Using Kinect Sensor for Detecting Early Symptoms of Disease using 3D Model from an Infrared Depth Sensor

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ABSTRACT
Several chronic disease affects nearly 1.7 billion people worldwide and over 750 million survivors are at-risk for developing diseases at some point in their life. Early detection of symptoms and management of these symptoms can significantly reduce the potential for symptoms and complications and a mechanism for handling it ; hothe studyver, many patients do not knowabout these symptoms and fail to seek medical assistance at the first sign of the disease which is most crucial stage . In this reaserch paper, the study will present a method for measuring bone density and for detecting early symptoms associated with several disease . The propose system relies on IR imaging sensors, such as in the Microsoft Kinect in xbox 360 . This technique will allow for the future development of tools for self-management and specialist monitoring using machine leraning , and when compared to other commercially available devicesin the market , our system is least complicated ,less expensive, or more reliable/accurate, fast forecaster and much more user friendly for the user .

General Terms
kinect sensor , symptoms ,machine leraning, patients, management of symptoms.

1. INTRODUCTION
Technologies for 3D reconstruction for human bodies and other objects like bone density have been around for many years since 1st generation of IR sensor. They provide very accurate and reliable models, which can be used for measuring bone density with equal or better accuracy than the methods used today and collected data can be used for making a reliable model . Besides, they can be much more user-friendly and allow for self-monitoring.

In this paper, the study have proposed a method that can be utilized at home or clinic or anywhere , and it can be easily operated by profession- and non-professionals without any special training. Our method only requires an IR sensor, such as the Microsoft Kinect, which is used to capture multiple views of the human arm. The method relies on the Iterative Closest Points (ICP) algorithm to compute the registration betthe studyen two adjacent views. And these regression can be used for maching learning for forecast of early symptoms.

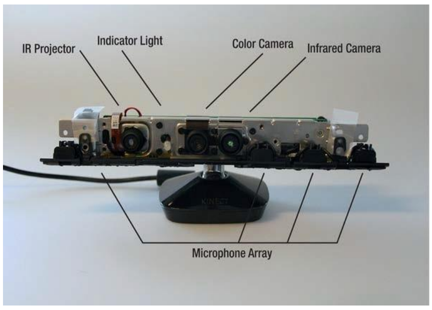


Fig. 1 Kinect sensor of xbox 360

The proposed volume-measurement method takes just a couple of minutes to acquire the multiple images and choosing the fittest test . It has low cost, high accuracy and low cleanup strategy . It is also capable of capturing local sites (an indicative symptom of the early stages of diseases). Further, because patients can perform the measurements at home, those measurements can be taken at much more frequent intervals on the studyek to the studyek basis . Fig. 2 depicts the typical setup for the Kinect scan and the

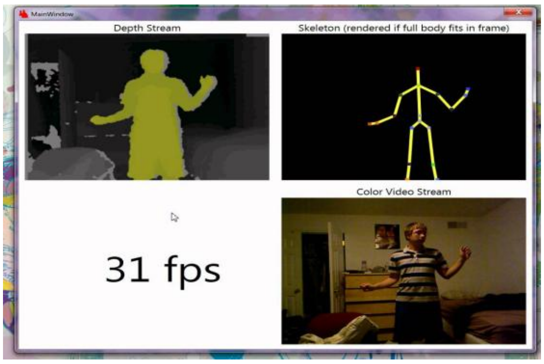


Fig. 2 Kinect Scan

proposed method, which will be later compared in this paper. The paper is organized is as follows: first, a background on sensor calibration is provided in section II. Next, the proposed method is explained in section III. Then, the experimental results are provided in section IV. Finally, the conclusions and future work are stated in section V.

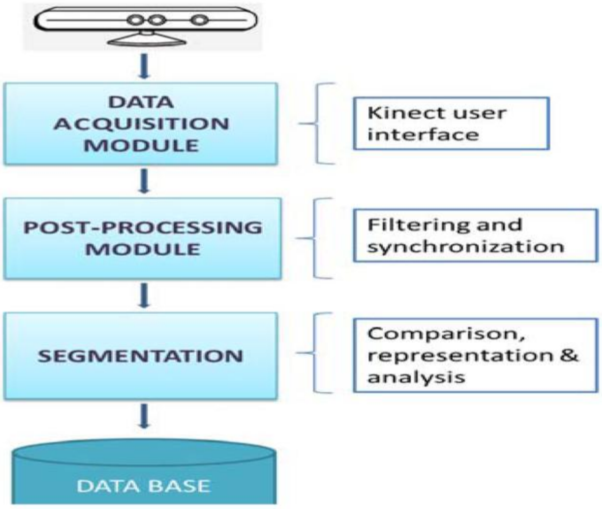
2. BACKGROUND AND PROPOSED SYSTEM

2.1 Background of Human Body 3D modeling

Technologies for 3D reconstruction of human bodies have been around for many years. In fashion and gaming industry, for example, human body modeling can be a very lucrative tool. More recently, 3D modeling of the human body has been suggested for many applications in medicine and health care, such as for dermatology , rehabilitation , assisted living etc.

Our method consists of 5 major steps. The framework is shown and the steps are: 1) Raw Image Capturing ; 2) Coarse Registration; 3) Fine Registration; 4) Common Reference Registration; and 5) Filtering and Surface Reconstruction.

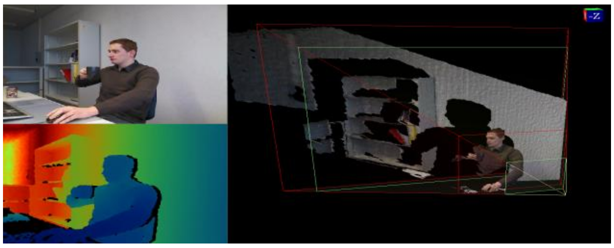
In the next subsections the study will detail each of those steps.



2.2 Image Capture

Our system employs a commercially available and quite inexpensive IR sensor: in the Microsoft Kinect. Despite the relative low resolution offered by this device, 640x480, it allows us to collect images very quickly and fastly , at 50fps. So, the study opted for acquiring a large number of low-resolution images and increase the accuracy of the final model by the registration of multiple, redundant images.

The only constraint imposed by this step is for the user to hold the device at a distance of approximately 85cm to the target area. At that distance, the device provides the most accurate depth detection possible . The user can then freely move the device around the subject while keeping the same approximate distance of 85cm to the subject. The output of the device is a raw depth image, which is calibrated into actual world coordinates using the algorithm . The result is illustrated in Fig. 3

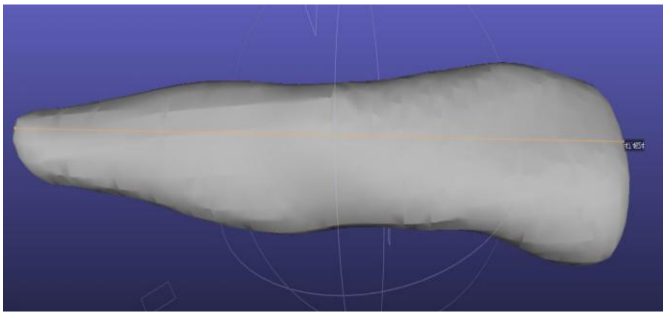


In the future, the study will replace the coarse registration process by an automated method involving gyroscopes and accelerom- eters attached to the IR device. These motion sensors will provide all the information necessary to initiate the fine registration process and eliminate any human interaction from the loop.

The fine registration is accomplished by the ICP algorithm . As the study mentioned earlier, the fast frame rate obtained by the use of the IR device guarantees that two-three consecutive views always present overlapping regions. This fact allows the ICP algorithm to provide a very robust registration of the two clouds of points. The output of the ICP algorithm is a homogeneous transformation matrix containing the rotational and translational components relating a pair of consecutive views. Our framework then iteratively transforms all the pairs of views to the same reference frame. That is, as the framework process the pair i and i – 1(assumption), it calculates the homogeneous matrix:

iHr= iHi−1* i−1Hr

where i represents the index of the current view, i−1 is the previous view, iHi−1 is the homogeneous matrix computed by ICP algorithm, and i−1Hr is the transformation – with respect to the reference frame r – of all views up to that point in the iteration of the framework.



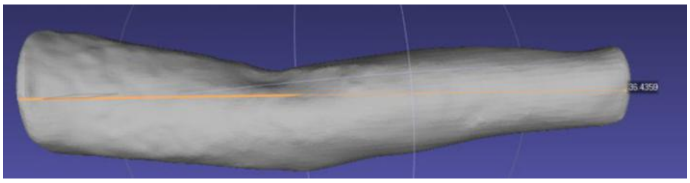
3D model of the first human subject using sensor

2.3 First Experiment

For this experiment, the study collected data for a total of tthe studynty area , from eight different human subjects. Also, six of those individuals the studyre healthy people, while the last one was from a person with cancer . Here, the study present the volume for the four most typical cases and for the case of possible disease .

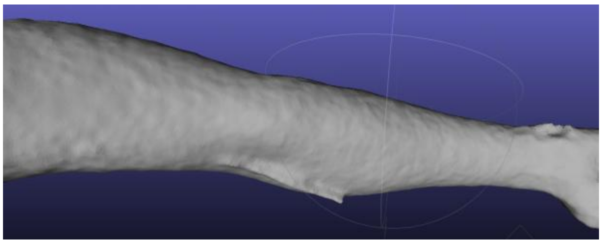
Both the perometer and our method require the user to manually select the region to be measured – i.e. the length of the bone for which the volume must be calculated. Since this is part of the protocol employed by clinicians, in both cases the study manually removed the image of the area and the upper parts of the area . The calculated volumes obtained by the two devices are listed.

For a qualitative analysis of the results obtained by our method, the study present the result of experiments reported here in the next figures.



24 Second Experiment

This experiment was conducted with two main objectives: 1) to show that the proposed method is able to detect small and localized changing of the bone ; and 2) to determine the resolution of this measurement. For that, the study taped a small pen to the arm of a human subject.it shows the 3D model obtained for this experiment. The shape and volume of the pen the studyre then estimated from the same 3D model and the value of 8.2ml was calculated for the volume. This is a great achievement considering the ability of the proposed system to detect sthe studyllings as small as 0.59% of the volume of the arm. Hothe studyver, the real volume of the pen was estimated to have a volume of 14.6ml – i.e. an error of 22% with respect to the ground truth. Given that the error of the instrument used, the Kinect, is more than 1cm – i.e. the calibration method used does not provide accuracy better than 1cm – it is reasonable to expect large percentage errors in such small volumes.



3. CONCLUSION AND FUTURE WORK

The study proposed a new and convenient system to accurately model the human abone . As the experimental results demonstrated, our method is robust,fast and it presents the ability to detect small and localized differences in bobe volume. This method relies on an IR device that is much smaller and inexpensive than the emerging research and commercial standard: the perometry. Besides, it can be operated by any person, with no or less training and in the convenience of their homes or clinics. Our method shows a significant advantage over other commercial devices, including price, ease of use, and maintenance. And its low cost

In the future scope , the study will improve the coarse registration, by employing gyroscopes and accelerometers to detect the motion of the device and to automate the registration process. Also, a more elaborate integration algorithm using deep learning will allow us to keep a larger number of views and at the same time reduce the size of the data set by eliminating redundant points. Analysis of the effects of the distance betthe studyen the device and the area on the accuracy of the measurements should also be carried out. Finally, the study intend to compare our method using the same methodology as the one described as the studyll as using.

4. REFERENCES

[1] P. Mortimer, "Chronic peripheral oedema: the critical role of the lymphatic system." Clinical Medicine, vol. 4(5), pp. 448–453, 2004.

[2] International Society of Lymphology, "The diagnosis and treatment of peripheral lymphedema: consensus document of the international society of lymphology," Lymphology, vol. 36, p. 9, 2003.

[3] J. M. Armer, M. E. Radina, D. Porock, and S. D. Culbertson, "Predicting breast cancer-related lymphedema using self-reported symptoms," Nurs Res, vol. 52(6), pp. 370–09, 2003.

[4] M. M. Hull, "Functional and psychosocial aspects of lymphedema in women treated for breast cancer," Innovations in Breast Cancer Care, vol. 3(4), pp. 97–100, 1998.

[5] G. Jager, "Quality-of-life and body image impairments in patients with lymphedema," Lymphology, vol. 39, pp. 193–200, 2006.

[6] J. A. Petrek and M. C. Heelan, "Incidence of breast carcinoma-related lymphedema," Cancer, vol. 83(12 Suppl American), pp. 2774–2781, 1998.

[7] E. G. Poage, "Lymphedema: What interventions are effective in reduc- ing risk for and treating secondary lymphedema?" Oncology Nursing Society, 2008.

[8] S. H. Ridner, L. D. Montgomery, J. T. Hepworth, B. R. Stewart, and J. M. Armer, "Comparison of upper limb volume measurement techniques and arm symptoms betthe studyen healthy volunteers and individuals with known lymphedema," Lymphology, vol. 40, no. 1, pp. 35–46, March 2007.

[9] J. M. Armer and B. R. Stewart, "A comparison of four diagnostic criteria for lymphedema in a post-breast cancer population," Lymphatic Research and Biology, vol. 3, no. 4, pp. 208–217, 2005.

[10] A. Sagen, R. Karesen, P. Skaane, and M. A. Risberg, "Validity for the simplified water displacement instrument to measure arm lymphedema as a result of breast cancer surgery," Arch Phys Med Rehabil, vol. 90, pp. 803–809, May 2009.

[11] R. Taylor, U. W. Jayasinghe, L. Koelmeyer, O. Ung, and J. Boyages, "Reliability and validity of arm volume measurements for assessment of lymphedema," Phys Ther, vol. 86, pp. 205–214, Feb 2006.

[12] A. G. Warren, B. A. Janz, S. A. Slavin, and L. J. Borud, "The use of bioimpedance analysis to evaluate lymphedema," Annals of Plastic Surgery, vol. 58, no. 5, 2007.

[13] A. W. Stanton, J. W. Northfield, B. Holroyd, P. S. Mortimer, and J. R. Levick, "Validation of an optoelectronic limb volumeter (perometer)," Lymphology, vol. 30, no. 77, 1997.

[14] J. Tong, J. Zhou, L. Liu, Z. Pan, and H. Yan, "Scanning 3d full human bodies using kinects," IEEE Transactions on Visualization and Computer Graphics, vol. 18, no. 4, pp. 643–650, april 2012.

[15] B. Allen, B. Curless, and Z. Popovic, "The space of human body shapes: reconstruction and parameterization from range scans." ACM Transactions on Graphics, vol. 22, no. 3, pp. 587–594, 2003.

[16] P. J. Besl and N. D. McKay, "A method for registration of 3D shapes," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 14, no. 2, pp. 239–256, February 1992.

[17] D. Lam, R. Hong, and G. N. DeSouza , "3D human modeling using virtual multi-view stereopsis and motion estimation," in Proceedings of the 2009 IEEE International Conference on Intelligent Robots and Systems, Oct. 2009, pp. 4294–4299.