Proceeding of International Conference on Ubiquitous Healthcare

uHealthcare 2010

October 28-30, 2010
Jeju Grand Hotel, Jeju, KOREA

Extending the Realm of u-Healthcare

Conference Hosts

Institute of Medical & Biological Engineering, SNUMRC
Chungbuk National University Medical Research Institute
Personalized Tumor Engineering Research Center, Chungbuk National University
Advanced Biometric Research Center, Seoul National University

Technical Co-sponsors

Korean Society of Medical & Biological Engineering
KIEE Information and Control Society
Japanese Society for Medical & Biological Engineering
IEEE EMBS

11:15 ~ 11:30:

(5.2) **Real-time Removal of Motion Artifacts from Photoplethysmographic Signal Using a Kalman Filter with Accelerometry**

Boreom Lee (GIST, Korea), Jong-Hee Han(Hanyang University, Korea)
Won Jin Yi (Seoul National University, Korea)

11:30 ~ 11:45:

(5.3) **Towards Efficient Analysis of Activities in Chronic Disease Patients**

Asad Masood Khattak, Zeeshan Pervez, Iram Fatima, Sungyoung Lee, Young-Koo Lee
(Kyung Hee University, Korea)

11:45 ~ 12:00:

(5.4) **Automation of Non-intrusive Nasal Breathing Detection by Using Far-Infrared Imaging**

Dai Hanawa, Yohei Yaginuma, Yusuke Enomoto, Taisuke Koide, Shuhei Terada, Kimio Oguchi
(Seikei University, Japan)

13:30 ~ 15:00

Oral Session 6: Activity Monitoring and Evaluation

Chairperson: **Stacy J. Morris Bamberg**, University of Utah

13:30 ~ 14:00: **Invited Lecture 6**

- **Just Enough Measurement' to Enable Accessible Rehabilitation Technology**

Stacy J. Morris Bamberg(University of Utah, USA)

14:00 ~ 14:15:

(6.1) **Active Contour Based Human Body Segmentation with Applications in u-Life Care**

Muhammad Hameed Siddiqi, Muhammad Fahim, Phan Tran Ho Truc, Young-Koo Lee,
Sungyoung Lee (Kyung Hee University, Korea)

14:15 ~ 14:30:

(6.2) **2D Image based Anthropometric Parameters Extraction Method**

Jang-Ho Park, Dae-Geun Jang, Umar Farooq, Seung-Hun Park
(Kyung Hee University, Korea)

14:30 ~ 14:45:

(6.3) **Feature Representation for Abnormal Human Activity Recognition**

Zafar Ali Khan, Won Sohn (Kyung Hee University, Korea)

14:45 ~ 15:00:

(6.4) **Gait Assessment for Parkinson's Patients using Spatial-Temporal Image Correlation**

Hyo-Seon Jeon, Sang-Kyong Kim, Won-Jin Yi, Beom Seok Jeon , Kwang Suk Park (Seoul
National University, Korea) Jonghee Han(Hanyang University, Korea)

Active Contour Based Human Body Segmentation with Applications in u-Life Care

Muhammad Hameed Siddiqi, Muhammad Fahim, Phan Tran Ho Truc, Young-Koo Lee, and Sungyoung Lee, *Member, IEEE*

***Abstract*— Automatically human body segmentation is one of the most important and challenging issue in the field of computer vision and pattern recognition for u-Life care. One of the main targeting services of u-Life care is to enable people to live independently longer through the early detection and prevention of chronic disease and disabilities. Computer vision, emplaced wireless sensor networks (WSN), and body networks are emerging technologies that promise to significantly enhance medical care for seniors living at home in assisted living facilities. With these technologies, we can collect video, physiological, and environmental data, identify individuals' activities of daily living (ADL), and act for improved daily medical care as well as real-time reaction to medical emergencies. Overall, projected benefits include greater independence for the elderly, lower medical costs through reduction in hospital and emergency room visits, improved health, and via longitudinal studies, increased understanding of the causes of diseases and the efficacy of their treatment. Activity recognition can be applied to many applications which can roughly be grouped into four general domains, namely smart surveillance, virtual reality, advanced user interfaces, and motion analysis.

The accuracy of the video-based activity recognition depends on the accuracy of the human body segmentation. To segment the human body automatically, is one of the main and important issue in the field of computer vision and pattern recognition. Many existing works have the problems of segmenting the human body automatically from the background [1]. In our previous work [2], we also have the problem of segmenting the human body automatically from the background; we just subtracted the empty frame from activity frame to segment the human body as shown in Fig.1.

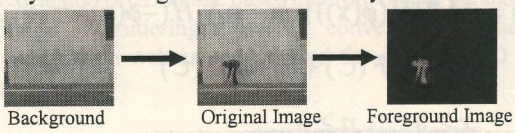

Fig.1. Segmentation based on subtracting empty frame from the activity frame

The author of [3] developed an algorithm for image subtraction for real time moving object. In their method they have obtained the motion mask by applying background subtraction and consecutive frame differencing, and then finally updated the background by using noise reduction operator that facilitate the result of moving object extraction. The limitation of this work is that it cannot work for static activities (like bending, jacking, hand waving etc.), because in these types of activities the human body have the same position. If we will subtract the consecutive frames from each other, then it will lose a lot of information. In [4], the author presented a method for real time background segmentation. In his method he represented each pixel in the frame by the group of clusters and the clusters are ordered accordingly, due to which the background has been modeled and adapted to deal with background and lighting variations. So by this way the incoming pixels are matched with the clusters to classify that weather the corresponding pixels belongs to the part of background or not. The limitation of this work is that, it cannot provide better result for human activity recognition, because the output of this work is like the output of edge detection which loses a lot of depth information that is related to human activity. The objective of this paper was to develop a new algorithm that can easily segment foreground (human body) from the background.

Our methodology is to incorporate an evolving term based on the Bhattacharyya distance [5] to the CV energy functional such that not only the differences within each region are minimized but the distance between the two regions is maximized as well. The proposed energy functional is

$$E_0(C) = \beta F(C) + (1-\beta)B(C) \tag{1}$$

where $\beta \in [0,1]$, $B(C) \equiv B = \int_Z \sqrt{p_{in}(z)p_{out}(z)}dz$ (2)

$$p_{in}(z) = \frac{\int_\Omega \delta(z - I(\mathbf{x}))H(-\phi(\mathbf{x}))d\mathbf{x}}{\int_\Omega H(-\phi(\mathbf{x}))d\mathbf{x}} \tag{3}$$

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$$p_{out}(z) = \frac{\int_{\Omega} \delta(z - I(\mathbf{x}))H(\phi(\mathbf{x}))d\mathbf{x}}{\int_{\Omega} H(\phi(\mathbf{x}))d\mathbf{x}} \quad (4)$$

$\phi : \Omega \rightarrow R$ the level set function, and $H(\cdot)$ and $\delta(\cdot) \square H'(\cdot)$ respectively the Heaviside and the Dirac functions [6]. In general, we can regularize the solution by constraining the length of the curve and the area of the region inside it. Therefore, the energy functional is defined by

$$E(C) = \gamma \int_{\Omega} |\nabla H(\phi(\mathbf{x}))| \, d\mathbf{x} + \eta \int_{\Omega} H(-\phi(\mathbf{x}))d\mathbf{x} + \ldots$$
$$\ldots + \beta F(C) + (1-\beta)B(C) \quad (5)$$

where $\gamma \geq 0$ and $\eta \geq 0$ are constants.

As a result, the proposed model can overcome the CV AC's limitation in segmenting inhomogeneous objects.

In the proposed algorithm four different types of activities like: bending, jacking, one hand waving (wave1), and two hands waving (wave2) have been segmented. In each category there are same activities performed by 10 different people. Each activity consists of about 70 frames. So the whole database contains of 280 images. In the proposed algorithm, the human body has been segmented automatically from the background using active contours. The developed algorithm has been tested, which gave us accurate results as shown in Fig.2. Also the developed algorithm is applicable in real time that will help the people in u-Life care.

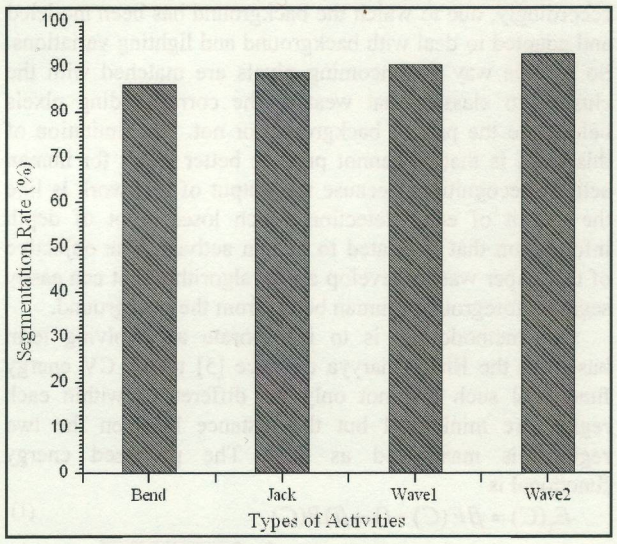

Fig.2. Accuracy of Segmentation

The overall segmentation results have been shown in Fig.3.

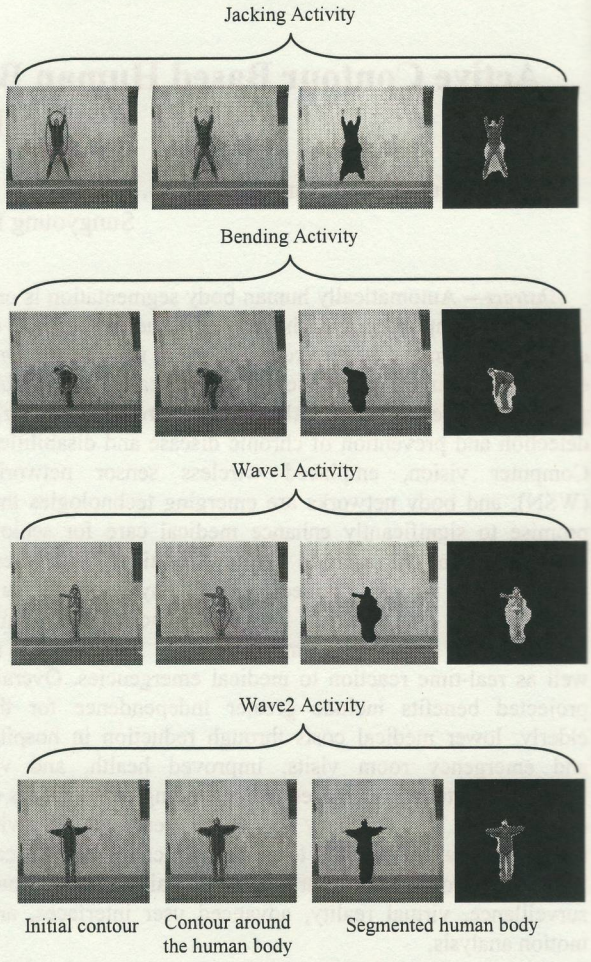

Fig.3. The whole process of segmenting the human body

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