Device for Hemodynamic Parameters Measurement in Veterinary Medicine of Small Animals

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Jan Havlík received the M.Sc. degree in Electronics from the Faculty of Electrical Engineering of the Czech Technical University in Prague, Czech Republic in 2001. In 2008 he received the Ph.D. degree in Electrical Engineering Theory at the same university.

He is currently working at the Department of Circuit Theory, Faculty of Electrical Engineering, Czech Technical University in Prague as an assistant professor. His research interests are biomedical engineering, medical electronics, biomedical hardware development, biomedical signal processing, telemedicine and telemonitoring.

Biomedical Electronics Group

- small research group at the Faculty of Electrical Engineering CTU in Prague
- biomedical electronics and the biomedical signal processing especially in the field of the telemedicine, telemonitoring and assistive technologies
- development of the devices for biological signal acquisition and processing, for example for primary screening of atherosclerosis, classification of tremor in multiple-sclerosis etc.
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Aims & objectives

- hemodynamic parameters are one of the basic clinical parameters, which should inform about an overall health state and indicate potential risks both in human and veterinary medicine
- oscillometry measurement is a frequently used method for non-invasive blood pressure measurement
- electrocardiography is a typical method for heart rate measurement

Aims & objectives

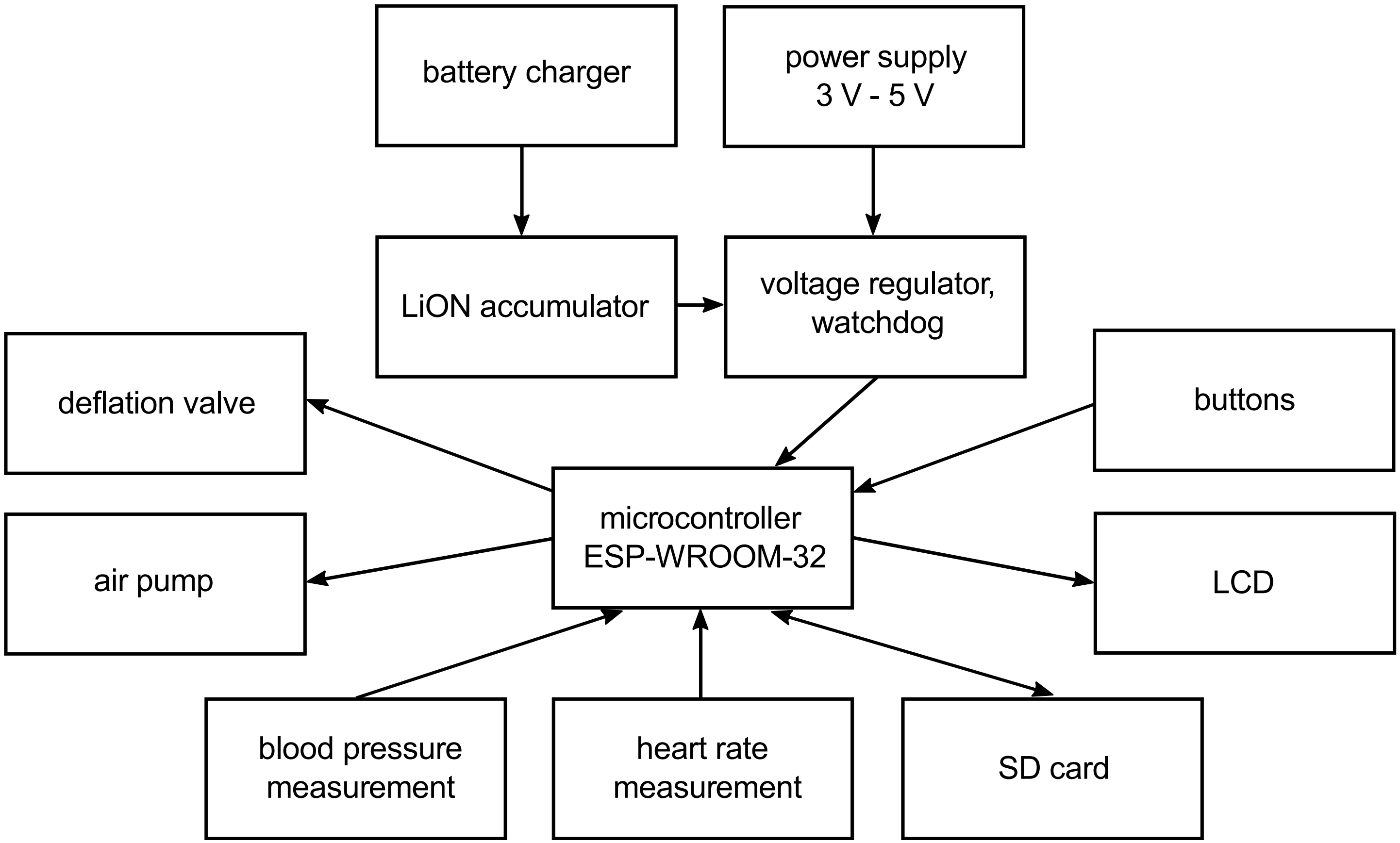
- the project aims to design and realize a device for non–invasive sensing of basic hemodynamic parameters (heart rate and blood pressure) in veterinary medicine of small animals (typically cats and dogs)
- and to design and implement signal processing methods for the determination of derived hemodynamic parameters, such as pulse transition time and pulse wave velocity

Methods

- a stand-alone measurement device
  - controlled by a microcontroller ESP32 (240 MHz dual-core microcontroller) with an integrated 802.11 b/g/n (WiFi) transceiver/receiver and dual-mode Bluetooth
  - storing data on a SD card for off-line processing
  - the oscillometry method for blood pressure measurement with the pressure sensor MP3V5050 (NXP Semiconductor)
  - the single-lead heart rate monitor based on the front-end AD8232 (Analog Devices)

Design of the Device

- the block diagram of the device

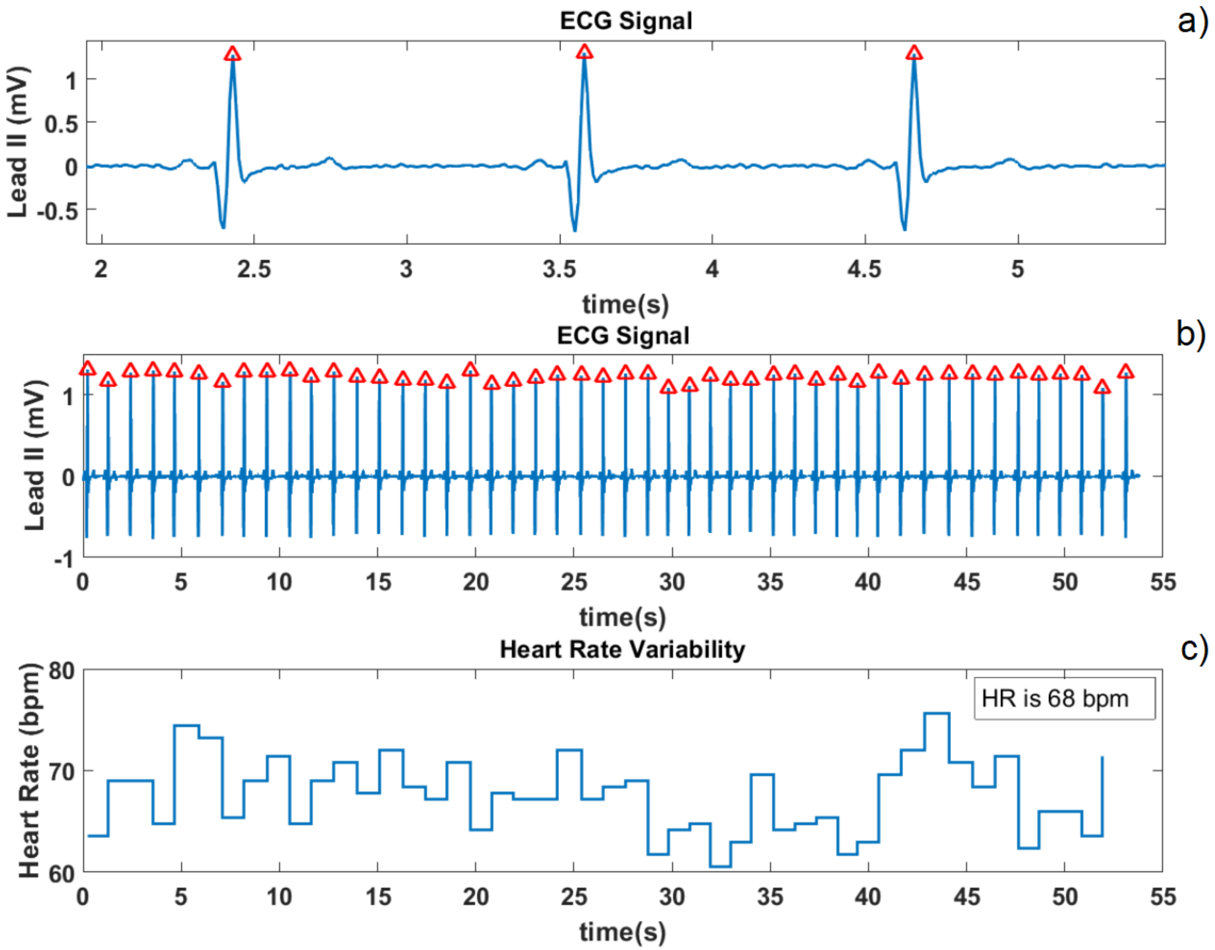


Experiment

- as a proof of concept, the device was evaluated on a human volunteer (healthy woman, 25 years, 174 cm, 67 kg)
  - the working range of blood pressure (from 60 mmHg up to 160 mmHg) and ECG signal (the amplitude of QRS complex about ones of mV) in human medicine is the same of working range of blood pressure and ECG signal in veterinary medicine of cats and dogs
- the ECG electrodes were placed on the right arm (RA electrode) and the left leg (LL), the acquired signal corresponds to the lead II
- the cuff was placed on the left hand

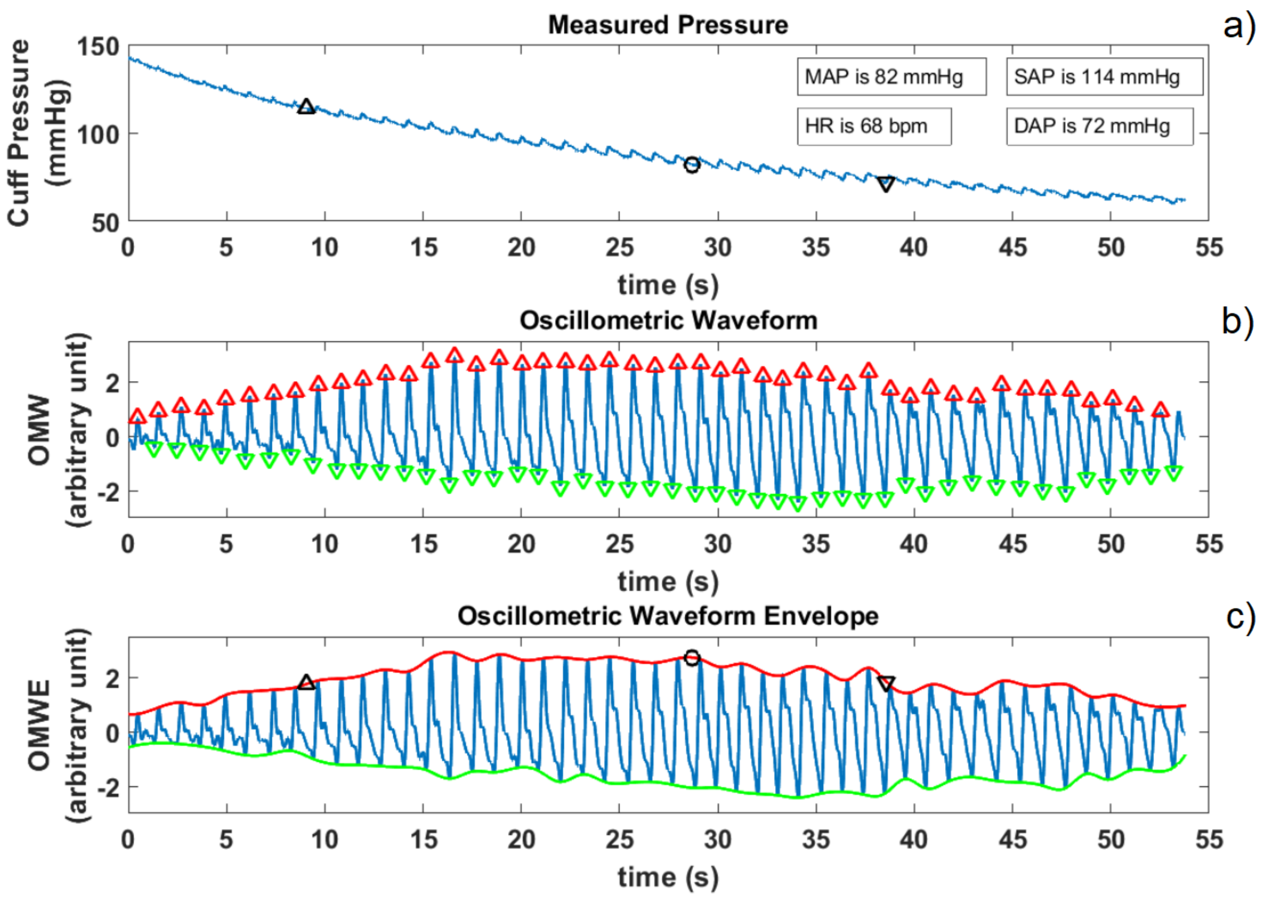
Results

- the ECG signal (lead II) obtained during the evaluation of the device



Results

- the oscillometry signal obtained during the evaluation of the device



Discussion & Conclusion

- the paper presents the partial results of the research in progress
- the concept of the device allows not only the measuring of ECG signal and blood pressure but also the possibility to determine additional hemodynamic parameters, such as
  - pulse transition time (a time difference between the R-peak in ECG and a related maximum of the pulse wave in oscillometric pulsations) or pulse wave velocity
- the future steps will contain the evaluation of the device on small animals in clinical practice and the design and implementation of additional signal processing algorithms