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A System Functions Set-Up through Near Field Communication of a Smartphone

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***Abstract*—**We present a method to set up system functions through a near filed communication (NFC) of a smartphone. The short communication distance of the NFC which is usually less than 4 cm could prevent any interferences from other devices and establish a secure communication channel between a system and the smartphone. The proposed set-up method for system function values is demonstrated for a blacbox system in a car. In demonstration, system functions of a blackbox which is manipulated through NFC of a smartphone are controls of image quality, sound level, shock sensing level to store images, etc. The proposed set-up method for system function values can be used for any devices with NFC.

***Keywords*—**System set-up, near field communication, smartphone, Android.

I. Introduction

SMARTPHONES have become indispensable gadgets in our lives as a telephone, a scheduler, a message sender and receiver, a multimedia player, an internet browser, and various other working device through installed application programs [1]. Cellular phones have recently evolved into smart machines, smartphones, of which functions are beyond the capability of desk top personal computers in some respects. One of the technological developments realized in smartphones is a wireless communication function [2]. The wireless communication function in smartphones had begun with the Bluetooth technology which has developed mainly for replacement of cables to connect between a cellphones and other communication device such as a personal computer, a multimedia player, etc. [3]. After the adoption of the Bluetooth technology by phones, other wireless technologies such as wifi and near field communication technologies have been proposed and applied to smartphones [4]. The wireless communication technologies have changed our lives such that the smartphones can be used as remote controllers, web browsers, and even as financial transaction gadgets. For the financial transactions, NFC technology is mostly employed to communication between two devices because the working distance of NFC between the two gadgets is usually less than 4 cm, which can be advantageous in terms of avoiding rf signal interferences and preventing tapping of signals between two devices [5].

In this paper, we apply the NFC technology to set function values of a system, which, in our case, is a blackbox. By employing the NFC technology to set function values of a blackbox, we can eliminate function keys, or display panel to set and to control function values in the blackbox. In addition, setting up and control values of functions through NFC enables users to access the system through user friendly interfaces of smartphones. To implement our system, we use an Android smartphone with which most NFC applications have been realized.

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II. Android Machine

Android and iOS are popular operating systems for mobile devices such as smartphones and tablets [6]-[10]. Android is a mobile operating system which uses the modified version of the Linux kernel, Fig. 1. The kernel is for core system services such as driver model, process management, memory management, etc. The middleware which provides services to applications beyond the services of the operating system includes system applications and libraries. To make applications, developers of Android can utilize application frameworks to access to device hardware and to installed functions. Application codes for Andriod mobile devices are made by Java programming language. IOS is another mobile

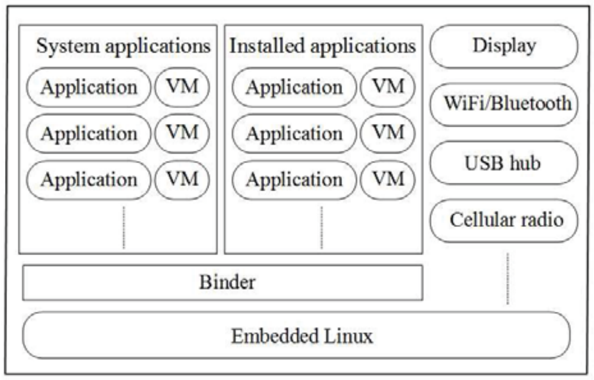


Fig. 1 Android architecture

operating system for products of Apple Inc. such as iPhone, iPod Touch, and iPad. IOS consists of four layers: the Core OS layer, the Core Services layer, the Media layer, and the Cocoa Touch layer, Fig. 2.

The Core OS and Core Services layers have the fundamental interfaces for accessing files, network sockets, low-level data types, etc. The Media layer includes fundamental technologies for drawing, audio, video and animation. The Cocoa Touch layer contains key frameworks for building iOS applications. The frameworks provide application basic structure and support for multitasking, touch based input, and determine appearance of an application. The Cocoa Touch is based on objective C.

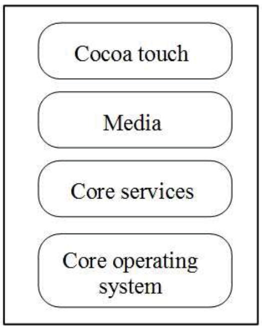


Fig. 2 IOS architecture

Between the two OSs', we use the Android OS to implement our system, because Android OS is easy to access to realize applications in a system, and because most NFC applications have been developed using Android OS. Apple has recently adopted the NFC in its system for financial transactions.

III. Near Field Communication Technology

For wireless communications between two points, several wireless communication technologies have been suggested, such as Bluetooth, WiFi, Zigbee, IrDA, RFID, NFC, etc. Each technology has its own purpose and adequate environment for its application.

TABLE I
Wireless Communication Technology for a Mobile Device

	Purpose	Range (m)
Bluetooth	Replacement of cables	10
Wi-Fi	Replacement of LAN	100
Zigbee	Control and monitoring	100
IrDA	Light-of-sight communication	1
RFID	Identification	100
NFC	Two way interaction	0.04

Bluetooth technology has been developed to replace cables between devices using UHF radio waves from 2.4 to 2.485 GHz and the working distance of the technology is usually less than 10 m, while about 100 m working distance of the bluetooth technology has been reported by increasing the source power of the bluetooth.

WiFi of which radio bands are 2.5 GHz UHF and 5 GHz SHF is proposed to replace local area network. The WiFi can connect to internet via a wireless network access point. The working distance of WiFi is about 20 m for indoors and a range of 100 m for outdoors.

Zigbee, developed for low power consumption and low data rates, is usually applied to monitoring and control for sensor networks. Its radio bands are 2.4 GHz in most countries, 915 MHz for Americas and Australia, and 868 MHz for Europe [11].

IrDA uses infrared light, to communicate between two devices [12]. While the infrared light can propagated far distance, its working range is assumed less than 1 m due to the working environment of the technology in use, because it cannot propagate through physical obstacles which exist on the path of the light. The IrDA requires a line of sight between the two devices.

RFID is for identifying and tracking tags attached to objects [13]. The working distance of RFID ranges from 10 cm to 100 m depending radio frequency and source power. The frequency of RFIS includes LF(120 -150 kHz), HF(13.56 MHz), UHF(433 MHz), 865-868 MHz, 902 -928 MHz, 2.45 - 5.8 GHz, 3.1 - 10 GHz.

NFC technology can replace the above mention technologies for short distance range communications. NFC is implemented by a loop antenna which induces electromagnetic induction to communicate with other NFC through the other NFCs' loop antenna. The short working distance of the NFC technology can be advantageous for credential communications such as financial transactions, file reading, file writing, because it can avoid radio frequency interferences and eavesdropping of other devices. Apple has recently adopted the NFC function for mobile payments.

In our proposed method, we use the NFC technology to set up function values for a blackbox of which function values should not be affected from rf signals of other devices, Fig. 3.

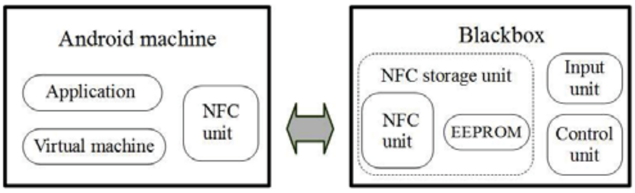


Fig. 3 Diagram of Andriod NFC communication with a blackbox

IV. Proposed Scheme

Using the NFC of a smartphone, we present a method to set function variables of a blackbox. There are many kinds of blackboxes in the market. Some blackboxes provide the recording image through the video panel of it, other blackboxes have only a camera and a memory to store the video images, and still others are combined with navigations. Since the main purpose of a blackbox is recording surrounding images by a camera of the backbox, especially around the moment of a car accident, most blackboxes are released with a camera or cameras, and a memory in a compact volume. Advantages of small size blackbox are that it does not require a large space to be installed in a car and that it does not hinder the driver's view. However, from the manufacture's point of view, it is not easy to install the control panel on the small blackbox. To resolve the problem of installing the control keys in a blackbox, we employ the wireless communication technique, NFC, to set function values of a blackbox. By using the wireless setting of function values of a blackbox, we can even eliminate the control keys, further reducing the size of a blackbox, Fig. 4. To set function values of a blackbox, we use the NFC of a smartphone and the NFC chip in our blackbox. The short working distance between two NFCs'

Fig. 4 Setting function values in a blackbox using NFC

which is usually less than 0.004 m can avoid rf interferences from other rf sources.

In our NFC code to set function values of a blakbox, we include several functions such as recording image quality which is related to the image file resolution and size, shock sensitivity which may activate the image recording due to collision, volume control for audio message of the blackbox, a parking voltage to prevent the battery discharge, camera angle adjustment to get the better view through the blackbox, etc., Fig. 5.

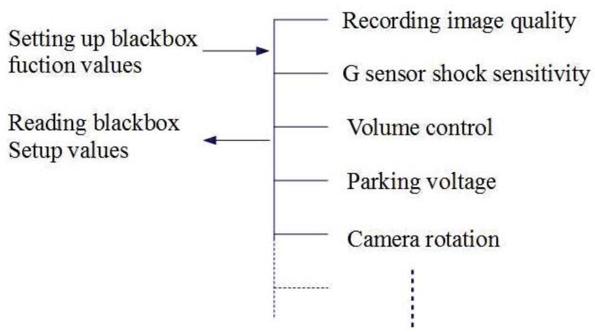
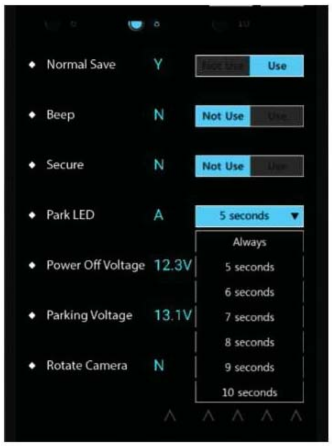


Fig. 5 Setup list

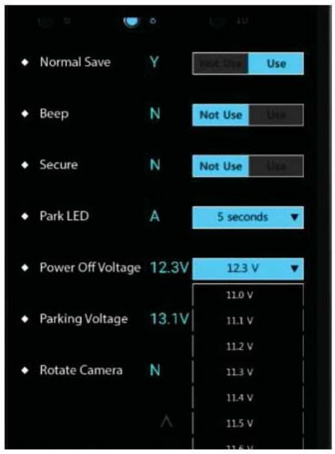
Fig. 6 shows three cases of setting function variables, LED blinking time setup, power off voltage setup and parking voltage setup. Through the NFC connection between a smartphone and the blackbox, those setup values can be transferred to the blackbox.

V. Conclusion

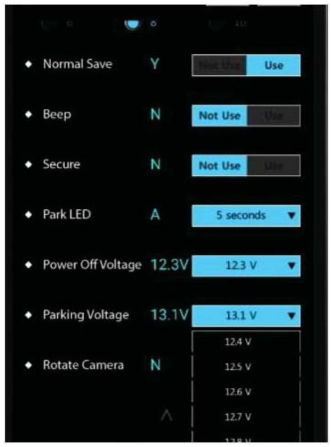
We examined several wireless communication technologies such as Bluetooth, Zigbee, RFID, etc., to set function values for a system and present a method to set up system function values through NFCs' between a system and a smartphone. The short communication distance of the NFC which is usually less than 4 cm could prevent any interferences from other devices and establish a secure communication channel between the system and the smartphone. The proposed set-up method for system functions is demonstrated for a blacbox system in a car. In demonstration, system functions of a blackbox which is manipulated through NFC of a smartphone are controls of image quality, volume level, shock sensing level to activate the image recording, etc. The proposed set-up method for manipulation of system function values can be applied to any devices which have the NFC function.



(a)



(b)



(c)

Fig. 6 Setup functions (a) LED blinking time setup (b)power off voltage setup (c) voltage setup for parking state

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