IoT Approach to Stick for Elderly People

Cheulwoo Ro[1], Taehee Kim[2], Jangwon Yoon[3], Mingyu Ju[4]

[1]Departtment. of Computer Engineering, Silla University, Korea

[2]Department of Game and Contents, Youngsan University, Korea

[3]ION, Inc., Korea

[4]Recursivesoft, Inc. Korea

Abstract

***Abstract*—An approach to a transformation of a passive stick into an IoT stick that could communicate a user's smartphone thus beyond. Once a device is connected to a smartphone, then the capacity of connectivity drastically expands. Any falling-off accidents by the stick user, the elder, is detected by motion sensing mounted on our stick triggers a generation of an alarm that is notified to a remote guardian over the network. In addition, heartbeat sensing and step counting are implemented to assist the user to monitor the health condition. The stick can also be used as a gaming stick for helpful exercise and gaming.**

***Keywords*—Smart Stick, IoT, Bluetooth**

1. INTRODUCTION

Healthcare using IoT technologies presents one of the largest successful business opportunities in accordance with the change of the form of consumption and interests for aging [1,2]. The health management through detection of the pulse signal and assessment of the risk situations utilizing the accelerometer and location sensors can be performed. We develop smart stick and its contents to support the elder′s activation of cognitive behavior by this health management.

Sticks are convenient companion for those who need support for walking. Many elderly people use stick for walking assistance. The technological advancement allowed us to be able to build affordable stick that are smart and connected. We have built an IoT stick, i.e., a smart stick, and report the process in this paper in order to share our experience.

We first illustrate in this paper the motivation and desired functions that we wanted to achieve through our approach to smart stick. We then explain technological skills and our implementation process applied to the smart stick.

II. PURPOSE FOR SMART STICK

Those who need stick mostly have incomplete self-mobility. Thus when they fall off outdoor and unfortunately if there is no one attended near for help, there will be rare opportunity to be acknowledged of the accident. Falling-off of stick users is known to happen in a surprisingly frequent rate and we were motivated to save any attended falling-off using the IoT technology. We employed motion sensing and Bluetooth smart for this purpose.

On top of the basic functionality, we have implemented more services. We employed a heartbeat sensor to monitor health conditions of a stick user. Since walking steps could be counted using the motion sensing, we also implemented a step counter. All these functionalities have been connected to a user's smartphone using an application we implemented through a Bluetooth smart communication. Since any motions of a stick could be monitored in real-time by a smartphone using such connections, user exercise and game playing using a stick have also been implemented.

III. SYSTEM IMPLEMENTATION

First, we have chosen motion sensing to detect falling off by using an MEMS chip sensor that incorporates accelerometer, gyroscope, and compass of three degrees of freedom(DOF) respectively, composing a 9-DOF motion sensor. Once a stick has fallen off, a freefall motion followed by a knocking on the ground happens before the stick rests slanted. All these events could be detected straightforward by a motion sensor that we chose to use, that is MPU-9255 by InvenSense, Inc. Our logic to detect a falling off has been chosen to be the case of the stick lying for longer than 1 minute after a knock. Once this event is generated, the smartphone application notifies an alarm to a remote guardian who has been registered in advance by linking smartphone applications. If a falling-off is either false or recovered, the user of the stick could disable the falling off state by pressing a button within the 1 minute period.

The smart stick consists of a built in heart rate sensor on the handle and a fall and motion recognition sensor through a built-in 6-axis, accelerometers and gyroscopes on the main board. It communicates with the user's smartphone by built in Bluetooth LE chip [3,4].

The smartphone application we implemented is versatile. It has a communication channel with a stick via. Bluetooth smart, low energy Bluetooth communication. On the other side the smartphone maintains a communication channel with a cloud service. This time, we use Amazon cloud service. Over the cloud service, the smartphone application could talk to any other smartphone applications. Before use, the smartphone applications of the user of a stick and an associated guardian could be linked using a QR code. Then, any alarm generated by the smartphone application of the stick user will be transferred to guardian's smartphone application. The guardian could be family or anybody designated. On receipt of alarm, the guardian could view the GPS locational information of the stick user and of course could choose any actions including making a phone call.

Another functionality of our IoT stick is that a user could use a stick for exercise especially that could help users to strengthen muscles and sense of balance to prevent falling-off. Since the stick has motion sensing functionality [5,6], the motion information of an exercise of a user could be transferred to the user's smartphone. The exercise motions are guided by the user's smartphone.

Other functions implemented are heartbeat counting and step counting. Heartbeat is counted by a light-based heartbeat detector. Steps are counted by the motion sensor. The microprocessor that is imbedded in the motion sensor carries out various signal processing and tapping is one of the functionalities that can be used for step counting. The biometric information by the history of motions are used to monitor the user's activity and statistics are obtained over time in order to provide advises on user's health condition and any other helpful suggestions.

We identified that the device design issue is important in the sense of how the design of an IoT enforced stick ought to be different compared to the conventional stick. The result of thoughtful design consideration is shown in figure 1 below. Button operations and the use of information indicators have been strategically considered [7].

Figure 1 IoT stick design

IV. CONCLUSIONS

IoT stick is interesting because they drastically expand functionality of conventional passive stick. Motion sensing makes stick capable of detecting any falling-off, counting steps, and obtaining any motion information. Connectivity to a smartphone allows the stick connected to the whole internet to offer wide possibilities. This study could be applied to other approaches that use such connectivity to any passive devices to increase functionalities.

We expect the use of smart stick can improve health outcomes and enhance care coordination. And, we will constantly focus on improving the functions of smart stick, so as to advance the health of silver generations and the performance of their health care system by monitoring the usage of sticks, and looking for ways to expand upon programs that work. It will seek to be slow agility and action-oriented: evaluating existing stick activities, learning from experience, and changing & updating functions if necessary.

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