Tool for Analyzing Activity of Evacuating and Supporting People Where are you now? Are you alright? –

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ABSTRACT

To investigate activities in the evacuated situation of people, the measurement system is newly constructed, that composed of a wearable sensor device of heart beats rates and mobile devices like an Android smartphone with a bluetooth low energy (BLE) connection. Smartphone not only displays the heart beats variation (HBR) and the current location of evacuation person by Global Positioning System (GPS), but also exports the CSV formatted file that would be used for further analyzing the activity of person in detail. As an example of the application of this system, we show the case of evacuation routes for elderly person in Hizen-Hamashuku Area, Saga Prefecture. Using the proposed measuring system, the activities of evacuates can be clearly shown on the map of Geospatial Information System (GIS).

Keywords : Smartphone app, Heart beats rate variation, GIS, GPS, safety life support.

1. INTRODUCTION

"Forewarned is forearmed." is the idiom for discussing on natural disaster prevention/mitigation issues. In recent years, very severe natural disasters have hit in all areas of Japan. For example, in April 2011, a big earthquake off the Pacific coast of Tōhoku of magnitude 6.6 hit on Tohoku area, causing huge TSUNAMI that swept away social infrastructures including the Fukushima Daiichi Nuclear Power Plant complex. Due to statistics of 2015, the following figures were confirmed: 15,894 deaths, 6,152 injured and 2,562 people missing, 228,863 people living away from their home [1]. On April 14, 2016, at the time of this writing, firstly the Kumamoto earthquake of magnitude 6.5 (tentative value) hit Kumamoto and Oita areas, following on April 16, the second earthquake of a magnitude of 7.3 (tentative value) hit the same areas, consecutively. These two big earthquakes and following aftershocks are damaging residential people. Those recorded data of disaster shows that the number of evacuated persons was less than 200 thousand who need all materials using in everyday life like foods, clothes, houses, etc. including mental health-care.

In order to see health conditions of an individual person based on the concept, "Where are you now? Are you alright?", we have been focused on heart beats rate variation [3]. Thankfully, modern electronics technologies are realizing to capture vital signals from a wrist type sensor device to mobile devices like smartphone via bluetooth low energy (BLE) connection. In this paper, we are developing the smartphone app enabling us to capture the data of heart beats rate (HBR) with current location including altitude and speed of moving person at one second of time-interval. Next, we are applying these devices to analyze the activity of the person; for example, what route will take from one's home to evacuation center, how strength of activities at the evacuation center, and so on at Hizen-Hamashuku Area of Kashima- City, Saga Prefecture were chosen as the location of the test.

2. Smartphone app for capturing HBR and GPS data

The application software we developed is composed of wrist type heart beats sensor device for capturing HBR data and Android mobile devices implemented Android 4.4 is selected for receiving HBRs from the sensor device and GPS data from satellites. Fig.1 shows the screen of smartphone device, which is composed of three parts: upper part shows the graph of HBR variation, middle part shows the numerical values of HBR and the current location of longitude, latitude, altitude [m], and speed [km/h] of smartphone device. The lower part shows the current

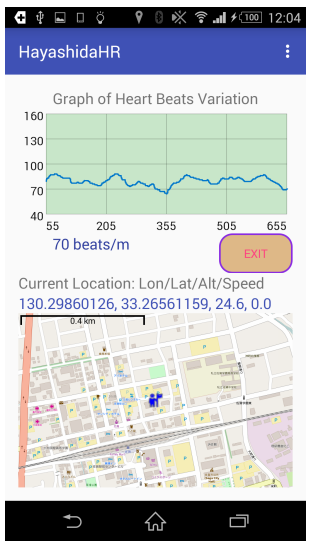

Fig1: Screenshot of smarthone

location on a map. These data set is exported as csv file format for analyzing the health and moving activity of a person in a personal computer.

3. Field test in Hizen-Hamashuku area

Hizen-Hamashuku includes historical houses established in Edo period, and specified as an Important Preservation Districts for Groups of Historic Buildings in 2006. As shown in Fig. 2, the altitude Hama-river located at national road No.207 is 4 meters, so they call this area as low-land facing ARIAKE Sea causing vulnerability on sea level, heavy rain, or TSUNAMI.

We select two typical evacuation routes: route one set starting location at Minami-Funatu to Hama communication center at an altitude of 12 meter-hight which has the capacity of 200 evacuates, and route two is to Kotohira-shrine at an altitude of 23 meter-height via alongside of Hama-river. On the way to the Kotohira-shrine, there is the Stone-step with 109 steps as shown in Fig.2.

Experiments were performed on April. 26, 2016 (fine day) at Hizen-Hamashuku with collaborator of residential person, named Mr. Ikeda, 68 year-old healthy gentleman. He took two evacuation routes: route 1 and route 2 as shown in Fig. 2 and Fig. 3.

Route 1: He started from the point of Minami-Funatu to Hama community center. The first duration of time-interval, of 130 seconds, he walked in normal mode under 80 [b/m]. From the interval from 130 to 250 seconds, he met friendly residents with standing-talk, showing very relaxing time. After that, he rushed to Hama communication center, showing hard-waking of over 80 [b/m]. These activities are shown in Fig. 3. The total travel-time took around 487 seconds including time-duration of 130 seconds for stand-talking with residential persons, resulting travel-time of 347 seconds.

Route 2: After a trial of traveling route 1, he started again from point of Minami-Funatu to Kotohira-shrine. As the same of route1, he walked in normal mode in time-interval to 130 seconds, but after passing through Hama Bridge, he found the Stone-step in front of him, then climb up it to Kotohira-shurine. This time-duration imposed a heavy load on him as shown by over 90 [b/m] of HBR. These activities are also shown in Fig. 3. He said after the trial, "I feel a little tired after first trail, plus additional climbing up Stone-step of 109 steps." The net of travel-time of 314 seconds, almost same time duration of route 1.

In both cases, vertical evacuation to higher land imposes on the exhaustion of physical strength of residents.

4. Conclusions

In this paper, to investigate the activities of a person under the evacuated conditions, we developed the measurement system with HBR and GPS composed of a wearable sensor device of heart beats rates and Android smartphone with bluetooth low energy connection. Smartphone not only displays the variation of HBR and the current location of the person, but also export the csv formatted file that would be used for further analyzing the activities of evacuation in detail. As an example of application of this measurement system, we can evaluate the evacuation routes for an elderly person. As a result,

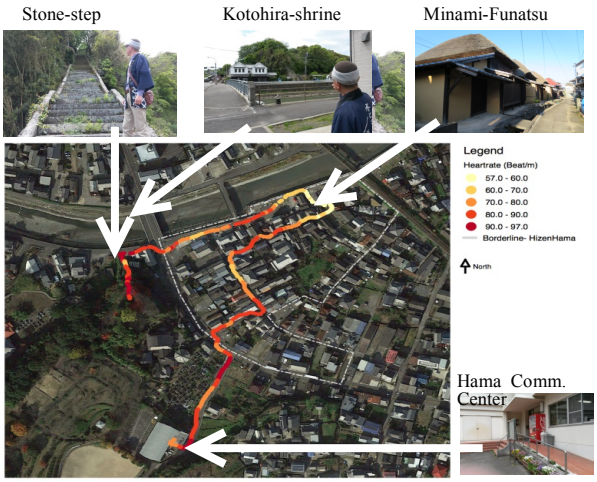

Fig. 2 Evacuation routes in Hizen-Hamashuku area

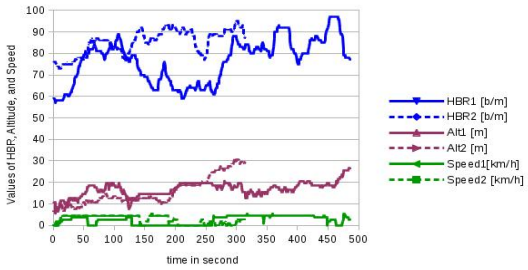

Fig 3: Time series of evacuation activities.

using the proposed measuring system, the activities of evacuates can be clearly shown on the map of Geospatial Information System (GIS).

Finally, in order to perform the vertical evacuation, i.e., to moving higher-land, it is necessary for an elderly person to have a periodical evacuation training or excise to achieve their safety life.

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