Automated Assessment of Animal Health and Wellbeing

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Health and wellbeing are issues of major importance in both animal husbandry and laboratory animal science. Animal health and (mental) wellbeing have suffered dramatically with increases in the size of farms and the number of animals kept per farm. Public support for intensive livestock farming has decreased as a result, and so innovation with respect to more welfare-friendly husbandry is urgently needed. Similarly, the use of animals for research purposes is a major concern for many people, and objective and transparent welfare monitoring of laboratory animals could help to reassure the public that suffering is being effectively recognised and alleviated. It is also important to monitor and improve laboratory animal welfare, since scientific data will be more relevant if the physical and mental condition of the subjects can be improved.

Animal welfare is receiving growing attention, in the form of European Union research initiatives (e.g. www.welfarequality.net) and EU legislation that requires reliable and objective monitoring of animal welfare on a large scale (e.g. Directive 2010/63/EU[ii] that regulates laboratory animal care and use). Objective tools to assess animal wellbeing and health are essential in order to help meet societal demands for better animal welfare in both food production and research.

Effective early detection of animal welfare problems can require automated observation of behaviour, including vocalisations and physiological parameters, if the number of animals in a production farm or animal research facility is too large in relation to the number of staff, and available experts on animal behaviour.

A consortium of scientific and technical partners is currently working on the 'SenseWell' project, which aims to develop an automated system for the early detection of symptoms of disease and chronic stress, and also of positive indicators of wellbeing. This way, animal health and wellbeing can be assessed 24/7, which supports the responsible management of large numbers of animals. This system will consist of an intelligent sensor network that is able to measure behaviour, vocalizations and physiology of freely moving subjects. It is based on recent advances in sensor technology, image processing, data fusion, acoustical signal analysis, pattern recognition and software architecture design. The outcome of this project will be a platform technology that is suitable for both behavioural research and welfare monitoring, which could make significant contributions to both animal welfare and the quality of the science.

In the SenseWell project, rats are used as a model for laboratory animals in general as well as for farmed animals such as pigs. Animals were housed in a large home cage environment (PhenoTyper® 9000, 90x90cm), which was developed in line with the PhenoTyper concept (Noldus Information Technology, Wageningen, The Netherlands), in which animals can be monitored for periods of several hours, for several days or weeks, in a familiar environment without handling or other disturbance. This large, home cage monitoring environment was designed specifically to further increase the scientific relevance of home-cage monitoring from an ethological perspective. That is, animals can express more dynamic movement patterns and therefore effects on distance and velocity of movement can be larger between groups / subjects of investigation. Furthermore, in a larger automated home cage, animals can be tested under social conditions, with more animals in a cage, which is more applicable to real-life situations in both laboratory animal housing and farming. Importantly, by the increased surface of the monitoring environment, dynamics in social interactions and structures can be amplified, in the sense that approach and avoidance between individuals can be expressed within a broader range.

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The large home cage monitoring environment (PT-9000) contains bedding, 1 or 2 large shelters, food and water, and is equipped with a camera and infrared lighting. Video images are analysed in real-time using tracking software (EthoVision® XT, Noldus Information Technology). The PT-9000 is further equipped with microphones to measure (ultrasonic) vocalisations (SonoTrack®, Metris BV) and can be further extended with telemetry receivers for wireless monitoring of physiological parameters such as heart rate and body temperature (PhysioLinq®, Telemetronics Biomedical BV). The latter system is specifically suitable for simultaneous measurements of a group of animals since individual signals can be identified. The main goal of the SenseWell project is to integrate all 3 systems and their data streams to create a 24/7 animal monitoring platform with reference-values for future support of early detection of welfare problems including automatic notifications. The results can be translated to larger animals and find their way in the design of new automated monitoring tools and advanced housing systems for farm animals.

By using different animal models and protocols, evoking specific responses such as stress, play and reward-anticipation, and simultaneous monitoring of behaviour, (ultrasonic) vocalisations, heart rate and body temperature, the aim is to construct a reference library of automatically generated (sets of combined) parameters that can be used as indicators of both positive and negative animal health and wellbeing.

Recent results and a current update on the status of the above described project will be presented.

Ethical statement

Experiments were performed according to the legal requirements of The Netherlands concerning research on laboratory animals (Wod/Dutch Animal Welfare Act) and have been approved by an Animal Ethics Committee ('Lely-DEC'). All procedures complied with the regulations controlling animal experimentation within the EU (European Communities Council Directive 86/609/EEC).

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[i] The SenseWell consortium consists of the following academic and commercial partners: Noldus Information Technology BV (L.P.J.J. Noldus); Metris BV (R.J.A. Bulthuis); Telemetronics Biomedical BV (G.J. van Essen); BioMetris, Wageningen University (G. van der Heijden); Faculty of Veterinary Medicine, Utrecht University (J.A. Stegeman); EEMCS, TU Delft (P.J. French); Delta Phenomics BV (J.E. van der Harst); Faculty of Science, Utrecht University (B.M. Spruijt).

[ii] http://ec.europa.eu/environment/chemicals/lab_animals/home_en.htm