# BOE Digital Human: Visualize Your Life Data

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***Abstract*—Electronic Health Record (EHR) contains patient-centric, electronically maintained information about individuals health information. Data Visualization that integrate with EHR is helpful for clinicians and patients to gain better insight and understanding into clinical care and management. This demonstration focuses on the digitization of paper-based health records, and it contains two aspects: 1. A 3D deformable human body model is applied as the health data visualization method, it focuses on human data visualization that is available for constructing customized deformable digital human model. The model contains body surface, organs, muscle and skeleton, and it is changeable together with users' real health data. 2. A design flow for automatically digitized the paper-based medical record to complete the personal EHR through pictures that are obtained directly from mobile devices.**

## I. Introduction

Medical institutions keep accumulating health medical data, which is highly complex in most of the recognized research labs and hospitals, meanwhile, more and more health medical data is being collected continually to keep pace with the growing medical informatics. Documentation with medical data is an essential part of the clinical process as well as a way of showing evidence of treatments. Paper-based health records to be shared with those who need them must go through a time-consuming process. Therefore, Electronic Health Record (EHR) is introduced to allow healthcare professionals to access the information they need almost instantly.

Health data visualization (HDV) is important to gain insight into Electronic Health Records (EHR), it will help the clinical process of analyzing large amounts of data and communicating the results in visual context, and the people can more easily understand and act upon the information. HDV is helpful to learn patient histories in an efficient, timely, and user friendly way. HDV tools are usually used for clinical research that focuses on showing patients' health history [1] or used by government agencies to visualize multivariate and geographically distributed health data [2]. Human body modeling [3] is a kind of HDV, and it is experiencing a continuous and accelerated growth. It pursues a realistic modeling of both the human body geometry and its associated motion. Human body modeling has been applied to games, virtual reality, and anatomy. However, the data visualization is rarely used for individuals to understand their health data, and human body modeling is never relative to a realistic personal human body.

## II. Methodology

Data-centric healthcare services are starting to become a hot spot in improving outcomes in hospitals and clinical environments. It is not only assists in improving patient outcomes and patient care, but also helpful in improving the operational performance and the cost management of the healthcare provider. All health data directly reflects how people deliver care and medicine.

### A. Deformable Human Body for HDV

3D deformable human body model is able to be generated with organs, muscle, and skeleton information after his/her height, weight, age, gender, and waist-hip ratio is known, and it is changeable with different input. The body model are built using a three-step statistical analysis method. First of all, analysis of real differentiation of human body data and the changes of data under certain parameters (height, weight, waist-hip ratio, .etc) of the model; Secondly, the parameters and the change values of the human body model are confirmed. Finally, the real customized 3D visible body model is able to be generated when the real data is entered. The training human body data sets are obtained from HIS and PET/CT images that contains the size, position, and posture of organs, muscle and skeleton.

### B. Automatically Digitized Design Flow

The procedure contains four main parts (as shown in Fig. 1): 1. Image preprocess (image subject detection, boundary definition, image subject extraction, image enhancement). The quality of image will directly affects the accuracy of OCR process, therefore, preprocessing is necessary before image analysis. The main purpose of image preprocessing is to eliminate irrelevant information in the paper-based medical records, save useful information, and enhance the relevant information. The method used in this paper is similar to [4]; 2. OCR is used to digitize the paper-based medical records, and release user's hands. Tesseract OCR Engine [5] and the commercial OCR service from Alibaba Cloud [6] were used in this paper; 3. OCR results analysis, it is the key step to make use of the output of OCR, the analysis contains text and picture recognition, row and column recognition, and table recognition. 4. Database-driven Self-Error-Correction, the most important thing for medical record is precision, for

mistakes in medical records may lead to serious consequence, such as misdiagnosis, miss treatment time, and take the wrong medicine. OCR results are always affected by the sharpness, resolution, brightness and contrast of the pictures. Here, a method is proposed to ensure the correctness of each word that is generated from paper-based medical record. Finally, the results will be structured stored in user's mobile. Additionally, most of the people does not know the meaning of laboratory examination results, the explanation will be added to the output file.

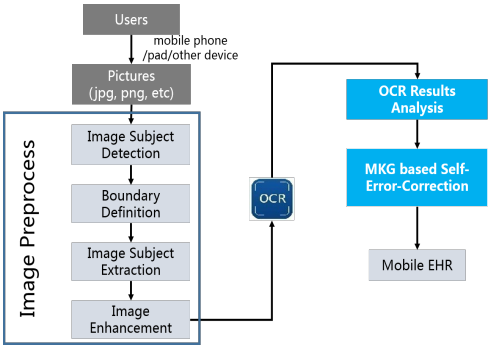


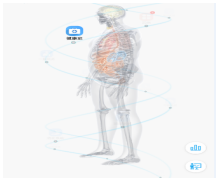

Figure 1: Design Flow for Automatically Digitized.

## III. Demo Scenarios

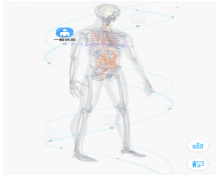
*1) Scenario 1: Deformable Human Body:* The gender, age, height, weight, waist-hip ratio was entered by user, and then the customized 3D visible body model was generated (Fig.2(c)). The model contains the information of body surface, organs, muscle and skeleton, and it is changeable together with the user input. Fig.2(b) was the body model generated by user with height of 178cm and weight of 55kg. Fig.2(a) was the same user when the weight was increased to 107.1kg.

*2) Scenario 2: Digitized Paper-based Medical Reports:* Personal healthcare data is obtained through pdf file or pictures to collect the health information from physical examination reports and the other kinds of medical reports. The health information is automatically digitized and structured the reports in categories with time stamp (Fig. 3).. The demo shows a blood examination report which is the most common laboratory test. The abnormal information will be highlight shown in the personal 3D body model.

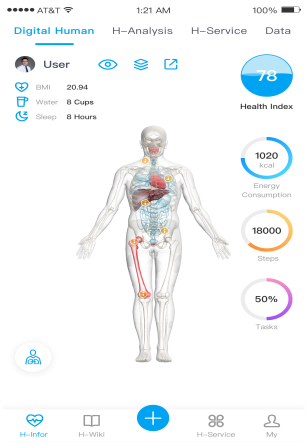
*3) Scenario 3: Diet and Exercise Prescription:* The system will recommend suitable diet and exercise (Fig. 4) according to the user's height, weight, age, disease, diet preference, exercise preference, geographical, season and the user's goals (gain muscle, lose weight, or keep in shape). The diet menu is able to be changed according to the user's dietary habit. For normal users, the system will automatically recommend the diet and exercise. For users with higher demanding, the system will recommend dieticians to them, and the system will help them to manage and record the diet and exercise information.



(a) 107.1kg



(b) 55kg




(c) 3D Visible Body

Figure 2: Deformable Human Body.

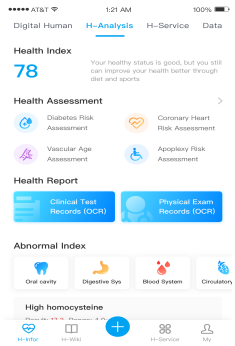



Figure 3: Digitized

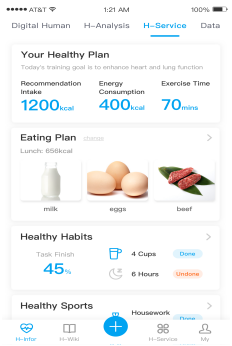



Figure 4: Prescription

## IV. Conclusion

The developed App using our method has attacked over 4 million downloaded, over 50k registered members, and over 1k medical reports uploaded in the past 6 months.

## V. Acknowledgment

The authors thank BOE Hefei Digital Hospital (Hefei, Anhui, China) for providing masked paper based medical records, the domain knowledge and expert advices for system implementation.

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