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Editorial

Applications of Internet of Things

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Abstract: This editorial introduces the special issue entitled "Applications of Internet of Things", of ISPRS International Journal of Geo-Information. Topics covered in this issue include three main parts: (I) intelligent transportation systems (ITS), (II) location-based services (LBS), and (III) sensing techniques and applications. Three papers on ITS are as follows: (1) "Vehicle positioning and speed estimation based on cellular network signals for urban roads," by Lai and Kuo; (2) "A method for traffic congestion clustering judgment based on grey relational analysis," by Zhang et al.; and (3) "Smartphone-based pedestrian's avoidance behavior recognition towards opportunistic road anomaly detection," by Ishikawa and Fujinami. Three papers on LBS are as follows: (1) "A high-efficiency method of mobile positioning based on commercial vehicle operation data," by Chen et al.; (2) "Efficient location privacy-preserving k-anonymity method based on the credible chain," by Wang et al.; and (3) "Proximity-based asynchronous messaging platform for location-based Internet of things service," by gon Jo et al. Two papers on sensing techniques and applications are as follows: (1) "Detection of electronic anklet wearers' groupings throughout telematics monitoring," by Machado et al.; and (2) "Camera coverage estimation based on multistage grid subdivision," by Wang et al.

Keywords: internet of things; intelligent transportation systems; location-based services; sensing techniques and applications

1. Introduction

In recent years, the techniques of Internet of Things (IoT) and mobile communication have been developed to detect human and environment information (e.g., geo-information [1,2], weather information [3,4], bio-information [5,6], human behaviors [7,8], etc.) for a variety of intelligent services and applications. The three layers in IoT are sensor, networking, and application layers [9–11]. For sensor and networking layers, the rise of mobile technology advancements [12–15] (e.g., wireless sensor networking, Wi-Fi, Bluetooth, smart mobile device, and Long Term Evolution (LTE)) has led to a new wave of machine-to-machine (M2M), machine-to-human (M2H), human-to-human (H2H), and human-to-machine (H2M) communications [16–20]. For the application layer, several IoT applications, which include energy [21,22], enterprise [23,24], healthcare [25,26], public services [27,28], residency [29,30], retail [31,32], and transportation [33,34], have been designed and implemented to detect environmental changes and send instant updates to a cloud computing server farm via mobile communications and middleware for big geo-data analyzes [35,36]. For instance, on-board units in cars can instantly detect and share information about the geolocation of the car, speed, following distance, and gaps with other neighboring cars [37–40]. While the area of IoT applications and mobile communication is a rapidly expanding field of scientific research, several open research questions still need to be discussed and studied. Therefore, the aim of this special issue is to introduce the readers a number of papers on various aspects of IoT applications.

This special issue has received a total of 23 submitted papers with only 8 papers [41–48] accepted. A high rejection rate of 65.21% of this issue from the review process is to ensure that high-quality papers with significant results are selected and published. The statistics of the special issue is presented as follows:

- Submissions (23);
- Publications (8);
- Rejections (15).

The distribution of authors' country is showed as follows:

- China (5);
- Korea (2);
- Brazil (1);
- Chile (1);
- Japan (1);
- Spain (1).

Topics covered in this issue include three main parts: (1) intelligent transportation systems (ITS), (2) location-based services (LBS), and (3) sensing techniques and applications. The three topics and accepted papers are briefly described below.

2. Intelligent Transportation Systems

Three papers on ITS are as follows: (1) "Vehicle positioning and speed estimation based on cellular network signals for urban roads," by Lai and Kuo [41]; (2) "A method for traffic congestion clustering judgment based on grey relational analysis," by Zhang et al. [42]; and (3) "Smartphone-based pedestrian's avoidance behavior recognition towards opportunistic road anomaly detection," by Ishikawa and Fujinami [43].

Lai and Kuo from China in "Vehicle positioning and speed estimation based on cellular network signals for urban roads" proposed a vehicle positioning method and a speed estimation method to analyze the cell IDs, cell sequences, and the cell dwell time of connected cells from cellular floating vehicle data (CFVD). The cell sequences can be considered to support the analysis of the judgment of urban road direction, and the cell dwell time of connected cells can be considered to support the analysis of the discrimination of proximal urban roads. The location and vehicle speed can be estimated by the k-nearest neighbor algorithm in accordance with the CFVD. In experimental environments, six urban road segments in Kaohsiung and Pingtung in Taiwan were driven in 27 runs for the evaluation of the proposed methods, and the results showed that the accuracies of vehicle positioning and speed estimation were 100% and 83.81%, respectively [41].

Zhang et al. from China and Chile in "A method for traffic congestion clustering judgment based on grey relational analysis" proposed a grey relational membership degree rank clustering algorithm based on a grey relational clustering model to analyze the traffic information (e.g., traffic flow velocity, traffic flow density and traffic volume) for the detection of traffic congestion. The proposed method based on grey relational analysis can obtain the membership degree rank of classes for judging the rank of data objects and improving the accuracy of traffic congestion detection. In experimental environments, the practical traffic flow records were collected from 30 drivers to evaluate the proposed method, and the results showed that the average accuracy of the proposed algorithm was 24.9% higher than that of the K-means algorithm [42].

Ishikawa and Fujinami from Japan in "Smartphone-based pedestrian's avoidance behavior recognition towards opportunistic road anomaly detection" used a random forest method as the classifier to analyze the azimuth patterns from smartphones for the detection of pedestrians' avoidance behaviors, and the road anomalies can be detected in accordance with the pedestrians' avoidance behaviors. In experimental environments, the practical pedestrians' avoidance behaviors were collected from 7 males and 2 females to evaluate the proposed method, and the results showed that the average accuracy of the proposed method was higher than that of other methods [43].

3. Location-Based Services

Three papers on LBS are as follows: (1) "A high-efficiency method of mobile positioning based on commercial vehicle operation data," by Chen et al. [44]; (2) "Efficient location privacy-preserving k-anonymity method based on the credible chain," by Wang et al. [45]; and (3) "Proximity-based asynchronous messaging platform for location-based Internet of things service," by gon Jo et al. [46].

Chen et al. from China in "A high-efficiency method of mobile positioning based on commercial vehicle operation data" proposed a mobile positioning method to analyze the information of global positioning system (GPS) and cellular network signals from commercial vehicle operation data for estimating the location of each cell-RSSI (received signal strength indication) pair in training stage. In the runtime stage, the trained location of each cell-RSSI pair was used to estimate the location of the vehicle in accordance with the information of cell and RSSI for mobile positioning. In experimental environments, 6,571,550 practical commercial vehicle operation records were collected to evaluate the proposed method, and the results showed that the average location error of the proposed method was lower than cell ID-based method [44].

Wang et al. from China in "Efficient location privacy-preserving k-anonymity method based on the credible chain" analyzed the user's environment and social attributes to determine the optimal k value for a k-anonymous location privacy protection method, and the k location nodes were contained in a fake trajectory which can be generated based on the credible chain. In experimental environments, numerical analysis and simulations were given to evaluate the proposed method, and the results showed that the service accuracy of the proposed method was 100% [45].

Gon Jo et al. from Korea in "Proximity-based asynchronous messaging platform for location-based Internet of things service" proposed a distance-based asynchronous messaging platform based on a location-based message-delivery protocol. The proposed platform and protocol can be used to disperse traffic and improve stability. In experimental environments, the proposed platform and protocol were implemented to analyze the transmission time and response time for the verification of obtaining location-based messaging [46].

4. Sensing Techniques and Applications

Two papers on sensing techniques and applications are as follows: (1) "Detection of electronic anklet wearers' groupings throughout telematics monitoring," by Machado et al. [47]; and (2) "Camera coverage estimation based on multistage grid subdivision," by Wang et al. [48].

Machado et al. from Brazil, Spain and Korea in "Detection of electronic anklet wearers' groupings throughout telematics monitoring" proposed sensor data fusion algorithms to analyze the data from anklet positioning devices for tracking convicted individuals. The proposed algorithms can collect and analyze the information of timestamps and locations to estimate the risk assessment. In experimental environments, 10,000 simulated devices generated a set of paths which were obtained from GPS module to evaluate the proposed method, and the response time of the proposed algorithms was evaluated to demo the practicality of the proposed algorithm [47].

Wang et al. from China in "Camera coverage estimation based on multistage grid subdivision" proposed a method based on multistage grid subdivision to efficiently estimate superior camera coverage. This study defined 16 codes of grids, and the grid can be subdivided until each grid can be covered as one of these codes. In experimental environments, the practical data from 15 cameras were collected to evaluate the proposed method, and the results showed that the camera coverage can be estimated by the proposed method with lower time consumption [48].

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