

M. McKnight, F. Lin, H. Kausche, T. Ghosh and A. Bozkurt, "Towards paper based diaper sensors," *2015 IEEE Biomedical Circuits and Systems Conference (BioCAS)*, Atlanta, GA, 2015, pp. 1-4.

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Abstract: This paper presents our initial efforts towards the development of screen printed sensors on folded paper substrates for multi-modal sensing of biopotentials, wetness, and pressure. These sensors contain three layers of sensing stripes forming a 16-pixel array where various layers are utilized for different sensing modalities. The performance of the paper-based sensors was assessed. The sensors were shown to exhibit a linear capacitive response to changes in force, as well as a decrease in impedance in the presence of wetness. We discuss the integration of these low-cost and partially disposable paper-based sensors into a wearable diaper system for Bluetooth-based wireless heart rate monitoring, respiratory rate tracking and urination frequency and amount detection.

keywords: {Bluetooth;biomedical equipment;cardiology;pneumodynamics;16-pixel array;Bluetooth-based wireless heart rate monitoring;biopotentials;folded paper substrates;linear capacitive response;multimodal sensing;paper based diaper sensors;partially disposable paper-based sensors;respiratory rate tracking;screen printed sensors;sensing modality;urination frequency-amount detection;wearable diaper system;Arrays;Biomedical monitoring;Impedance;Monitoring;Sensor phenomena and characterization;Sensor systems;biopotential recording;impedance sensing;paper sensor;smart diapers},

URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7348427&isnumber=7348273>

T. Fujimoto, T. Hashimoto, H. Sakaki, Y. Higashi, T. Tamura and T. Tsuji, "Automated handling system for excretion," *Proceedings of the 20th Annual International Conference of the IEEE Engineering in Medicine and Biology Society. Vol.20 Biomedical Engineering Towards the Year 2000 and Beyond (Cat. No.98CH36286)*, Hong Kong, 1998, pp. 1973-1976 vol.4.

doi: 10.1109/IEMBS.1998.746989

Abstract: The new automated system for excretion was developed. The system consisted of a diaper cup and control unit. The diaper cup is composed of a resin-molded cup and exchangeable diaper made of cotton cloth. The diaper cup is connected to the control unit with a suction hose, a hose for heated air, a tube for warm water and an electric lead for the sensors. The control unit is composed of a suction motor unit for excreta, a tank of warm water for washing the area surrounding the excretory organs, a collection tank for the excreta, valves and a control board for the whole unit. A reflecting light sensor for detecting faeces and an impedance sensor for detecting moisture are set in the internal part of the diaper cup. The experiments were performed for seven elderly patients and results showed that the sensor successfully detected urination. We found that the system is effective and increases the quality of life of people requiring diapers

keywords: {biocontrol;electric sensing devices;geriatrics;moisture measurement;nozzles;optical sensors;patient care;waste disposal;automated handling system;collection tank;control board;control unit;diaper cup;elderly patients;electric lead for sensor;enhanced quality of life;exchangeable diaper;excretion;faeces detection;heated air hose;impedance sensor;incontinence;moisture detection;nozzle;reflecting light sensor;resin-molded cup;suction hose;suction motor unit;urination detection;valves;warm water tube;Automatic control;Control systems;Cotton;Hoses;Impedance;Resistance heating;Temperature control;Thermal sensors;Valves;Water heating},

URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=746989&isnumber=16113>

T. Stockinger, U. Muller, F. Padinger, S. Bauer-Gogonea, S. Bauer and R. Schwodiauer, "Paper-based interdigitated impedance sensor for moisture and vapor measurements," *2017 IEEE SENSORS*, Glasgow, 2017, pp. 1-3.

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Abstract: A low-cost, easy-to-fabricate paper-based capacitance sensor with inkjet printed interdigitated electrodes is presented. The sensor enables measurements of the dielectric properties of electrode free polymer films, a quick technique for assessing the insulating quality of polymer sheets. We demonstrate the suitability of the sensor for moisture and vapor measurements, permitting direct operation of the sensor in water or body fluids. Potential applications of the sensors may arise in smart diapers and wound dressings. In addition, the sensors allow for the study of water adsorption and desorption kinetics under a wide range of humidity conditions. We show that the effective permittivity of the sensor follows a Guggenheim-Anderson-DeBoer sorption isotherm, enabling us to simultaneously record and quantitatively analyze the wetting and drying of moist paper in printed electronics manufacturing.

keywords: {adsorption;capacitive sensors;desorption;drying;flexible electronics;humidity;humidity measurement;humidity sensors;ink jet printing;moisture;permittivity;permittivity measurement;polymer films;thin film sensors;wetting;desorption kinetics;dielectric properties;easy-to-fabricate paper-based capacitance sensor;electrode free polymer films;inkjet printed interdigitated electrodes;insulating quality;interdigitated impedance sensor;low-cost sensor;moist paper;moisture measurements;polymer sheets;vapor measurements;water adsorption;Adsorption;Electrodes;Humidity;Moisture;Permittivity;Polymers;Substrates;humidity;interdigitated electrodes;paper sensor;printed electronics;sorption isotherm},

URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8233955&isnumber=8233862>