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Internet of Things for Smart Crime Detection

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Abstract

The rapid economic development in South Korea has resulted in increase of crimes. Timely detection and reduction of crimes are primary focus of police officers. Internet of Things (IoT) and increasingly cheap and wearable sensors can be used to facilitate this task. Generally, the application of IoT technologies to the fields of smart cities, smart logistics and healthcare can be seen more often. In this paper, we present the design of IoT based smart crime detection system. The proposed system is able to detect crimes in real-time by analyzing the human emotions.

Keywords: Internet of Things, crime detection, crime prediction.

1 Introduction

In recent decades, the economy of South Korea has developed significantly. This rapid economic development has resulted in increase of crimes. For example, National Police Agency says that the crimes in South Korea has increased by 37% from 475,369 in 2002 to 1,752,598 in 2011 [10]. Timely detection and reduction of these crimes are primary focus of police officers. Internet of Things (IoT) and increasingly cheap sensors (wearable and implanted) can be used to facilitate this task. Specifically, we can attach the wearable sensing devices to a user body, and perform emotion mining of a user to identify if he/she is in dangerous situation.

Generally, the application of IoT technologies to the fields of smart cities, smart logistics and healthcare can be seen more often. IoT technologies can be applied to smart cities in order to improve the daily life local residents. Li et al. [1] proposed a new IoT-based application, so called smart community that has several useful functions for local residents, such as neighborhood watch and pervasive healthcare. Bi et al. [2] investigated the impact of IoT technologies on enterprise systems in modem manufacturing. Xiao and Wang [3] proposed the intelligent traffic monitoring using various IoT technologies. IoT technologies can increase the efficiency of logistics. Li et al. [4] proposed a IoT-based configurable information service platform for product lifecycle management (PLM). Laisheng [5] proposed a modern logistics monitoring platform based on a set of IoT technologies. Hribernik et al. [6] proposed a IoT-based method for connecting the information and material flows in autonomous cooperating logistics processes. IoT technologies are applied to the healthcare in order to increase the efficiency of health monitoring of patience. Amendola et al. [7] presented an ongoing research on RFID technologies for personal healthcare. Jara et al. [8] proposed an interconnection framework for mobile health (mHealth) based on the IoT to perform continuous and remote vital sign monitoring of a patient. Fan et al. [9] proposed a smart rehabilitation systems in IoT that uses ontology to better understand condition and requirement of the patient.

In this paper, we present the design of IoT based smart crime detection system. The proposed system is able to detect crimes in real-time by analyzing the human emotions. In this paper, we first give detailed introduction to the various application fields of IoT. Then, we describe the proposed system that has the following modules: emotion sensing, emotion recording, crime detection, crime visualization and crime prediction. As far as we know, the application of IoT in crime detection is new although some researchers attempted to perform crime detection using sensing technologies.

The rest of the paper proceeds as follows. Section 2 discuss IoT application fields. Section 3 presents design of the proposed crime detection system. Section 4 highlights conclusion.

2 IoT Application Field

Numerous research are proposed on application IoT technologies to various fields. In this section, we discuss these research results.

Several researchers proposed the IoT-based applications for smart cities. Li et al. [1] proposed a new IoT-based application, so called smart community. The smart community embraces wireless communications and ubiquitous sensing technologies that enable to connect the smart homes in a local community, and provide several useful functions for local residents, such as neighborhood watch and pervasive healthcare. Bi et al. [2] investigated the impact of IoT technologies

on enterprise systems in modem manufacturing. Specifically, the authors discuss application of IoT technologies in data acquisition and sharing in manufacturing, information integration across the boundaries of enterprises, decision-making activities, and human and thing interaction. Xiao and Wang [3] proposed the intelligent traffic monitoring using various IoT technologies. The proposed method first performs vehicle identification by reading global unique EPC (Electronic Product Code) code using RFID reader. In order to determine the position of vehicle the GPS technology is used, and data of mobile objects are transmitted using GPRS scheme.

There have been numerous research on application the IoT technologies in logistics. Li et al. [4] proposed a IoT-based configurable information service platform for product lifecycle management (PLM). An abstracted information model is proposed as the basic means to describe PLM process. The authors perform data integration and intelligent interaction in PLM by combining ontology and representational state transfer (REST)-ful service. Zhengxia and Laisheng [5] proposed a modern logistics monitoring platform based on a set of IoT technologies. In order to identify goods, in the proposed method the authors use RFID technologies, where each goods is attached with the EPC. Wired and wireless communication means are used for transmission tasks, such as LAN and GRPS. Global positioning system GPS is used for location and tracking of goods. Hribernik et al. [6] proposed a IoT-based method for connecting the information and material flows in autonomous cooperating logistics processes. The authors represented the information flow as the multi-agent system (MAS) and material flow consisting of actual physical objects. The authors form IoT for transport logistics by combining these two flows, in which the logistics objects or “things” are capable of processing information, communicating with each other and taking their own decisions.

A number of researchers proposed IoT applications to solve healthcare issues. Amendola et al. [7] presented an ongoing research on RFID technologies for personal healthcare. The authors discussed the environmental passive sensors for collecting useful information, such as temperature, humidity, and other gases, about the user’s living environment. They also described body-centric RFID tags, such as wearable and implanted, for measuring various biological state of a person. Jara et al. [8] proposed an interconnection framework for mobile health (mHealth) based on the IoT. By proposed framework, it is possible to perform continuous and remote vital sign monitoring of a patient. It also enables patient monitoring by remote centers, and personal platforms such as tablets. The authors achieved it by proposing a personal clinical device used for the wireless transmission of continuous vital signs through 6LoWPAN, and patient identification through RFID. Fan et al. [9] proposed an ontology-based automating design methodology (ADM) for smart rehabilitation systems in IoT. The authors use ontology for better understanding the symptoms and medical resources to formulate a rehabilitation strategy and reconfigure medical resources according to the specific

condition and requirement of the patient. On the other hand, the IoT is used to provide a communication means between all resources.

3 IoT Technologies for Crime Detection

In this section, we describe the proposed system that has the following modules: emotion sensing, emotion recording, crime detection, crime visualization and crime prediction. Figure 1 shows the components of the proposed system.

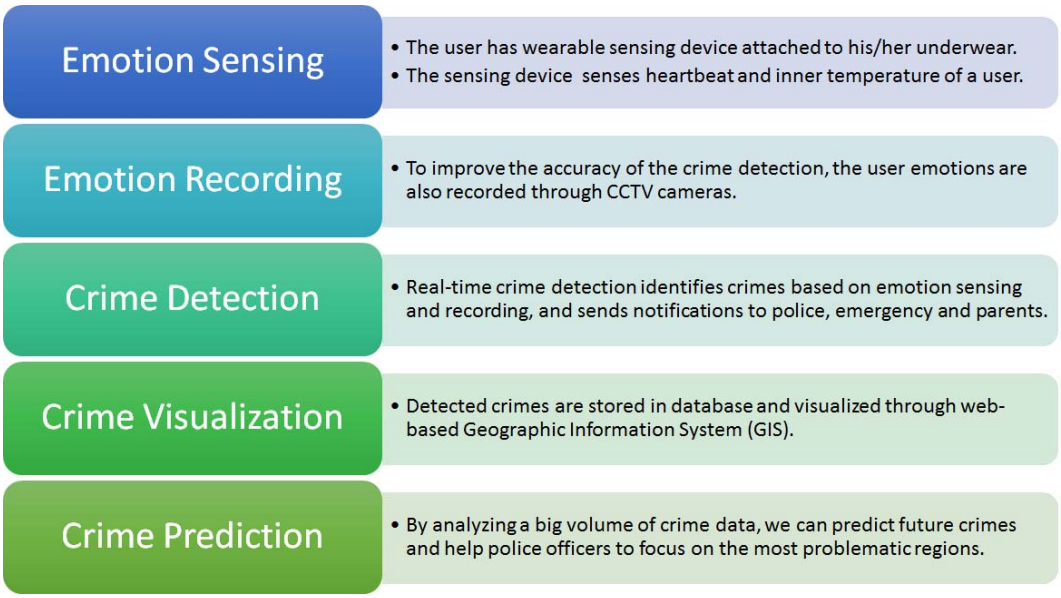

Fig.1. The components of the proposed system.

In order to identify if the user is in dangerous situation, wearable sensing device are attached to user underwear. These devices sense the heartbeat and body temperature of a user. However, the accuracy of emotions can be ambiguous. For example, the heartbeat of a surprised person can be identical to the heartbeat of a person in danger. Thus, in order to improve accuracy of emotion detection, the users are monitored through CCTV cameras. We programmed the CCTV cameras to identify over 36 emotional states of a user. In order to perform real-time crime detection, we apply k-means algorithm. K-means algorithm clusters Seoul regions into k groups, so that the total distance between the group's members and its corresponding centroid. Once crimes are detected, the appropriate parties, such as police, emergency and parents, are notified. Detected crimes are recorded in database, and visualized through web-based Geographic Information System (GIS). It has helpful functions not only for police agencies, but also to ordinary users. For example, it throws a warning message about potential risk when the user enters to the dangerous location. By analyzing the crime data using machine learning algorithms, we can discover meaningful patterns and trends that will be helpful for both police agencies and users. In this paper, we used decision tree

based classification model. The proposed method predicts crimes by analyzing the biological data of a person that are received by various sensor in his/her body.

4 Conclusion

In this paper, we introduced the design of IoT based smart crime detection system that is able to detect crimes in real-time by analyzing the human emotions. One of the main advantages of proposed method is that it is serves as a useful tool for both police agencies to determine crime and citizens to be on the safe side of the places they live in.

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