A Smartphone Connected Software Updating Framework for IoT Devices

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***Abstract*—This paper proposes a software framework and hardware architecture to exchange the binaries and profiles from smartphones to IoT devices and reprogram devices with smartphones. This scheme, when included in a system of smartphones interconnected with locally deployed IoT devices in wired or wireless manners, can be used to implement a practical updater.**

***Keywords*—Internet of Things, smart device, IoT device, integrated packaging, dynamic updates;**

I. Introduction

As an extension of IoT technology and the wearable device market, numerous personalized services connected with smart phones are steadily increasing. In particular, studies on ubiquitous personalized services including u-Health, environment monitoring, security, and social networks for collecting the sensing data from a sensor field using a smartphone are being conducted[1-2].

Over the last few years, various projects to update a wireless IoT device have been studied. However, a large number of these researches require an OS or middleware support installed into the processor in advance[3-4].

For the OS independent reprogramming of IoT devices, this paper proposes a software framework to abstract the communication channel and type of micro-processor of an IoT device and a hardware modular board to update an application of a light-weight IoT device connected with an application on a smart phone.

II. Problems

In particular, this research focuses on OS-independent updates, heterogeneous IoT devices support, and interoperation with a popular commercial smart phone ecosystem. To resolve the above issues, we suggest the use of the a software framework and a updating hardware architecture, which enables users to easily update the program of IoT devices

This architecture is composed of a smart phone ecosystem, integrated packaging, a modular hardware for updating, and a software framework.

The remaining section describes these research items in greater detail.

III. Proposed Architecture

Figure 1 shows a smart phone ecosystem and integrated app packaging to update IoT devices dynamically using smart phones.

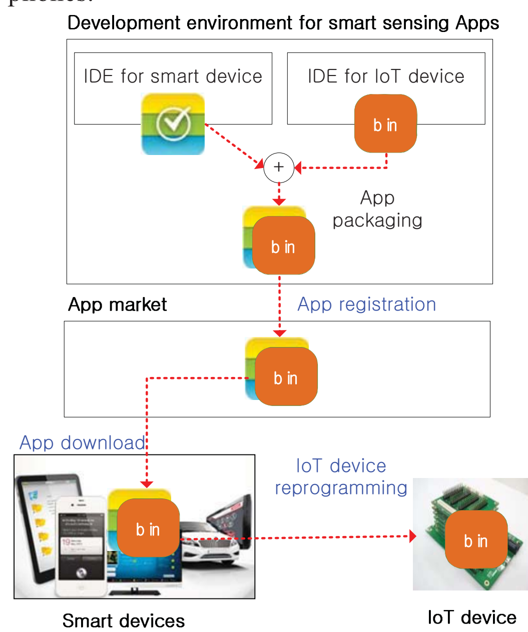

Fig. 1. Smart phone ecosystem and integrated packaging

IoT device application deployment and updates within the application ecosystem of smart phones interacting with IoT devices consists of integrated app packaging, app registration on the App market, app download and execution, and the reprogramming of IoT devices.

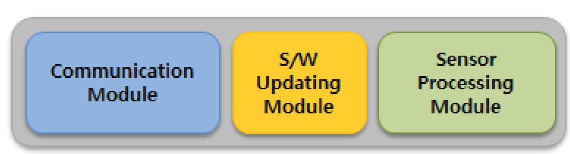

Fig. 2. Hardware architecture of update supporting IoT device

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The IoT device supporting the proposed architecture in this paper is composed of a communication module, software updating module, and sensor processing module, as shown in Fig. 2.

The communication module sending and receiving data with a smart phone can support Bluetooth, Wi-Fi, UART, and Bluetooth Low Energy (BLE) communication. In this paper, we focus particularly on Bluetooth, BLE and UART updating.

A sensor processing module usually embedded a light-weight micro-processor, such as Atmel AVR and TI MSP, and gathers and processes sensing data from attached sensors and transfers processed data through the communication module to the smart device.

As an extra module to maintain the latest application for the processor of the sensor processing module, the software updating module supports various updating protocols and interfaces as the processor type that IoT devices have.

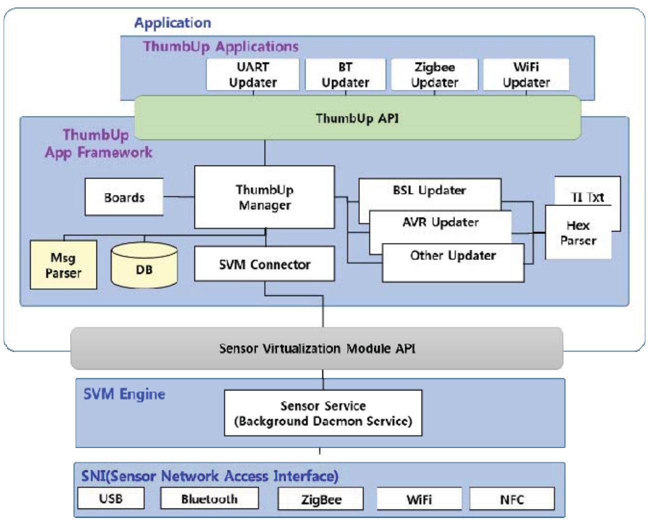

Fig. 3. ThumbUp overall software architecture.

The dynamic update software running on smart phones for IoT devices is composed of the *ThumbUp App framework*, which can be used to develop smart phone applications, and *ThumUp Applications*, for personalized services containing a wired or wireless updating service such as shown in Fig. 3.

The *ThumbUp App framework* is a group of software components implemented by the communication channel abstraction APIs, and the *sensor virtualization module* (*SVM*) enabling easy access to IoT devices as a background daemon service on the smart device. *SVM* also enables virtualizing external sensors so that smartphone applications can easily utilize a large number of sensing resources.

IV. RESULTS

Table1 shows a list of boards supported by the proposed updating system architecture. Currently, the architecture supports an Arduino board, which is widely used for the purpose of DIY hardware, TelosB, which is a popular prototype board in wireless sensor networks. In addition, it also provides a device update service to the MSP430F5438 device developed for testing.

TABLE I. APPLICABLE BOARDS

Board	Processor	Communication
Arduino	ATMega 2560	UART, Bluetooth, BLE
TelosB	MSP430F1611	UART
Custom	MSP430F5438	UART, Bluetooth, BLE

Figure 4 shows the result of binary updating speed tested and measured as each communication type. We measured the updating speed with Arduino Mega SDK through UART, BT 2.0 and BLE communication modules.

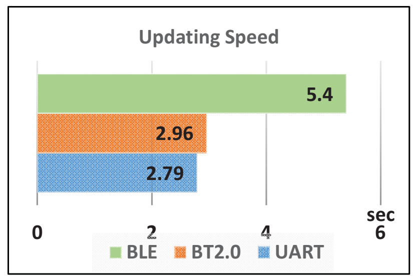

Fig. 4. Updating speed comarison (binary size 4513 bytes)

V. CONCLUSIONS

This paper suggested a software updating technology, which is composed of a software framework based on an integrated app packaging and a modular hardware supporting the reprogramming of IoT devices without the aid of a special OS or middleware.

ACKNOWLEDGMENT

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