. A series of processes allows the user center of Context-aware Service through exchange and collection of status information, interpretation and reasoning.

However, this environment is much more complex than the environment that is not connected to previously. In addition to that it has high barriers to entry and must consider a number of design variables to design the system.

In recent years, many companies and related societies are much more aware of Internet of Things (IoT). Start of IoT has evolved the development of (Radio-Frequency Identification) RFID technology and network. IoT is a similar concept as

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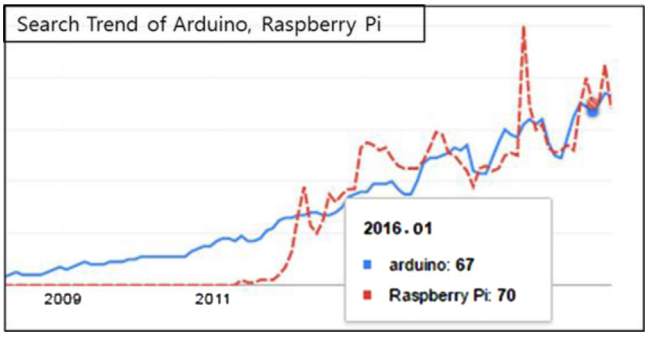

Fig. 1. Search trends of embedded system.

Machine to Machine(M2M) has, and we have to clarify the differentiation. When viewed as a category of existing concepts that up to several types of communications via a connection to the device, IoT is highlighted for providing services that can benefit more users in a wide range. Arduino [13] or Raspberry Pi, such as parts used in embedded systems are rapidly growing. Fig. 1 illustrates the search trends of Arduino and Raspberry Pi. Health Wearable Device is one of its examples. It is capable of tracking the physical activity that is the user can check the number of steps, such as heart rates. In this reprocessing by using the tracking information, such as physical activity, results can be presented to the user as proactive proposals and recommendations.

In a broad perspective, the design of the system described above, the developer can interconnect a virtual environment with the physical process of the connection you want. However, steps to configure the hardware and software together are very difficult in this process. Also, it does not have the system for verification and management. In order to solve the bottleneck in these procedures, constructing a IoT Simulation virtual environment is always necessary. If the developer builds a model and predicts the outcome in advance through a simulation, it is possible to verify the initial intent of developers and reduce trial and error before the actual design.

In this study, it has been developed a web-based collaboration framework which can be a flexible connection between macroscopically virtual environment and the physical environment along with physical verification/management to attempt to resolve the bottlenecks encountered during base expansion and development process of IoT environment.

This paper is organized as follows. In Section 2, we discuss the trends of the related research that has been done and in Section 3, we describe the proposed web-based collaborative framework. Scenarios-based projects will be conducted within the framework and each project's simulation environment is developed by open source Application Programming Interface (API). In Sections 4 and 5, we discuss the results and conclusion.

2. Related works

Because of the unique properties of the complex diverse and unique Internet of Things system, people have experienced difficulties in IoT Software Development. Recently many studies about the configuration of IoT framework have been conducted. These studies include a form of design verification through the management and simulation of IoT environment. Lina Yao and Quan Z. Sheng [7] provided integrated Web-based interface for managing the IoT environment, and developers are able to make better decisions in environment that they have placed. Lina Yao and Quan Z. Sheng's system utilizes a hierarchical framework, which can share and manage the information generated by the physical sensor.

Ho Dong Ryu and Soo Yong Jeong [8] provided a method for ensuring the reliability and stability of embedded systems which are used in IoT. This method is used to build a virtual execution environment of the software in the process of embedded systems development and analyze real-world scenarios function performed by the path difficult to efficiently perform unit tests in a way to advance the unit tests.

The development of embedded systems, since the hardware and software elements are concurrently included, is experiencing difficulties. Recently, research on web-based modeling and simulation is increasing [1-3].

Xuan FU Zha [9] developed a web-based framework for collaborative design of Micro-Electro-Mechanical Systems (MEMS). This framework provided different users involved in the design process from other locations and linked to the social information and can be simulated and verified from the use of client-server distributed knowledge by the design rules imposed on the additional process, verifying the expected performance simulation from the design rule violations and violation of procedure process.

Designing and development of embedded systems, is one of the most complex software development methods. It is not easy to build embedded systems software of virtual execution environment for embedded systems development. An effective way to design and implement such a complex application is modeling and simulation (M & S) [4-6].

Mohammad Moallem [10] proposed a method to solve the discontinuity between the simulation model and the final embedded software on the basis of modeling and simulation.

Seung Woo Kum and Tae Beom Lim [11] proposed the IoT integrated control framework to support the user's status information management. The proposed framework is raised to support the development of IoT services by providing an integrated management service of the IoT and single API for service configuration. Also is built a test bed for the real IoT devices and services to verify the reliability of the proposed framework.

Yong Jin Jeong [12] et al. described the prototyping embedded software development methodology that reflects the uniqueness and differentiation during development and use virtual prototyping development methodology to simulate the embedded system. IoT environment may be thought of as a combination of a number of embedded systems. It is necessary to understand the nature of the various fields of embedded systems in collaboration between system developers. Effective problem solving method while working on a project is using real prototyping. However, there is a limit to the test by creating a real prototype. So, in this study, it has been developed a Web-based collaboration framework which can be a flexible connection of macroscopically virtual environment and the