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"Body Weight and Measurement Analysis from Human Body Images."

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Abstract :

In the past few decades, overweight and obesity are spreading widely like an epidemic. Generally, a person is considered overweight by body mass index (BMI). In addition to a body fat measurement, BMI is also a risk factor for many diseases, such as cardiovascular diseases, cancers and diabetes, etc. Therefore, BMI is important for personal health monitoring and medical research. Currently, BMI is measured in person with special devices. It is an urgent demand to explore conveniently preventive tools. This work investigates the feasibility of analyzing BMI from human visual appearances.

We also intensively study BMI estimation from frontal view face images via two key aspects: facial representation extracting and BMI estimator learning. First, we investigate the visual BMI estimation problem from the aspect of the characteristics and performance of different facial representation extracting methods by three designed experiments. Then we study visual BMI estimation from facial images by a two-stage learning framework. BMI related facial features are learned in the first stage. To address the ambiguity of BMI labels, a label distribution based BMI estimator is proposed for the second stage. The experimental results show that this framework improves the performance step by step. Finally, to address the challenges caused by BMI data and labels, we integrate feature learning and estimator learning in one convolutional neural network (CNN). A label assignment matching scheme is proposed which successfully achieves an improvement in BMI estimation from body images.

Keywords :

Body weight analysis, visual analysis of body mass index (BMI), anthropometric features, visual-body-to-BMI dataset.

Introduction :

In modern lives, there are various social networks with different functions, such as image sharing, dating, job hunting, and blogging. With the popularity of digital camera, more and more people record their lives via photos or videos and post the records to social media.

Photos from social networks contain lots of hard biometric and soft biometric information, such as pupil color, gender, height, weight, age, etc. Such biometric information can be utilized for individual identification. Among the soft biometric measures, body weight and fat are good indicators of health conditions. Body mass index (BMI) is an important soft biometric measure that is related to people's daily lives. Given an individual's height and weight, BMI = (weight / (lb) / height (in2))*703. BMI is an important visual characteristic to describe a person. It is widely used for measuring the adiposity, especially for the overweight issue. In medical science, both BMI and body weight can be used to estimate the risk for some diseases, such as breast and endometrial cancers. Currently, computer vision has been a favored means for providing new techniques to automatically detect various diseases. Considering the inconvenience of measuring BMI with special devices, exploring an automatic BMI estimation method from visual images data could make it efficient to monitor the health conditions in a large-scale setting.

Literature Survey :

1. **Body Weight Analysis from Human Body Images.**

Authors : Min Jiang, Guodong Guo.

Human body images encode plenty of useful biometric information, such as pupil color, gender, weight, etc. Among this information, body weight is a good indicator of health conditions. Motivated by the recent health science studies, this work investigates the feasibility of analyzing body weight from 2-dimensional (2D) frontal view human body images. The widely used body mass index (BMI) is employed as aMore specifically, a framework is developed for analyzing body weight from human body images. Computation of five anthropometric features is proposed for body weight characterization. Correlation is analyzed between the extracted anthropometric features and the BMI values, which validates the usability of the selected features. A visual-body-to-BMI dataset is collected and cleaned to facilitate the study, which contains 5900 images of 2950 subjects along with the labels corresponding gender, height, and weight. Some interesting results are obtained, demonstrating the feasibility of analyzing body weight from 2D body images. In addition, the proposed method outperforms two state-of-art facial images based weight analysis approaches in most cases.

2. Predicting body measures from 2D images using Convolutional Neural Networks.

Authors : Joao W. M. de Souza; Gabriel B. Holanda; Roberto F. Ivo; Shara S. ˜ A. Alves; Suane P. P. da Silva; Virg´ınia X. Nunes; Luiz La

Abstract : Nutrition is a significant determinant of health, the resolution of many nutritional issues, initially requires an anthropometry examination. Body measures provide data for studying the relationship between diet, nutritional status, and health. Manual and automatic methods can perform body measurements. The manual method usually uses an anthropometric tape. However, the automatic process uses the equipment of Dual-energy X-ray absorptiometry (DXA). Our work presents a new approach to calculate body measures using 2D Camera Images, applying Digital Image Processing, Convolution Neural Networks, and Machine Learning techniques.

Proposed System :

The proposed weight estimation approach is based on the volume estimation. RGBD videos are collected to facilitate this study. The condition for collecting the data is simple. Though the noise may be generated during the scanning and fusion process, the proposed weight estimation approach includes clustering and fitting stages to suppress such noise. The significance of this study comes from several aspects. First, this work provides a non-contact way by using affordable. It can be used as convenient self-monitoring tool or tele-medical equipment for users rather than asking them to find scales and metric tapes to measure their body weight and height.

System Architecture :

For system developers, they need system architecture diagrams to understand, clarify, and communicate ideas about the system structure and the user requirements that the system must support. It's a basic framework can be used at the system planning phase helping partners understand the architecture, discuss changes, and communications intensions clearly.

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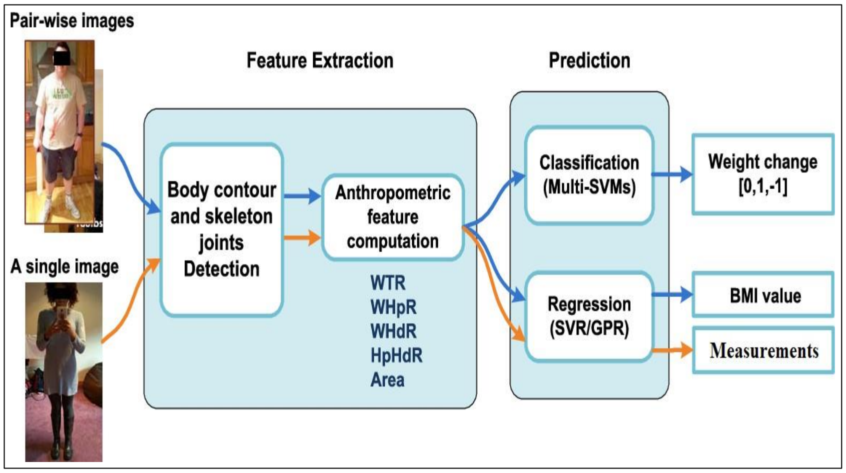
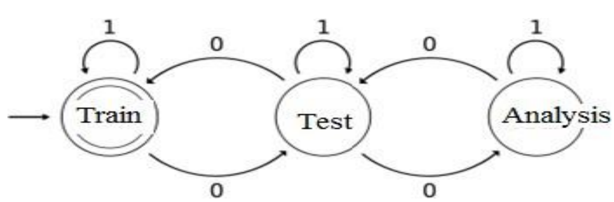


Figure. System Architecture

Mathematical Model :

A System has represented by a 5-different phases, each phase works with own dependency System S = (Q, Σ,δ, q0, F) where

- Q is a finite set of states.
- Σ is a finite set of symbols called the alphabet.
- Δ is the transition function where δ : Q × Σ → Q
- q0 is the initial state from where any input is processed (q0 ε Q).
- F is a set of final state/states of Q (F Q).



All t(n) policies will return 1 then from training patterns and it generate the similarity weight of fitness function of specific rules.

- Q = { VaiSet[i=0. . . . .n]} set of generated attribute of various images as initial set
- Σ = {data conversion, saveinDB}
- Δ = { Correclty classified Instnaces *100 / Sum F(x)}
- q0 = {First event generated by sensor function Σ i=0 }
- F = {Generated report according to class [a,b,c,....,n]}

Algorithm :

Algorithm 1/Pseudo Code

Image Processing: In computer science, image processing is the use of computer algorithms to perform image processing on digital images. As a subcategory or field of digital signal processing, digital image processing has many advantages over analog image processing. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing. Since images are defined over two dimensions (perhaps more) digital image processing may be modeled in the form of multidimensional systems.

Algorithm 2/Pseudo Code

Deep Convolutional Neural Network (DCNN):

Input: Test Dataset which contains various test instances TestDBLits [], Train dataset which is build by training phase TrainDBLits[] , Threshold Th. Output: Hash Map ≤class label, Similarity Weight ≥all instances which weight violates the threshold score.

1. neighbors.
2. Calculate the distance between the query- instance and all the training samples.

Summary :

- Provide input image into convolution layer
- Choose parameters, apply filters with strides, padding if requires. Perform convolution on the image and apply ReLU activation to the matrix.
- Perform pooling to reduce dimensionality size
- Add as many convolutional layers until satisfied
- Flatten the output and feed into a fully connected layer (FC Layer)
- Output the class using an activation function (Logistic Regression with cost functions) and classifies images.

Conclusion :

In this work, we investigate the relation between body weight and visual body appearance and estimate the BMI values from body images. Our work proposes a new approach to predict body measurements using digital image processing, dense human pose estimation - CNN and machine learning techniques to perform segmentation and, finally, make measurements.

Our contributions focus on predicting human body measures in images and create a new concept for body segmentation using outputs features of Dense Pose Estimation - CNN as the input of classifiers that perform body segmentation. The approach with Dense Human Pose Estimation and Expectation-Maximization reached the best results, with mean squared error (MSE) always bellow 4.606 +- 3.412 cm when compared with specialist measures. In future works, we intend to develop methods to calculate body fat percentage from images using CNNs and integrate this method to mobile and web applications.

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