Modern Microelectronic Human Body Features Sensors

Wojciech Wodo[1], Konrad Zawada[2]

[1]Faculty of Fundamental Problems of Technology, [2]Faculty of Electronics, Wroclaw University of Technology

Wrocław University of Technology

Introduction

While adequate measurement of human body temperature remains one of the most basic and important factors in monitoring patients' condition, there are some problems inherent to the procedure and applied equipment. Our preliminary research and scientific publications on the subject point to a solution, that we believe is possible to accomplish by our team.

Regular portable thermometers enable temperature measurement on demand and are mostly inaccurate due to the unstable conditions of the procedure [1] and human body state [2]. Additionally, patient's temperature varies depending on the place of measurement, therefore numerous approaches can yield different results and it is difficult to tell which is closest to the real one. Typically, precise temperature monitoring requires using an invasive way of measurement with a probe inside the human body [4], which is not always the method of choice.

Our collaboration with mountain rescue teams and emergency medicine physicians revealed the necessity for constant and adequate monitoring of body temperature. Often adduced examples include cases of overheating and hypothermia [2], both of which can be detected and treated based on adequate and continuous measurements of body temperature, thus saving the patient from coma or death. Further examples span over mountain climbers, alpinists, sportsmen and rescue teams -- all working in a potentially hostile environment. Naturally, these are cases, where not only invasive methods are inapplicable, but also other, such as arm-pit or rectal measurements are simply impossible, or at least cumbersome to perform.

Goal of the Project

The goal of our project is to develop a working prototype of an easily wearable electronic hardware device allowing to monitor the temperature of human body and providing warnings if readings are out of order (exceeded thresholds or gradient too high) in conditions, where the usage of standard thermometer would not be possible. The device shall monitor the temperature inside the auricular canal [3], which will allow consistent and precise readouts while remaining non-intrusive and easily applicable in a wide range of cases. Admittedly, some studies [5] indicate that tympanic temperature less accurate then rectal, but, given the non-intrusiveness factor, our approach seems to be much more promising. The proposed solution seems promising not only in terms of improving methods for temperature measurements. It is our belief that if our approach is correct, different human body features might be measured in similar way e.g. blood saturation, skin humidity, sleep motoric, etc.

Casing in a form of hearing aid

Technical Features

The prototype will show an energy-efficient, small electronic circuit (of the size of a hearing aid), capable of operating in hard conditions (from -50 to +50 degrees Celsius). The device will be paired with a smartphone or a computer via Bluetooth for data collection and transmission. Wireless communication will be encrypted to protect personal and medical data. We plan to perform hardware tests in thermostat chamber and clinical tests on patients and volunteers to examine the correlation between internal temperature measured via invasive probe and our electronic device. This should let us adjust establish correction coefficients and assess applicability of the device. Additionally we would like to equip mountain rescue teams with our devices to examine them in real hard weather and operating conditions.

Hostile operating environments

References

[1] Kelly, G. 2006. *Body temperature variability (part 1): a review of the history of body temperature and its variability due to site selection, biological rhythms, fitness, and aging.* Alternative Medicine Review: A Journal of Clinical Therapeutic. Rev. 11, 278–293.

[2] Kelly, G. 2007. *Body temperature variability (Part 2): masking influences of body temperature variability and a review of body temperature variability in disease.* Alternative Medicine Review: A Journal of Clinical Therapeutic. Rev. 12, 49–62.

[3] Jakobsson J, Nilsson A, Carlsson L. *Core temperature measured in the auricular canal: Comparison between four different tympanic thermometers.* Acta Anaesthesiologica Scandinavica 1992; 36: 819–824.

[4] Niedermann et al. 2014. *Prediction of human core body temperature using non-invasive measurement methods.* International Journal of Biometeorology. Vol. 58. No. 1, 7-15

[5] Robinson JL, Jou H, Spady DW. 2005. *Accuracy of parents in measuring body temperature with a tympanic thermometer.* BMCFam Pract 6 (1): 3. doi:10.1186/1471-2296-6-3. PMC 545063. PMID 15644134.

wojciech.wodo@pwr.edu.pl