

For research article

Response to Reviewer 1 Comments

1. Summary

Thank you very much for your invaluable time and for providing us with many helpful and constructive comments. We made many revisions following your suggestions. Here we would like to respond to your comments, point by point, and explain our revisions marked in yellow.

2. Questions for General Evaluation	Reviewer's Evaluation	Response and Revisions
Does the introduction provide sufficient background and include all relevant references?	Yes	
Is the research design appropriate?	Can be improved	
Are the methods adequately described?	Yes	
Are the results clearly presented?	Can be improved	
Are the conclusions supported by the results?	Can be improved	

3. Point-by-point response to Comments and Suggestions for Authors

Comments 1: Ensure that all full meanings (eg, SP, MP, RF, RF, VP, Shape, SVM, etc.) are written on the first mention and continuously used throughout the manuscript.

Response 1: Thank you for your valuable comments on our manuscript. In light of that, we have listed the key acronyms in the article in detail, as detailed in the "Abbreviations" section on Line 418, Page 21 of the article. In this section, we list the key acronyms that frequently appear in this article or are important to the research of this article, and attach their full names or meanings to the right side of the table. Hopefully, the addition of the "Abbreviations" section will make it easier and clearer to read the article.

Comments 2: Provide more information about signal acquisition hardware- Sampling rate, signal preprocessing phase, and duration of each emotional state recording.

Response 2: Thank you for your valuable feedback. We appreciate your careful analysis of our manuscript. Regarding your comments on the specifics of the experiment, we would like to make the following adjustments:

- (1) Information about signal acquisition hardware: In order to better show the specific hardware used in the experiment, we added Table 3 on Page 6 to describe the hardware details, including: hardware photos, name of the detected signal, types, brands, sampling

rates, measurement frequency, signal-to-noise ratio (just for the voice capture devices). Meanwhile, the actual hardware equipment is shown as follows:

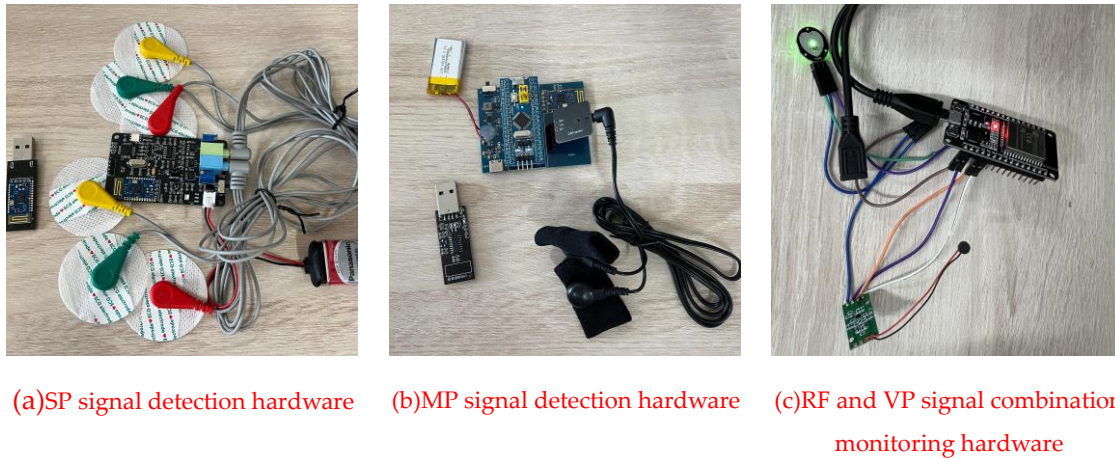


Figure 1. Four sets of signal detection hardware devices

- (2) Signal preprocessing phase: We acknowledge your concern regarding the less description of the signal preprocessing process. Before, we show the preprocessing process of normalizing different signals in Equation 1 to solve the problem that there are certain differences in the amplitude level of apparent physiological signals in different individuals, which is not convenient for the processing of a single data. Now, on Line 181, Page 7, we have added the issue of missing values in the signal acquisition using the 'spline' method during the experiment. In this way, the preprocessing process of our experiments has been demonstrated in detail. Since the pre-data acquisition work of our experiments only requires accurate acquisition of raw data of four signals, and no other operations are required, and can be completed by using MATLAB software, which is widely used in the field of data analysis and signal processing, there are no other excessive preprocessing steps.
- (3) Duration of each emotional state recording: We appreciate your observation regarding the details of the experimental process. In the experiment, we could not control the duration of the actual emotion because the emotional mobilization of pet dogs was done by the dog owners who knew their habits better. However, through the real-time video recording of the scene during the experiment, and the real-time storage and export of data, we will select a typical emotional state with a duration of about 15 seconds for data extraction and processing. For example, if the dog is very emotional at this time, we will select the most excited 15S clip for data acquisition; If the dog's emotions are not very obvious at this time, we will also randomly select a 15s segment for data collection for the universality of the data. Specific text details are added on Line 184, Page 8.

Comments 3: Some figures lack a detailed caption or axis label (eg, figures 5-7). Increase clarity by describing what is shown in each figure caption, including units and references.

Response 3: Thank you for your insightful comments. We apologize for the lack of axis label and unit in the figures in our paper. Based on the suggestion, we have checked and revised all the figures in the paper in more detail. For example, for Figure 6, we have added a description

of the ordinate axis, which means that the ordinate is SHAP value, representing the contribution rate of the result. For Figure 7, we added the abscissa axis for the training set size and the ordinate axis for accuracy. For Figure 8, we have also supplemented the label of the ordinate. For details, they can be found at [Figure 6 on Page 15](#), [Figure 7 on Page 16](#), [Figure 8 on Page 18](#).

Comments 4: Add a detailed description of the labeling of emotional stages (happiness, sadness, fear, anger). Consider behavioral signal, expert verification, or video coding references to support the accuracy of emotion classification.

Response 4: Thank you for your valuable feedback. It is indeed not reasonable to describe the labeling of emotional stages less. The judgement of the emotions of pet dogs directly was by the owner, but we mobilize emotions by using specific items to induce emotions. The theory of animal behavior is well established. In dogs, for example, reward-related brain activation is a response to food, praise, play, and familiar human smells, which cause them to feel happy. [1-3] Dog anger is caused by threatening stimuli, such as an unfamiliar barking dog or approaching stranger or other potentially dangerous stimuli [4]. Behavioral fear-induced tests performed on dogs involve loud noises or sudden or novel objects [5], and at the same time, a large body of research literature has shown a correspondence between dog behavior and its emotions, as shown in [Table 1](#) of this paper. [6-9] Therefore, we believe that it is relatively accurate to use emotion induction props to fix the categories of emotions generated by emotion induction. For another set of experiments in judging emotions in life, we chose border collie, who has already mastered the use of pet communication buttons. As shown in [Figure 2](#), when the experimental border herd ate delicious dog food, the button representing happiness was selected from the four buttons to express emotions. This kind of border herding uses the pet communication button to express emotions has been experimentally verified [10], and the use of pets to generate their own emotions can be more representative of the accuracy of the dog's emotional category at this time.



Figure 2. Test dog1
expresses emotions on his
own

Figure 3. Test dog2 expresses
emotions on his own

Figure4. Test dog3 expresses
emotions on his own

However, it is a pity that because the five border collies recorded in the life record were taken by means of surveillance or mobile phone records of the dog owner, their clarity and beauty do not meet the standard of being used as illustrations in the paper, so the record pictures cannot be inserted in the paper. We will pay attention to this in future experiments and learn from this problem. Details of the experimental process are added on Line 155, Page 5. Hopefully, our addition of the experimental process will improve the reader's understanding of the paper.

Comments 5: Expand the ethics section to explicitly mention how fear and sadness induction procedures ensured animal welfare (e.g., signs of stress, use of enrichment afterward, withdrawal protocols).

Response 5: Thank you for your valuable feedback. Previously, we elaborated on the importance of monitoring abnormal emotions in dogs at the social level of humans, which can prevent harm to humans caused by aggressive behaviors of dogs due to fear, anger, etc. In addition to this, we have also added to Line 42, Page 2 to show the importance of emotion detection in terms of the dog's own physical and mental health. Excessive anger and fear will cause abnormal physiological indicators of the dog and affect its health. Mood control can be achieved with anxiolytics or sedatives. Meanwhile, the monitoring of sadness emotions can also understand the dog's illness in advance and help to seek medical attention in time. Details and references(Ref[4-7] in our paper) have been shown, and it is hoped that a description of dog welfare aspects can be added.

Finally, we would like to extend again our cordial thanks to you for your invaluable time as well as your constructive suggestions that helped improve our paper.

4. Additional clarifications

References:

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