A New Flexible Photoplethysmography (PPG) Sensor Patch for Continuous Measurement of Blood Flow Volume and Pressure based on AI algorithms

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A new flexible hotoplethysmography (PPG) sensor patch measuring blood-flow volume (BFV) and blood pressure (BP) based on AI algorithms is successfully designed and prototyped. With this patch, the measurement on BFV and BP is non-invasively, and can be continuously collected over more than 24 hours, resulting in valuable long-time monitoring data for medical diagnosis. These long-time, continuous BVF measurements are particularly important for monitoring the quality of an arteriovenous fistula of a hemodialysis patient for prognosis. As opposed to the developed patch, an expensive and bulky BFV monitor is commonly adopted in clinic practice as a gold standard for BFV measurement once per months. The instrument needs to be operated by professional, well-trained medical personnel. The PPG sensor patch developed is instead a low-cost, small-sized, wearable, and easy-to-use sensor that is capable of continuously measuring BFV and BP via AI algorithm. New designs of front-end analog circuit, signal processing, and an intelligent neural network calibration method are employed to achieve high correlations of R2 = 0.88 for BFV and R2 = 0.85 for BP, as opposed to their gold standard counterpart monitors.

Biography:

Dr. Paul C.-P. Chao received his Ph.D. degree from Michigan State University, USA, and then with Chrysler Corp in Auburn Hill, Detroit, USA before joined National Chiao Tung University (NCTU), Taiwan. He is currently University Distinguished Professor of the electrical engineering department at NCTU, and Distinguished Lecturer for IEEE Sensors Council, 2018 – 2010. His research interests focus on sensors, actuators and their interface circuitry. Dr. Chao has published more than 280 peer-reviewed papers (books, journal papers, conferences, reports) and 38 patents.

Dr. Chao was the recipient of the 1999 Arch T. Colwell Merit Award from Society

of Automotive Engineering, Detroit, USA; the 2004 Long-Wen Tsai Best Paper Award from National Society of Machine Theory and Mechanism, Taiwan; the 2005 Best Paper Award from National Society of Engineers, Taiwan; the 2007 Acer Long-Term Award; the 2009 Best Paper Award from the Symposium on Nano-Device Technology; the 2010/2014 Best Paper Award from the Annual ASME Conference on Information Storage and Processing Systems (ISPS); the second most downloaded paper in IEEE Sensors Journal in 2011; the Best Poster Paper award of IDMC 2015; the prestigious Outstanding Research Award from National Association of Automatic Control in Taiwan in 2015; the prestigious National Innovation Award of Taiwan government 2016; The 2017 Best Industrial Project Award by Ministry of Science and technology, Taiwan government; The 2017 Presidential Outstanding Professor of Engineering in Nation (Taiwan) (awarded by the president of the nation in the Presidential House of Taiwan, ROC); Two 2017 Future Technology Awards (Taiwan Oscar Invention Award) from Ministry of Science and Technology (MOST), Taiwan Government; The 2018 Outstanding Professor of Electrical Engineering in Nation (Taiwan), National Association of Electrical Engineering, Taiwan; The second National Innovation Award of Taiwan Government in 2018.

Dr. Chao has served as University Associate Vice Presidents of NCTU for academic affairs (2009-2010) and research and development (2015); the Secretary General, IEEE Taipei Section, 2009-2010; the founding chair of Taipei chapter for the IEEE Sensor Council; Member-at-Large for IEEE Sensors Council, 2012-2014. Dr. Chao received major IEEE awards for this service: The IEEE Large Section Award from IEEE Head Quarter for the outstanding service as the Secretary for 2009-2010, and The IEEE MGA Award from IEEE Region 10 for outstanding service as the Secretary for IEEE Taipei Section, 2009-2010. He was the General Chair of the 2016 ASME ISPS and IoT conference in Santa Clara, CA, USA; chairs and co-chairs of major conferences. For editorial services, he is currently Topical Editors of IEEE Sensors Journal and IEEE IoT Journal. He was the Associate Editors of ASME Journal of Vibration and Acoustics and Journal of Circuit, System and Computer; guest editors of special journal issues. Dr. Chao received the award of the 2017 Best Topical Editor, Runner up, IEEE Sensors Journal. He is a senior member of IEEE and ASME Fellow.