

# RoMon: An open-source web-based solution for rodent behavioural training and monitoring

Surjeet Singh<sup>1\*</sup>; Edgar Bermudez Contreras<sup>1</sup>; Robert J. Sutherland<sup>1</sup>; Majid H. Mohajerani<sup>1</sup>

<sup>1</sup>Canadian Center for Behavioural Neuroscience, University of Lethbridge, Lethbridge, Canada T1K 3M4

\*surjeet.singh@uleth.ca



## Introduction

Measuring behavioural phenotypes in animals in their home-cage environment is important for assessing the effects of experimental manipulations [1].

Existing solutions do not accommodate either complete automation of multi-stage training processes involving large numbers of animals [2].

Thus the significant human involvement currently required for experiments on complex behaviours still represents a considerable impediment to large-scale rodent studies.

### OBJECTIVE:

The objective of this work is to provide an open source low-cost web-based solution for automated animal training and monitoring.

## Methods and Materials

The core of this system is a Raspberry Pi which is a low cost (35\$), credit-card sized computer [3].

A web interface has been developed in php that allows the user to control the infrared camera module v2 (Pi NoIR) and the general-purpose input/output (GPIOs).

Python and OpenCV are used for controlling the experiment variables and perform data analysis.

To test this system we used a cued fear conditioning paradigm [4] to study animal behaviour before, during and after training in a mouse model of AD (APP NL-G-F) and C57BL/6 mice as control (n=2, 10 months old).

Table 1. List of components

Components
Raspberry pi 3
Infrared Camera Module v2 (Pi NoIR)
AUKEY 180° Fisheye Lens
Speakers
CROUZET Miniature Side Rotary (High Sensitivity) Switch
LEDs (Red, Yellow, Green, IR)
Bio-Chem Valve™ 2-Way NC Pinch Valve
Optimice® Animal Home Cage

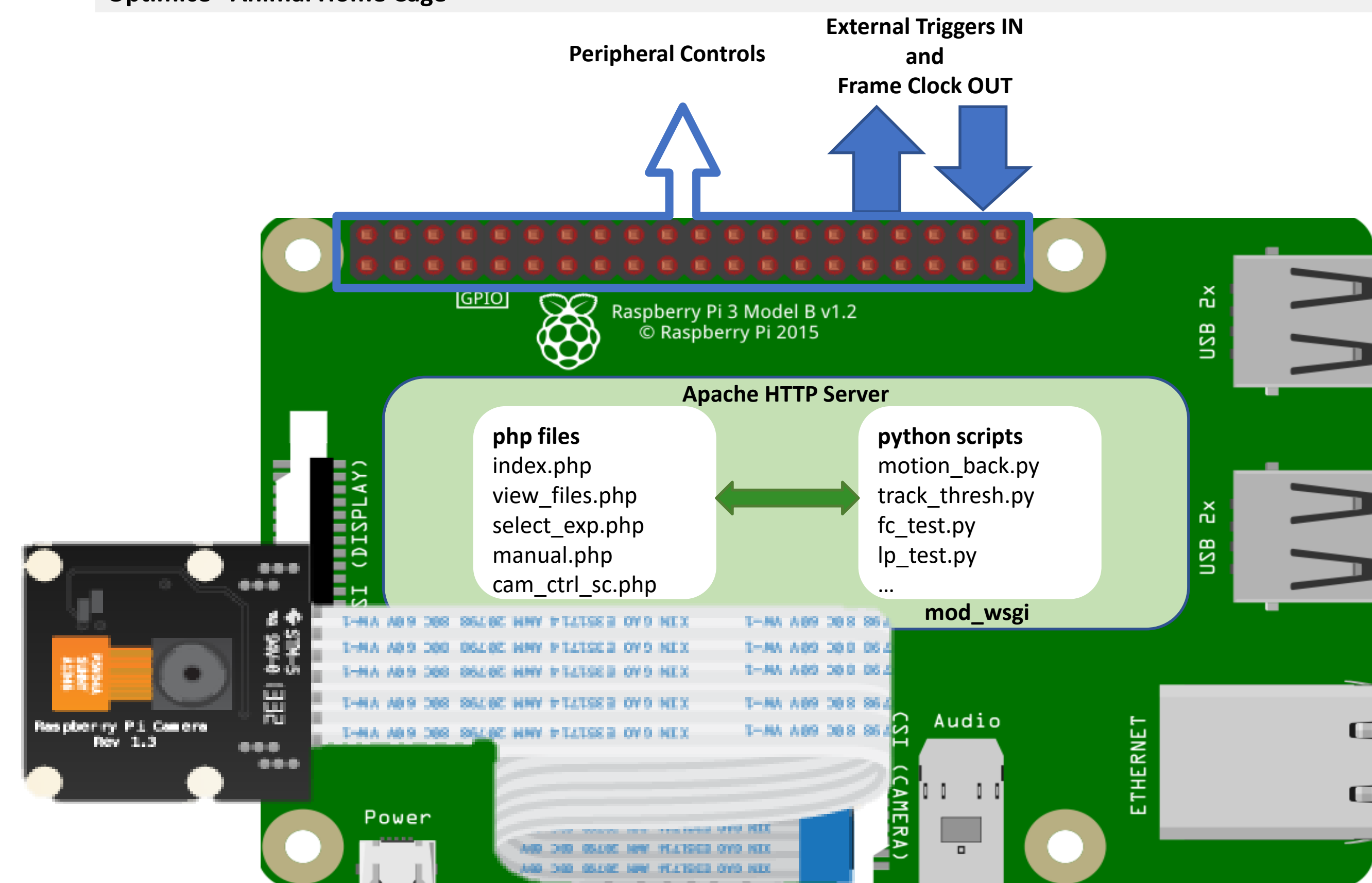


Figure 1. System Architecture.

## Results

Automated data collection and analysis using the proposed web based solution.

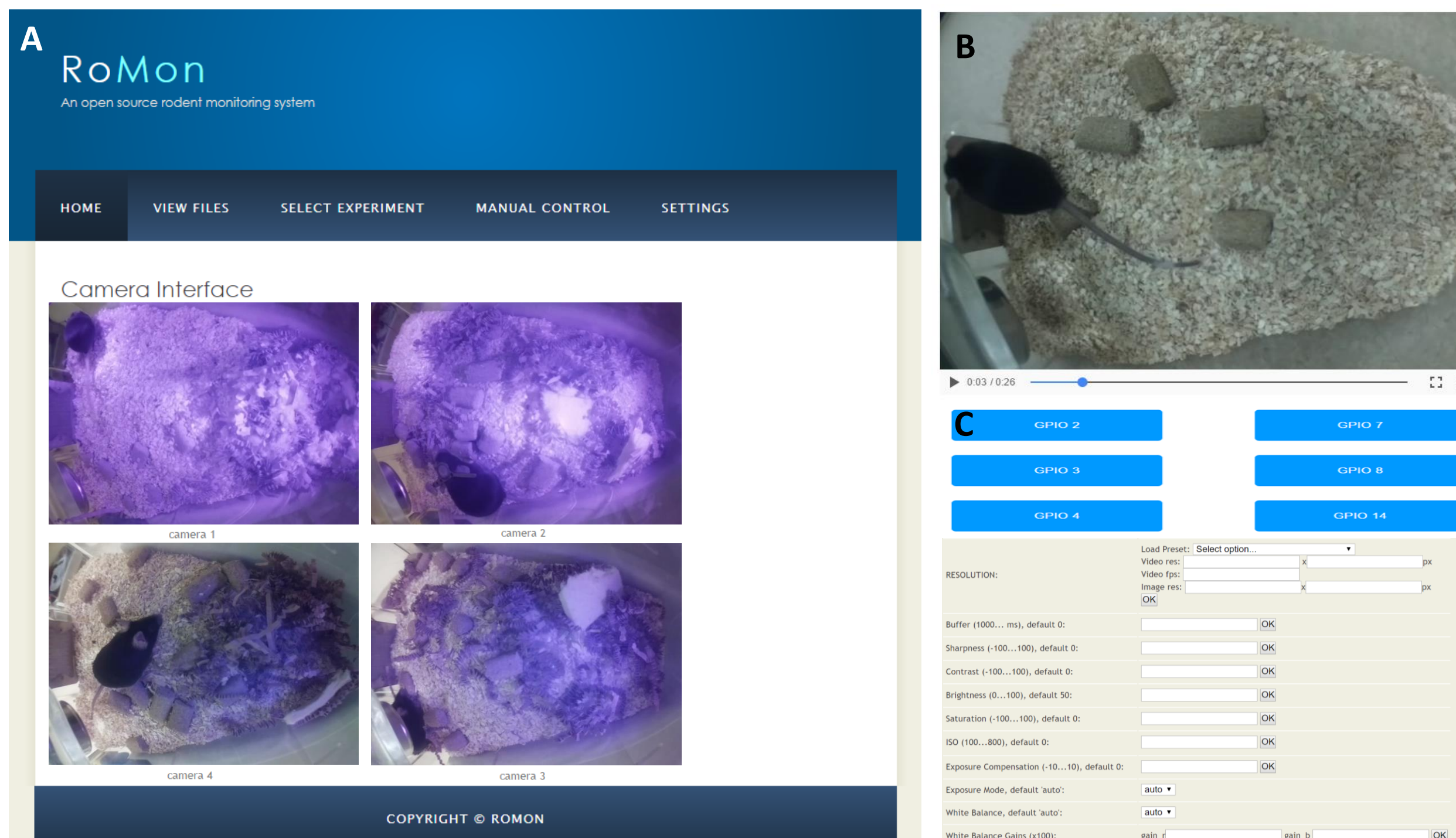


Figure 2. (A) Web interface for live preview, (B) view stored data, and (C) manual control of GPIOs with camera settings

NOTE: Using this system we have been able to record videos @ 120 fps (4X4 binning)

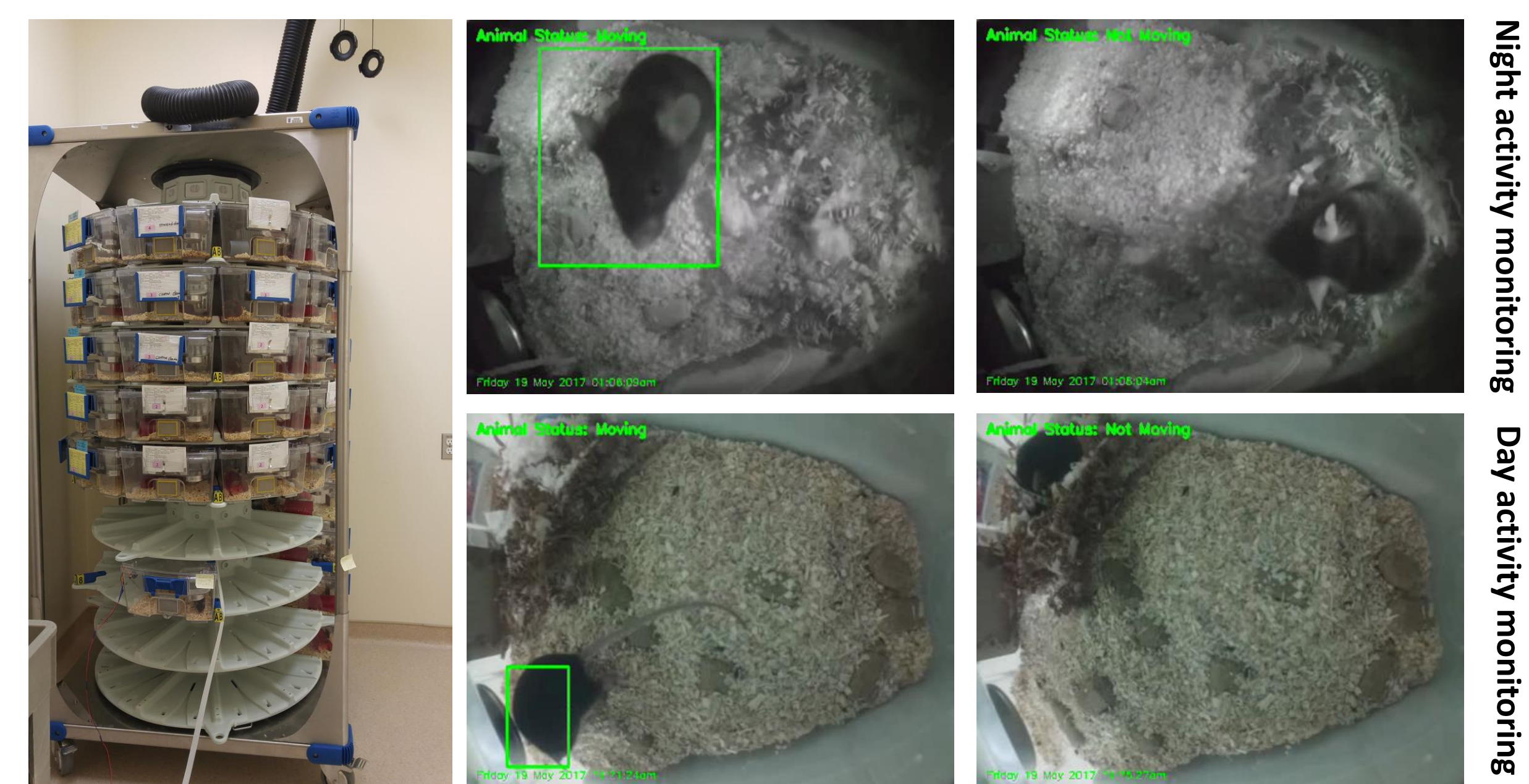


Figure 3. System setup and online animal activity monitoring using frame differencing algorithm in home cage.

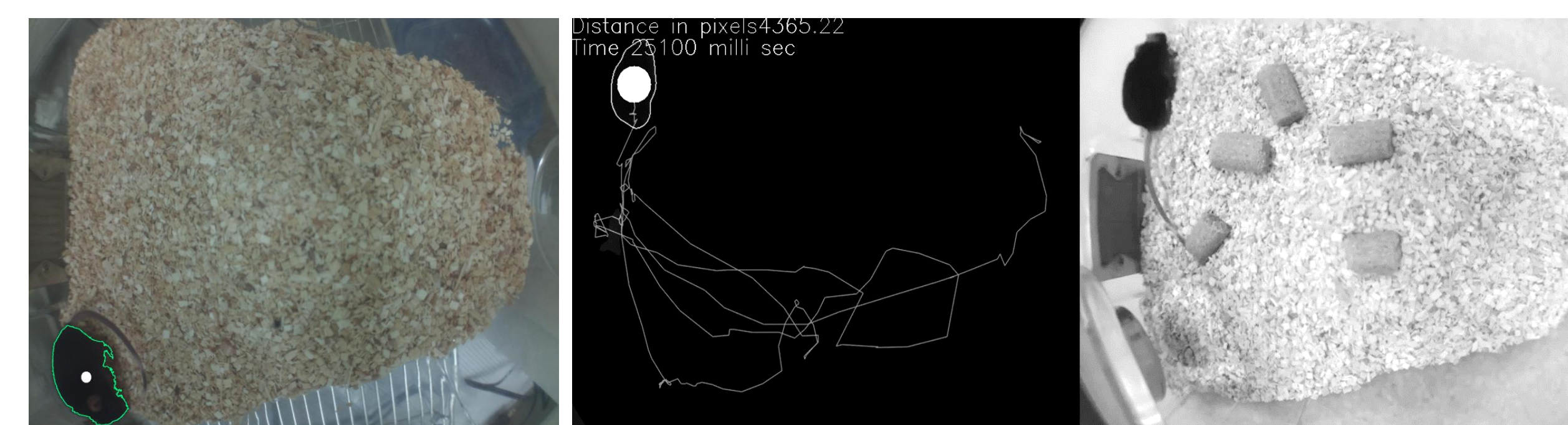


Figure 4. Online animal tracking using intensity based thresholding.

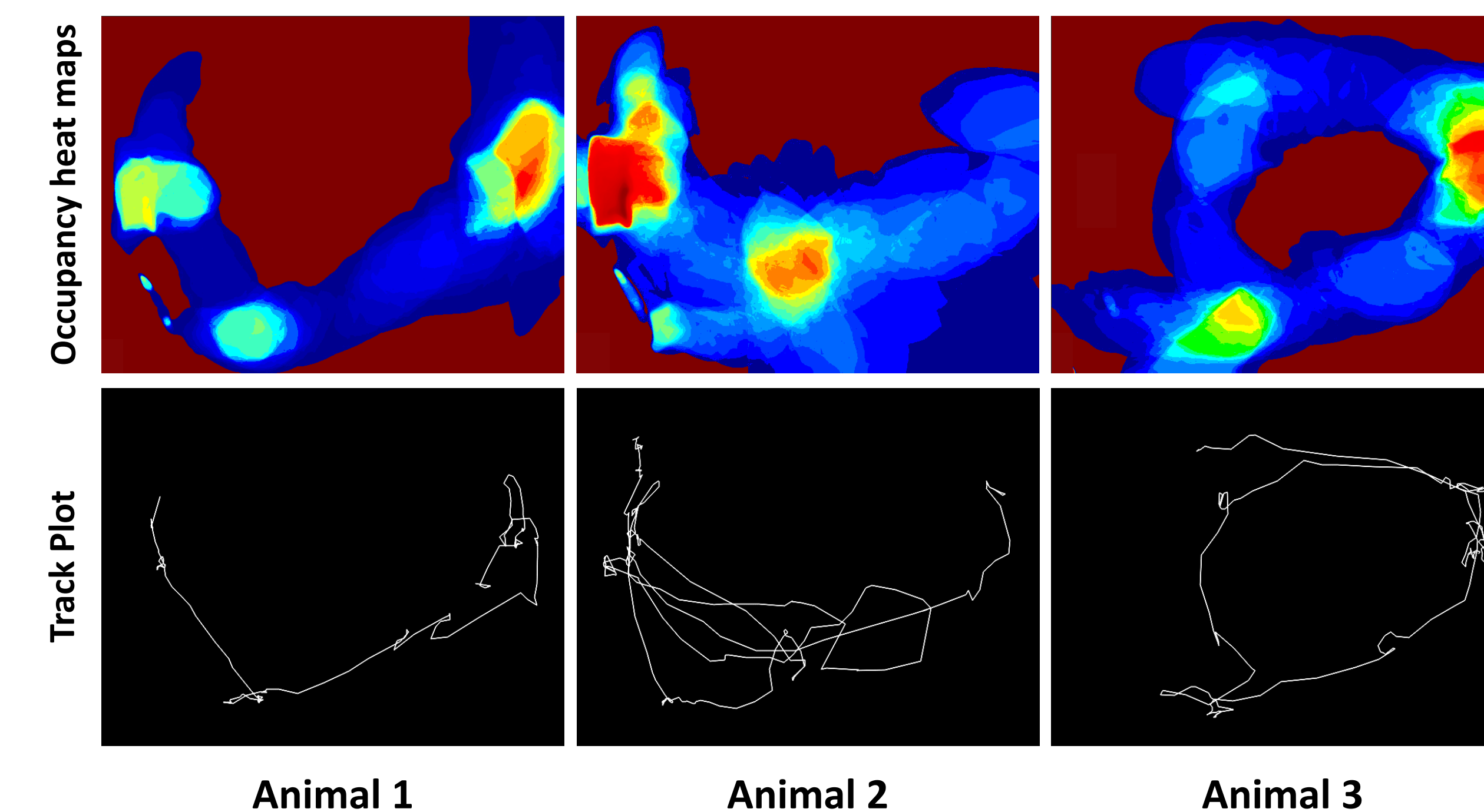


Figure 5. Occupancy heat maps and trajectory plots of animal activity in their home cages.

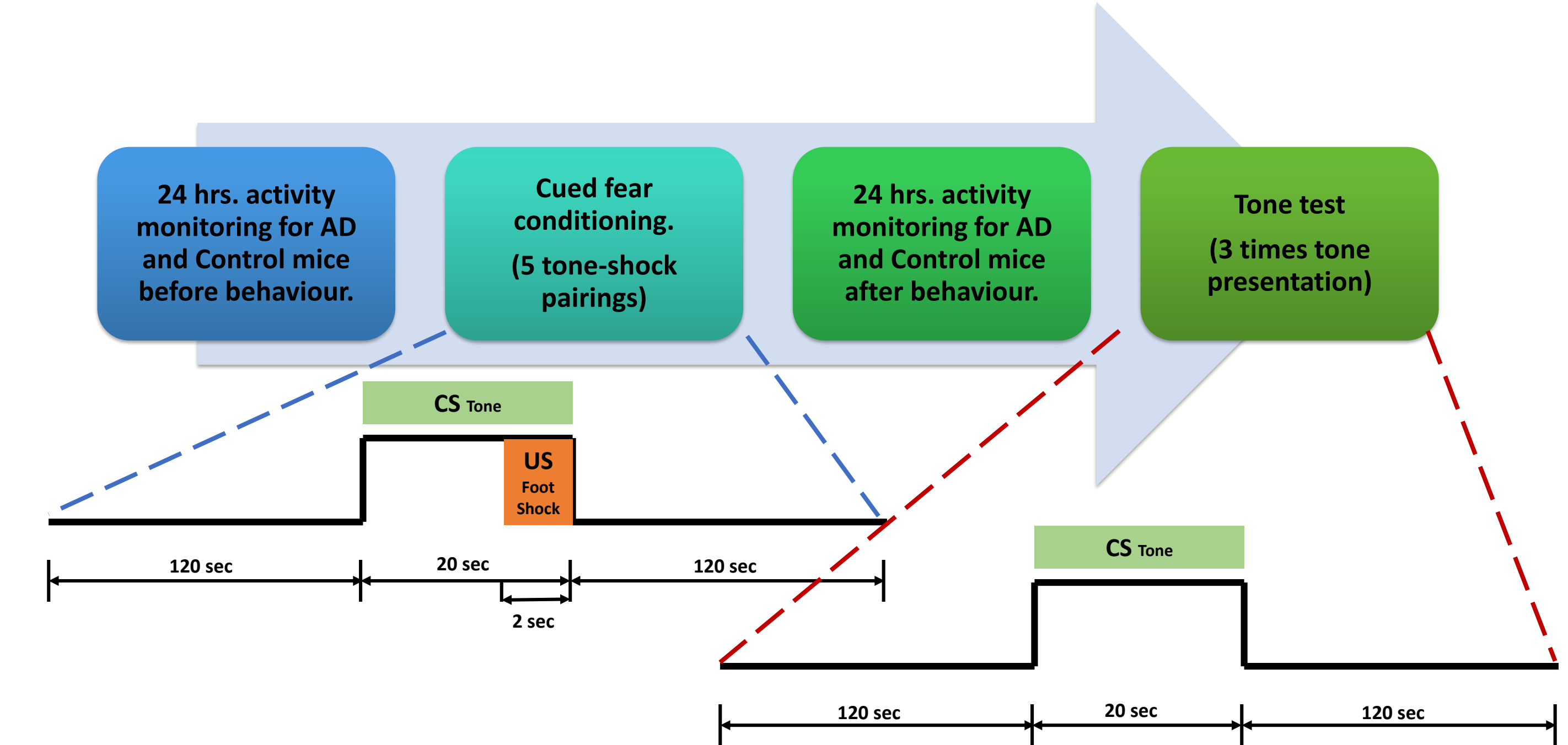


Figure 6. Experiment timeline

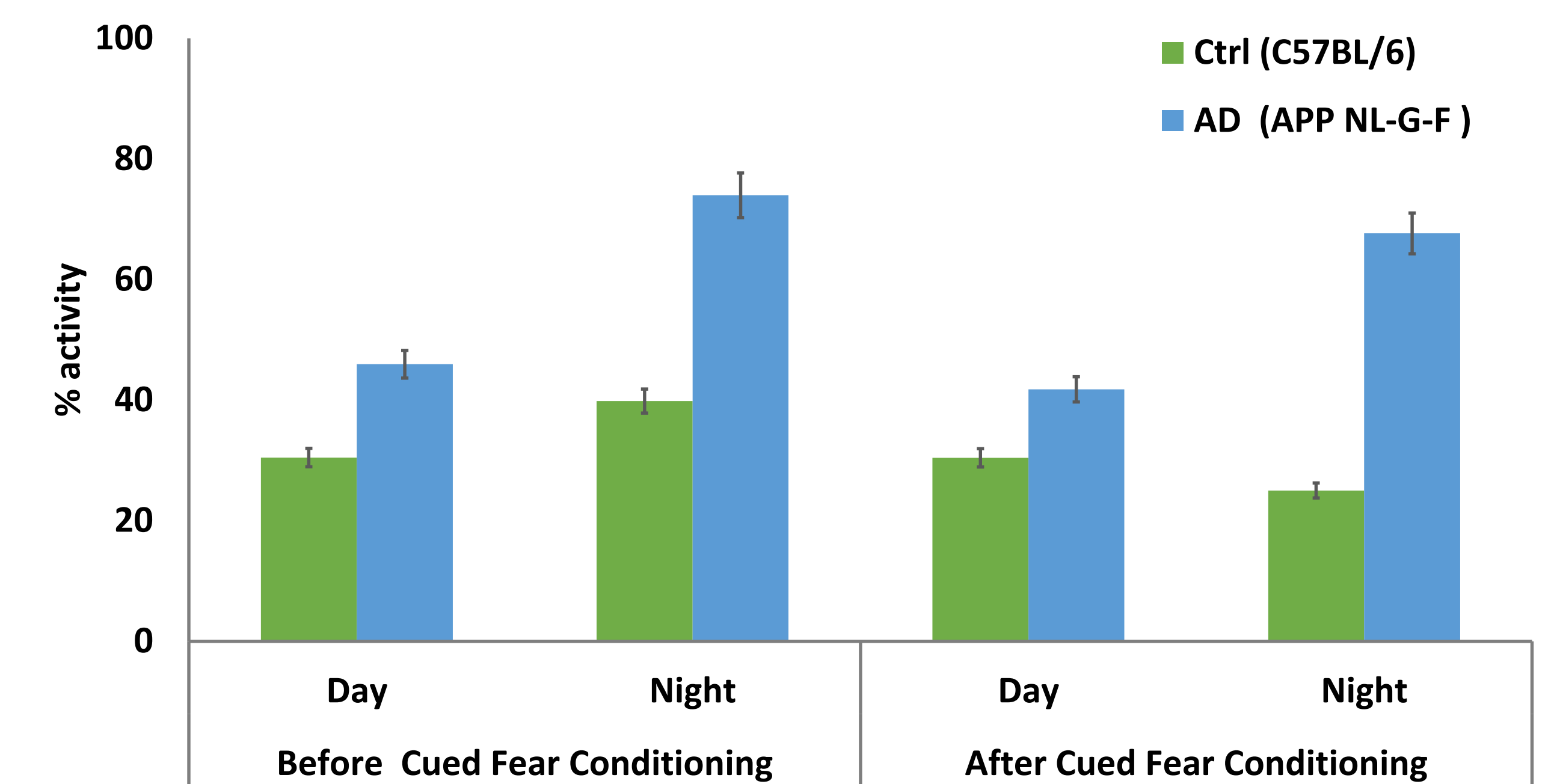


Chart 1. Average day and night time activity of 10 months old control and AD mice before and after cued fear conditioning. (n=2)

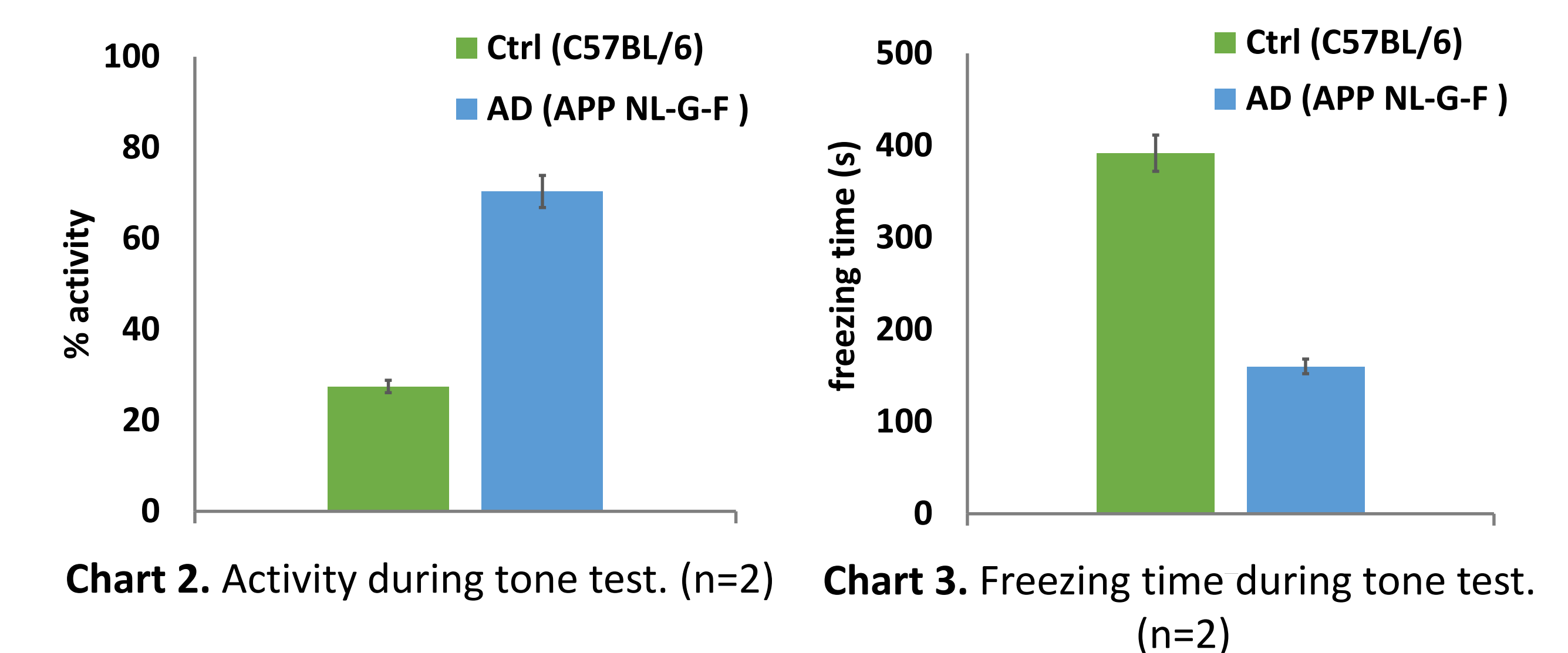


Chart 2. Activity during tone test. (n=2) Chart 3. Freezing time during tone test. (n=2)

## Conclusion

The automated and systematic implementation of training protocols with simultaneous monitoring of animal behaviour within the animal's home-cage dramatically reduces the effort involved in animal training and data acquisition while also removing human errors and biases from the process. Further, our system is available to the research community as open-source, which will facilitate the creation of new research avenues in behavioural neuroscience using a low-cost open-source platform.

## Acknowledgement

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## References

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