SYSTEM AND METHOD FOR MONITORING CARDIAC AND BREATH RATE OF RODENTS

IITM Technology Available for Licensing

Problem Statement

- Generally, the heart's cardiac signals are picked up using **non-invasive electrodes**, minimally invasive electrodes, or telemetry (wireless) techniques.
- However, the **ECG recording devices are expensive**, and require a skilled or trained person to handle the device.
- In-vivo studies in animals, particularly in rodents, are usually performed widely in life science research.
- During such studies, **it is vital to monitor the basic physiological parameters such as body temperature, heartbeat rate and breath rate** of the animals.

Intellectual Property

- IITM IDF Ref. **2327**
- **IN 202241015433**

Technology Category/ Market

Category - Medical Devices
Applications - Bio-medical instrumentation, Bio-signal monitoring device, Small animal monitoring system.
Industry - Medical devices, Biomedical Research, Veterinary Medicine.

Market - The veterinary monitoring equipment market size accounted for USD 427.5 million in 2022 and is estimated to grow at **9.4% CAGR** to reach USD 1 billion by 2032.

TRL (Technology Readiness Level)

TRL - 4: Technology validated in lab scale.

Research Lab

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FIG. 1. illustration of the Ag-AgCl based electrodes being placed on the right arm (RA), left arm (LA), and right leg (RL) of the anesthetized animal.

Technology

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- The present invention provides **a system with a single sensing unit for estimating the breath rate and heartbeat rate of the animals**, rodents in particular, from their cardiac signals/ECG signals in a non-invasive, cost-effective minimalistic manner. (refer Fig. 2)

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- Said **system facilitates acquiring, interpreting the cardiac signals** in a non-invasive manner and serves the purpose of estimating the breath rate and the heartbeat rate of animals from the cardiac signals without the employment of separate means for said purpose.

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- In other words, the system does not employ any respiratory sensor, to estimate the breath rate, rather **it processes the cardiac signals and provides an accurate estimate of breath rate and heartbeat rate** from said cardiac signals which it acquires from the animal in the interval of every 1-2 ms, sufficient to evaluate the accurate PQRS waveform of the cardiac signals.

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- The present invention also provides **a non-invasive, non-diagnostic method for estimating the breath rate and heartbeat rate** of the animals, rodents in particular from their cardiac signals/ECG signals, which is highly affordable and easy to perform. (refer Fig. 3)

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Key Features / Value Proposition

1. **Retrospective Cardiopulmonary Imaging:** The system detects, analyzes, and processes cardiac signals (ECG) to enable retrospective gating for cardiopulmonary imaging, reducing radiation exposure.
2. **Integration with High Frame Rate Detector:** The system could be integrated with a sensitive high frame rate detector and employed for retrospective cardiac gating, which generates high-resolution cardiac images with less radiation exposure.
3. **Cost Efficiency:** The cost of the system is at least 70% less than the existing solutions.
4. **Direct Monitoring and Estimation:** Offers an effective direct method for monitoring and estimating the cardiac or breath rate of anesthetized rodents without the need for separate respiratory sensors.
5. **Heartbeat Rate Estimation:** The heartbeat rate is estimated from consecutive R-peak waves and derived from the PQRS waveform, which also helps in prospective cardiac gating studies.
6. **Simplified Vital Sign Monitoring:** It provides a simple derivation method to estimate the heart and breath rate, which is helpful for monitoring physiological vitals and in in-vivo pharmacological studies.

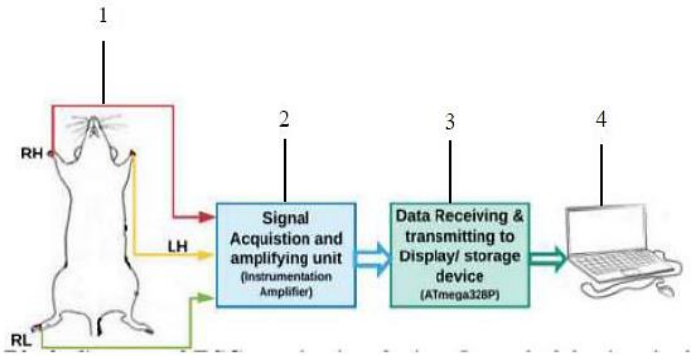

FIG. 2. Block diagram of system for estimating the heartbeat rate and breath rate of animals, according to one example embodiment of the invention. One end of the three-lead electrode (1) is connected to the animal (rodent), and the other is connected to the signal acquisition and amplification unit (2), comprising the instrumentation amplifier (IA). Then the data receiver and transmitter block (3) records the signal using the AT-mega328p and 10 saves it on the PC (4).

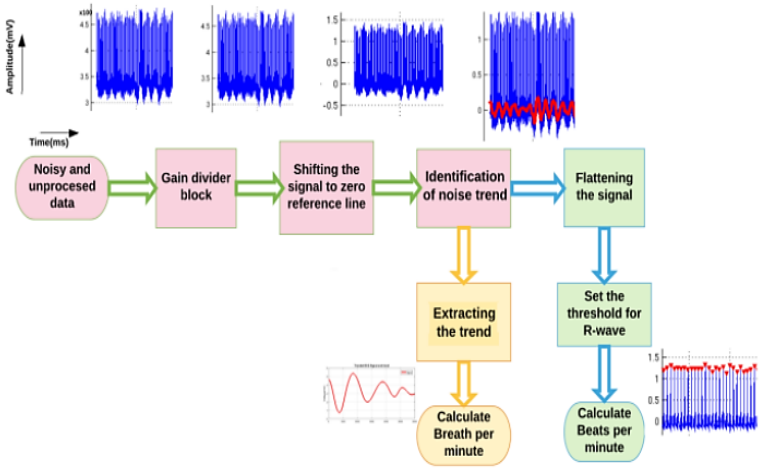

FIG. 3. Block diagram of the method implemented to estimate the breath and heartbeat rate of the animals from the noisy, unprocessed cardiac signal, according to one example embodiment of the invention. The block begins with denoising and gain dividing the unprocessed signal. Then the signal is brought to zero reference line and fitted using inbuilt curve fitting functions of MATLAB, to extract the breath wave and R peak wave from which breath rate and heartbeat rate are estimated respectively.

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