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Real-Time Assessment of Human Skin's Mechanical Parameters Using ARM-LPC 2148

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Abstract—Wrinkly skin and soft skin are closely related to both extent and excellence of collagen in the dermis. In residential countries skin aging has a vital role in quantitative assessment of human skin elasticity is important [1] and the proper working of the skin are maintained by an important balance between the water content of the stratum corneum (SC) and skin surface oils. This balance is disrupted by exposure to external factors like: humidity, UV radiation, temperature and hormones [5]. This non-invasive method can be useful for objective and quantitative investigation of age related changes in skin, skin elasticity, skin hydration, and evaluation of the effects of ornament eland antiaging contemporary products [5].Skin provides many functions critical to the human body such as regulation of body temperature and protection from water loss. The things of skin related to these functions, elasticity, hardness and hydration of skin are directly affected by chronological aging and photo-aging and vary amongst locations on the body. As the process of aging occurs, a lot of changes are observed in our skin. More wrinkles and natural coloring are seen, there is less moisture and lipids and the skin also becomes sagged because of the loss of its elasticity. The estimation of the skin elasticity is very important, because it is not as visible as other signs of aging such as furrows [11]. The capability to enumerate this property is essential so the aged status of skin can be described for patients and skin healing therapies can be evaluated. Therefore, the intention of this paper is to study the stretching and indentation resistance of skin at various rates and size scales. This result provides a deeper sympathetic of the favorable effect of moisturizers in treatment of dry skin conditions and challenges the view that moisturizers, like glycerol and urea [2], are advantageous for skin health by simply increasing the SC hydration.

Keywords-Humidity Sensor, LPC2148, Negative Pressure, Pressure Sensor, Zigbee.

I. INTRODUCTION

With the exception of the bones and the musculature, the skin is the leading organ, being about 1.7 m^2 in area and approximately 4 kilograms in mass, or about 5.5% body weight [19].Skin of the human body is a boundary organ between the inside and outside of the body, as well as it cares, holds and bears the organs in the body [4].The outmost stratum of skin (i.e., the stratum corneum, SC) is the interface that splits the water-rich inside of the body from the moderately dry external surroundings[5]. The mechanical properties of the skin play a key role in one crucial function of the skin: its shielding function of the fundamental nerves [6].We evaluated the age and regional body transformations of the viscoelastic properties of human skin [18].When the skin is stretched,

collagen, with its high tensile strength, prevents tearing, and elastic fibers, intermingled with the collagen, later return to its outstretched state [5]. In aging people, many humanities are interested in skin aging. In skin aging, it is important to reveal elasticity of skin [1]. An important balance between the water content of the stratum corneum and skin surface lipids are maintain the proper functioning and the presence of the skin. This balance is disrupted by exposure to external factors [5]. Cancer and scleroderma are diagnosed by skin's mechanical properties which provide valuable information for medical treatments, and for understanding of physiological process like aging [3]. There are various methods to diagnose these diseases such as Acoustic Radiation Force, Data Acquisition Setup[9], Measurement Object, Strain Imaging, Instrumental Setup, Image Processing[9], Sebum Level of the Skin Surface, Skin Visco-elasticity Measurement[1-2], Optical micrograph of an epidermal hydration mapping system [9]. High resolution ultrasound imaging is available by high frequency ultrasound because both wavelength and beam width are inversely proportional to the ultrasonic frequency [2,7] and also measured using Single Frequency-Susceptance Measuring Method[8] example Magnetic Resonance Elastography (MRE) which measures the tissue particle disarticulation and velocity through MR imaging [3]. Vibro-acoustography, on the other hand, tracks the similar information through ultrasound. Optical Coherence Elastography (OCE) uses light interference to register the speckle position from frame to frame in order to monitor tissue elasticity at different regions[3].Skin mechanical properties provide valuable information for medical diagnosis, such as cancer and scleroderma, and founder standing of physiological process like aging. A number of modalities have been developed to measure the tissue responses to external mechanical stimulus [13]. MRE, MRI, Estimation of Skin Elasticity by Measuring Surface Wave Velocity under Impulse Stimulus Using Compact Optical Sensors [13].

II. BLOCK DIAGRAM

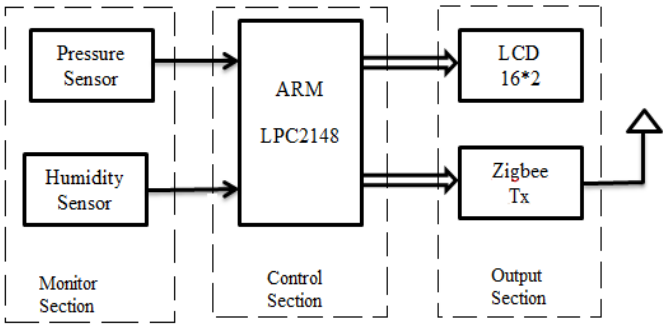

Figure1. Skin Elasticity and Hydration measurement system Block Diagram

The skin analyzer is simple: to include operating within the field of dermatologic instrumentation for nearly3 decades in one platform, that is absolutely configurable simply by connecting application probes. Figure1. Shows total operating of skin analyzer with the assistance of pressure and humidness sensors in monitoring section after monitoring controller section control that signal and takes appropriate action over them and transmit these signal to PC by Zigbee transmitter module.

2.1. Skin Elasticity

2.1.1. Principle

The elasticity measurement of the skin surface with probe provides a vacuum chamber and uses adhesive tape to prevent creeping and folding of the skin under the edge surrounding the measurement chamber.
The suction method features an elevation phase and a retraction phase. Young and smooth delicate skin, which is well moisturized, will normally be relatively easy to elevate by applying suction, and it will retract rapidly. Old and loose skin will also be easy to elevate, however, it will retract slowly.
Skin elasticity measurement is useful for the quantifiable estimation of age-related variations [17].Measurement of visco-elastic features of the skin, two types of responses are obtained by this, an immediate (elastic) and delayed (nonelastic) portion [12].

2.1.2. Pressure Sensor

This pressure sensor has an amplified analogy output. Through internal sets the sensor is compensated for offset, sensitivity, nonlinearity and temperature drift. The sensor has a range of 0-2 PSI FS and the output is ratio metric to the power supply voltage and pressure ranges from 0.3 to 100 pounds per square inch (psi) on request.

Figure2. SPD002GAsiL Pressure Sensor

2.2. Skin Hydration

2.2.1. Principle

The Moisture Module provides info about the hydration state by assessing the conducting properties of the very upper stratums of the skin, when exposed to an alternating voltage. Accordingly, the technique is referred to as a conductance measurement and the output is presented in the unit of micro-Siemens (µS).

Table1. Ideal values of Moisture on various areas

Spring And Fall	Summer	Winter
Area 1: ***Forehead*** (35-55%)	**Area 1**(40-60%)	**Area 1**(30-50%)
Area 2: ***Under Eye*** (45-55%)	**Area 2**(50-60%)	**Area 2**(40-50%)
Area 3: ***Cheeks*** (35-55%)	**Area 3**(40-60%)	**Area 3**(30-50%)
Area 4: ***Top of Hand*** (35-55%)	**Area 4**(40-60%)	**Area 4**(35-50%)
Area 5: ***Wrist*** (40-50%)	**Area 5**(45-55%)	**Area 5**(35-45%)
Area 6: ***Palm*** (45-65%)	**Area 6**(50-65%)	**Area 6**(40-55%)

2.2.2. Humidity Sensor

Humidity is defined as the amount of water vapor in an atmosphere of air or other gases. Humidity parameters are stated in different ways and the corresponding elements are based on the measurement technique used. The most commonly used terms are — "Relative Humidity (RH)",

"Parts Per Million (PPM)" by weight or by volume and "Dew/Frost Point (D/F PT)", in which the two latter are subclasses of "Absolute Humidity (AB)"[15].

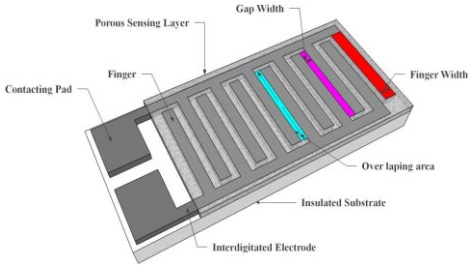

Figure4. Schematic view of the 'Hument HPR' type humidity sensor [16]

2.3. LPC2148

It acts as chief of whole structure and it is fully assembled with 16-bit ARM7TDMI-S microcontroller, 8 to 40 kB of on-chip static RAM, 32 to 512 kB of on-chip ash program memory, two 10-bit A/D converters deliver an entire of 6/14 analog inputs, Single 10-bit DAC provides flexible analog output, Multiple serial interfaces including 2-UARTs ,two Fast I^2C-bus, 60 MHz max. CPU clock available from programmable on-chip and outcome of the Zigbee receiver will connect to PC Desktop by RS232.

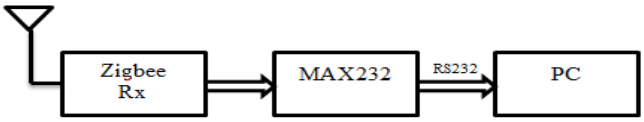

Figure5. Receiver section with Zigbee

2.4. Zigbee

The focus of network applications under the IEEE802.15.4 / ZigBee standard include the features of low power consumption, needed for only two major modes (Tx/Rx or Sleep), high density of nodes per network, low costs and simple implementation.2.4GHz and 868/915 MHz dual PHY modes [14]. This represents three license-free bands, Low power consumption, Maximum data rates, High throughput and low latency for low duty cycle applications (<0.1%), Channel access using Carrier Sense Multiple Access with Collision Avoidance (CSMA - CA), Addressing space of up to 64 bit IEEE address devices, 65,535 networks, 50m typical range, Fully reliable "hand-shake" data transfer protocol, Different topologies as illustrated below: star, peer-to-peer, mesh [16].

III. CONCLUSION

As we seen, this scheme is very beneficial to measure the skin elasticity and hydration. This method is applicable for in vivo elasticity measurement and it would provide significant information in human skin aging and numbers of diseases related to elasticity of skin and take certain actions over it. With skin hydration we kwon the hydration of skin and types of the skin whether is it dry, oily, sensitive, combination or normal and based on this we will do the treatment over it. This system can be used in Scientific skin research, Prove efficiency of treatments, Claims substantiation, Ageing studies, Hydration state analysis, Barrier function analysis, Irritancy/allergy testing, Scleroderma/Psoriasis, Pre/Post laser Monitoring etc. this system is very easy to handle, cost efficient, small in size etc.

REFERENCES

[1] Ryo Nagaoka, Takuya Izumi, Kiyono Kubo, Kazuto Kobayashi, Yoshifumi Saijo, "Elasticity of Artificial Skin by MeasuringDisplacement Induced by Acoustic Radiation Force", IEEE International Ultrasonics Symposium Proceedings, pp.1378-1381, 2012.

[2] Kazutoshi Kumagai, Hideyuki Koike, Yukina Kudo, Ryo Nagaoka, Kiyono Kubo, Kazuto Kobayashi, Yoshifumi Saijo, "Imaging of Sebaceous Glands of Human Skin by Three-dimensional Ultrasound Microscopy and Its Relation to Elasticity", 33rd Annual International Conference of the IEEE EMBS Boston, Massachusetts USA,pp.7199-7202, August 30 - September 3, 2011.

[3] Bo Qiang, Xiaoming Zhang, James Greenleaf, "Estimation of Skin Elasticity by Measuring Surface Wave Velocity under Impulse Stimulus Using Compact Optical Sensors", IEEE International Ultrasonics Symposium Proceedings, pp.185-188, 2009.

[4] Xie Chi, Liu Nian, Gao Zhongyou, Lin Daquan, Guo Zuoda, "Investigating Testing Elasticity of Equivalent Material for Human Skin", Proceedings of the 2005 IEEE Engineering in Medicine and Biology 27th Annual Conference Shanghai, China,pp.5862-5864, September 1-4, 2005.

[5] Naveed Akhtar, Shahiq uz Zaman, Barkat Ali khan, Muhammad Naeem Amir and Muhammad Ali ebrahimzadeh, "calendula extract: effects on mechanical parameters of human skin", acta poloniae pharmaceutica n drug research, vol. 68 no. 5 pp. 693n701, 2011.

[6] Jean-Luc Gennisson, Th´er`ese Baldeweck, Micka¨el Tanter, Stefan Catheline, Mathias Fink, Laurent Sandrin, C´eline Cornillon, and Bernard Querleux, "Assessment of Elastic Parameters of Human Skin Using Dynamic Elastography", ieee transactions on ultrasonics, ferroelectrics, and frequency control, vol. 51, no. 8, august 2004.

[7] Michael Vogt, Helmut Ermert, "Development and Evaluation of a High-Frequency Ultrasound-Based System for In Vivo Strain Imaging of the Skin", ieee transactions on ultrasonics, ferroelectrics, and frequency control, vol. 52, no. 3, march 2005.

[8] Woo Young Jang, Jeong Je Park, Hye Jin Jeong, Hong Sig Kim, Jae Chan Park, "Time Series Trend of the Water Content on the Different Human Anatomical Sites Using Single Frequency-Susceptance Measuring Method", Proceedings of the 28th IEEE EMBS Annual International Conference New York City, USA, Aug 30-Sept 3, 2006.

[9] Xian Huang, Huanyu Cheng, Kaile Chen, Yilin Zhang, Yihui Zhang, Yuhao Liu, Chenqi Zhu, Shao-chi Ouyang, Gil-Woo Kong, Cunjiang Yu, Yonggang Huang, and John A. Rogers, "Epidermal Impedance Sensing Sheets for Precision Hydration Assessment and Spatial Mapping", IEEE transactions on biomedical engineering, vol. 60, NO. 10, october 2013.

[10] Nadia Magnenat-Thalmann, Prem Kalra, Jean Luc Lévêque, Roland Bazin, Dominique Batisse, and Bernard Querleux, "A Computational Skin Model: Fold and Wrinkle Formation", IEEE transactions on information technology in biomedicine, vol. 6, no. 4, december 2002.

[11] Alonso, A., N. Meirelles, V. Yushmanov, and M. Tabak.. "Water increases the fluidity of intercellular membranes of stratum corneum: Correlation with water permeability, elastic and electric resistance properties". J Invest Dermatol 106:1058-1063, 1996.

[12] Ahn S., Kim S., Lee H., Moon S., Chang I. "Skin Res. Technology". 13, 280, 2007.

[13] Schlangen L.J.M., Brokken D., Van Kemenade P.M.: Skin Res. Technol. 9, 122, 2003.

[14] Dr.S.S.Riaz Ahamed, "the role of zigbee technology in future data communication system", Journal of Theoretical and Applied Information Technology, 129-135.

[15] Hamid Farahani, Rahman Wagiran and Mohd Nizar Hamidon, "Humidity Sensors Principle, Mechanism, and Fabrication Technologies: A Comprehensive Review", Sensors 2014, 14, 7881-7939; doi: 10.3390/s140507881, 30 April 2014.

[16] P.Rohitha, P. Ranjeet Kumar, Prof.N.Adinarayana, Prof.T.Venkat Narayana Rao, "Wireless Networking through ZigBee Technology", International Journal of Advanced Research in Computer Science and Software Engineering, Volume 2, Issue 7, July 2012.

[17] Hyo Sub Ryu, Young Hyun Joo, Sun Ok Kim, Kyoung Chan Park and Sang Woong Youn, "Influence of age and regional differences on skin elasticity as measured by the Cutometer", 14: 354–358, Skin Research and Technology 2008.

[18] Liliana Tavares , Lídia Palma , Osvaldo Santos , M Angélica Almeida, M Julia Bujan & Luís Monteiro Rodrigues, "Relationship between skin hydration and elasticity in normal weighted subjects and the influence of age", Biomed Biopharm Res. , (9) 2: 191-198, 2012.

[19] CHRISTOPHER EDWARDS, "Evaluation of Biomechanical Properties of Human Skin", ty Elsemer Science Inc.655 Avenue of the Americas, New York, 1995.

