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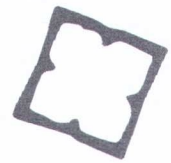
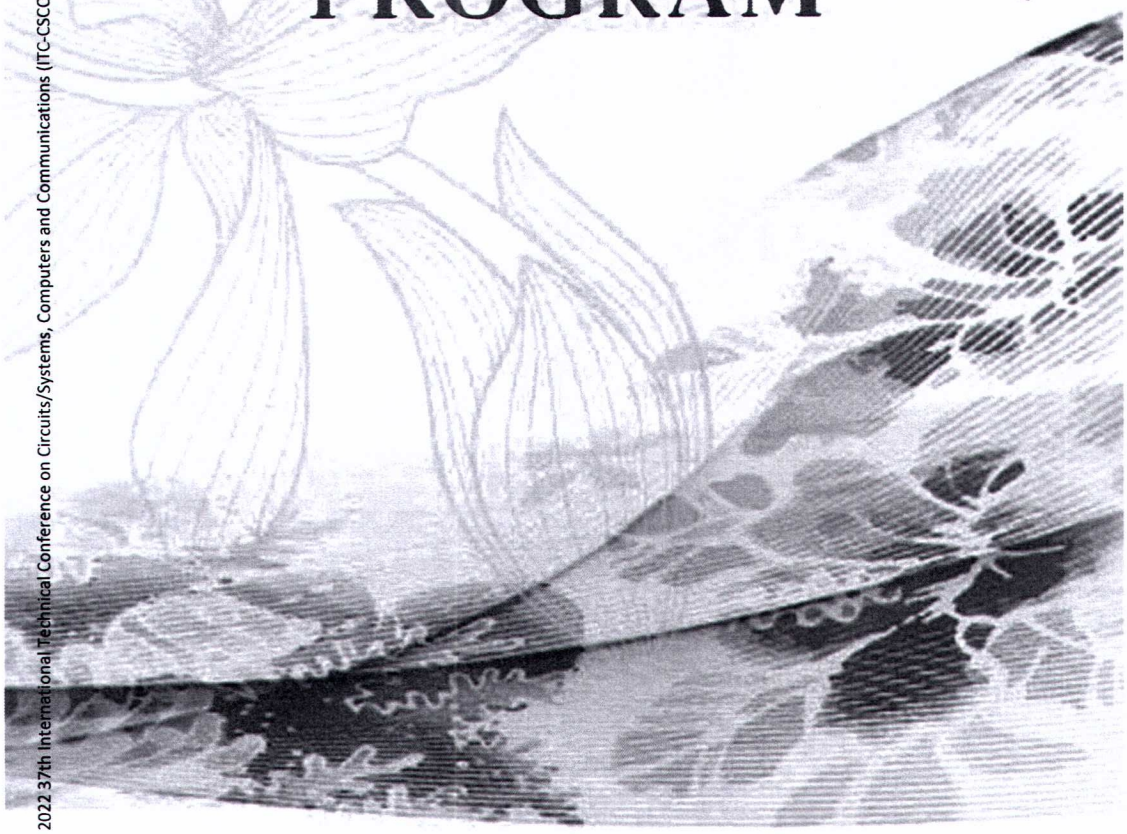
ITC-CSCC 2022

The 37th International Technical Conference on Circuits/Systems, Computers and Communications

July 5-8, 2022 || Phuket, THAILAND



PROGRAM



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WELCOME TO ITC-CSCC 2022

With the great success of the International Technical Conference on Circuits/Systems, Computers and Communications (ITC-CSCC) as the world leading conference devoted to the advancement of high technologies in Circuits, Systems, Computers, and Communications, we would like to invite all the scholars and experts around the world to attend the 37th ITC-CSCC 2022 to be hosted in Phuket, Thailand.

The conference is open to researchers from all regions of the world. Participation from Asia Pacific region is particularly encouraged. Proposals for special sessions are welcome. Papers with original work in all aspects of Circuits, Systems, Computers, and Communications are invited. Topics include, but not limited to, the followings

Circuit & System Areas

- • Analog Circuits
- • Computer Aided Design
- • Intelligent Transportation Systems & Technology
- • Linear / Nonlinear Systems
- • Medical Electronics & Circuits
- • Modern Control
- • Neural Networks
- • Power Electronics & Circuits
- • RF Circuits
- • Semiconductor Devices & Technology
- • Sensors & Related Circuits
- • Verification & Testing
- • VLSI Design

Computer Areas

- • Artificial Intelligence
- • Biocomputing
- • Computer Systems & Applications
- • Computer Vision
- • Face Detection & Recognition
- • Image Coding & Analysis
- • Image Processing
- • Internet Technology & Applications
- • Motion Analysis
- • Multimedia Service & Technology
- • Object Extraction & Technology

- • Security
- • Watermarking
- • Blockchain
- • Data Analytics
- • Internet of Things
- • Virtual Reality

Communication Areas

- • Antenna & Wave Propagation
- • Audio / Speech Signal Processing
- • Circuits & Components for Communications
- • IP Networks & QoS
- • MIMO & Space-Time Codes
- • Multimedia Communications
- • Mobile & Wireless Communications
- • Network Management & Design
- • Optical Communications & Components
- • Radar / Remote Sensing
- • Communication Signal Processing
- • Ubiquitous Networks
- • UWB
- • Visual Communications
- • Wireless Sensor Networks
- • Underwater Communications

We are looking forward to seeing you all at the ITC-CSCC 2022.

ITC-CSCC 2022 Organizing Committee

THE HISTORY OF ITC-CSCC

The ITC-CSCC has been originated from the JTC-CAS (Joint Technical Conference on Circuits and Systems) 1986 which was jointly organized by the KIEE (Korea Institute of Electronics Engineers) and the IECEJ (Institute of Electronics and Communication Engineers of Japan) and held at Hanyang University, Seoul, Korea, Oct. 23-24, 1986.

It started as an annual bilateral conference between the KIEE which was renamed to IEIE (The Institute of Electronics and Information Engineers) and the IECEJ which was renamed to IEICE (Institute of Electronics, Information and Communication Engineers) later. In 1988, the JTC-CAS had its title changed to JTC-CSCC (Joint Technical Conference on Circuits/Systems, Computers and Communications).

In 1996, the JTC-CSCC had its title changed to ITC-CSCC (International Technical Conference on Circuits/Systems, Computers and Communications). In 2002, the ITC-CSCC was held in Phuket, Thailand which was the first time to be held in a place other than Korea and Japan.

Currently the ITC-CSCC is sponsored by the IEIE (The Institute of Electronics and Information Engineers), IEICE (Engineering Sciences Society and Electronics Society), and the ECTI (Electrical Engineering/Electronics, Computer, Telecommuni-cations and Information Association, Thailand).

This conference has been set and rotated in three countries: Korea, Japan and Thailand as shown below.

ITC-CSCC 1986-2021

No.	Conference	Date	Location	General Chair	TPC Chair
1st	JTC-CAS 1986	Oct 23-24	Seoul, Korea	Kyu Tae Park	In Chil Lim
2nd	JTC-CAS 1987	July 21-22	Tokyo, Japan	Masao Iri	Lsao Shirakawa
3rd	JTC-CSCC 1988	Nov 4-5	Seoul, Korea	In Chil Lim	Keun Choong Kin
4th	JTC-CSCC 1989	June 25-26	Sapporo, Japan	Isao Shirakawa	Yoji Kajitani
5th	JTC-CSCC 1990	Dec 10-11	Jeju, Korea	Tae Won Rhee	Seung Hong Hong
6th	JTC-CSCC 1991	July 22-23	Hiroshima, Japan	Kenji Onaga	Tatsuo Nishi
7th	JTC-CSCC 1992	July 27-28	Gyeongju, Korea	Tae Won Rhee	Moon Key Lee
8th	JTC-CSCC 1993	July 26-28	Nara, Japan	Kenji Onaga	Tatsuo Nishi

33rd	ITC-CSCC 2018	July 4-7	Bangkok, Thailand	Lunchakorn Wuttisittikulkij	Pisit Vanichchanunt
34th	ITC-CSCC 2019	June 23-26	Jeju, Korea	Chungyong Lee	Kwang-Hyun Baek
35th	ITC-CSCC 2020	July 3-6	Nagoya, Japan	Kohkichi Tsuji	Norihiko Shinomiya
36th	ITC-CSCC 2021	June 28-30	Jeju, Korea	Seon Wook Kim	Suk-Ju Kang

The JTC-CAS had its title changed to JTC-CSCC in 1988.
The JTC-CSCC had its title changed to ITC-CSCC in 1996.
JTC-CAS: Joint Technical Conference on Circuits and Systems
JTC-CSCC: Joint Technical Conference on Circuits/Systems, Computers and Communications
ITC-CSCC: International Technical Conference on Circuits/Systems, Computers and Communications

MESSAGE FROM TECHNICAL PROGRAM CHAIRS

On behalf of the technical program committee (TPC), we would like to deeply thank all participants and it is our great pleasure to welcome you to the 37th International Technical Conference on Circuits/ Systems, Computers, and Communications (ITC-CSCC 2022).

We are very excited about the technical program that brings together many high-quality papers from 10 countries, 309 contributed papers that were totally submitted to our conference for this year. Our team which consists of TPCs and more than 216 reviewers has worked hard to complete the process of peer review and selection. Each paper received at least two reviewers from the respective research community. Finally, an outstanding program of 257 contributed papers is comprehensively offered at the conference with an acceptance rate of 83.2%. In addition, there are 3 keynote speeches. Consequently, the conference program has 33 online and 19 on-site sessions.

Finally, we would also like to express our deepest gratitude to all committee members and chairs who voluntarily invest their own time in selecting papers and arranging such a successful and memorable conference. We hope you enjoy the technical program and that while at the conference you can take advantage of the excellent chance to exchange ideas with other researchers and practitioners, and also initiate some fruitful collaboration between universities or institutions. Welcome you all to Phuket, Thailand.

Best regards

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A semi-automated annotation for boar sperm classification using deep convolution neuron network

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Abstract—**This study aims to develop a semi-automated annotation based on deep convolution neuron networks in mobility computer-assisted sperm analysis for boar sperm classification (mobile-CASA). The semen from two boar breeders was captured into 250 frames and labeled as good or bad using sperm head morphology. A semi-annotation is split into two processes. At first, an expert reviews the images and annotates a few frames to verify the sperm's annotations. After the expert has finished, relevant frames will be selected and passed on to an AI model recursively until the learned model can accurately identify sperm morphology. The experiment results show that our proposed tend to reduce the workload of the domain expert and improve detection accuracy from 0.65 to 0.95. In addition, this model can embed in mobile devices that are easy to use and access by general farmers.**

Keywords: semen analysis, computer-assisted sperm analysis, sperm morphology classification

INTRODUCTION

The assessment of sperm morphology is important for the success of artificial insemination in boar. Computer-Assisted Sperm Analysis (CASA) has been developed to be used as a tool for a sperm quality measurement, but this software is very costly and hardly to access by general farmer. Therefore, the embedded artificial intelligence devices or mobile tools using deep learning techniques have been developed for object detection and classification in open-source microscopic tools and software. In various studies including bioinformatics [1], computer vision [2], and medical image analysis [3] had been reported in sperm detection and classification. Michael Biehl et al. [4] proposed automated boar semen quality assessment to classify the sperms into normal and abnormal sperms. Serge Zaugg et al. [5] introduced an automated real-time whale sperm classification. The Faster RCNN (FRNN) by Kanjanawattana. S. et al, [6] was introduced to detect the bull sperms on the glass slide and classify the viability of the sperms as dead or alive automatically. It is possible that the system may misclassify the object because some features of the objects and junks have been similar. Therefore, this study introduces a semi-automated annotation based on deep convolution neuron network in mobility computer-assisted sperm analysis for boar sperm classification.

MATERIALS AND METHOD

A. *Data acquisition*

The boar semen was manually gathered by a farmworker, which recorded video from a glass slide by microscope. On average, the data set has 250 frames per video. The images were labeled as good (normal) or bad (abnormal) based on the sperm head morphology. A total of 528 captured images were used and divided into 400 (75%) for training, while 128 (25%) for testing. The frame number was randomly selected in training and testing.

B. *Methodology design*

In this section, we explain our framework illustrated in fig. 1 The annotation is split into two processes. At first, an expert reviews the images and annotates a few frames to verify the sperm's annotations. After the expert has finished, relevant frames will be selected and passed on to an AI model.

C. *An expert annotation processes*

An expert identified each sperm image by using the morphological landmarks of the sperm. To prepare the annotation labels, hand drawing was performed to separate the smallest bounding boxes represented the region of interest (ROI) and separated images of the good (normal) or bad (abnormal) sperm.

D. *An AI annotation process*

In the annotation process, the effective real-time object recognition algorithm called as YOLO family was used to detect and annotate the boar sperm. The training was beginning with the YOLO-v4-tiny because it is faster than other versions. Then, the deeper version such as YOLO-v3 was used for improving sperm detection. The overall processes are followed:

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The 1st iteration: Step 1) using the first annotation was manually performed only 25% of frames, then, the YOLO-v4-tiny model was trained and detected sperm morphology. Step 2) automatic annotations using the ground-truth generation function were automatically draw the new annotation. Step 3) the expert can adjust and modify AI annotation. Step 4) AI model in the next iteration was trained until the learned model can accurately identify sperm morphology using more complex architecture (Fig. 1a). It is possible that the system may misclassify. The expert can adjust and modify the AI annotation, then, the new annotations were used to train AI model in the next iteration until the learned model can accurately identify sperm morphology.

The $2^{nd} - 3^{rd}$ iteration was followed the 1^{st} iteration using YOLO-v3 (more complex architecture). AI model in the next iteration was trained until the learned model can accurately identify sperm morphology using more complex architecture (Fig. 1b-1c).

The 4th iteration: Step 1) using the fourth annotation was performed by AI with 100% of frames, then, the YOLO-v3 model (using the 3rd iteration) was trained and detected sperm morphology (normal or abnormal) with all frames. Step 2) the outputs were reported in sperm count, sperm normal rate, and sperm abnormal rate for farmworker decision (Fig. 1d).

E. Evaluation Metrics

Intersection over Union (IoU), Recall (RE), and the mAP. An Average Precision (AP) were used to measure the model performance.

$$AP = \frac{1}{N}\sum_{k=1}^{N} P(k)\Delta r(k) \quad (1)$$

Where the $P(k)$ refers to the precision at a specifically given threshold k, and $\Delta r(k)$ as the shift in the Recall. For multiple object detection, the mAP calculates the mean of all AP for each category as follow:

$$mAP = \frac{1}{N}\sum_{i=1}^{N} AP_i \quad (2)$$

Intersection over Union (IoU) were compared over iteration to describe the extent of overlap. The improved model shows a greater region of overlap with the prediction box and the ground truth. The IOU calculated as:

$$IoU = \frac{Area\ of\ Intersection}{Area\ of\ Union} \quad (3)$$

F. Implementation

The mobility computer-assisted sperm analysis system (mobile-CASA) consisted of digital microscope, AI Board, and user monitor. The boar sperm video was live streaming from the digital microscope and fed to AI Board. The application for operating the mobile-CASA system worked with NVIDIA Jetson nano including deep learning software.

EXPERIMENT RESULTS

A. Boar sperm annotation and detection

This study proposes a semi-automated annotation based on deep convolution neuron network. The mAP was calculated for the accuracy of the boar sperm detection model. As is shown in Table 1, the proposed framework shows different experimental results in testing dataset. In the first iteration, 25% of frames were annotated only the humans and fed to the YOLOv4-tiny model. The mAP and recall are very low in 0.65 and 0.66 respectively. Clearly, the little dataset and the tiny model have too much loss in detection performance. In the second iteration, 50% of frames were automatically drawn by the AI using a more complex model (YOLOv4). The mAP and recall are 0.75 and 0.76 respectively. Although mAP and recall increased by 10% compared with the YOLOv4-tiny, some objects are missed detection. Then, the expert can adjust and modify AI annotation. In the third iteration, 75% of frames were automatically drawn by the AI using a more complex model (YOLOv3). The mAP and recall increased by 8% compared with the YOLOv4. Finally, 100% of frames were automatically drawn by the AI with the highest mAP and recall in 0.95. In summary, the sufficient dataset, deeper layer of training model, and AI&Expert annotation contribute to improving model performance. Fig. 2 (a) shows the missed detection (red arrow). In the same frame as show in fig 2 (b) and (c), the next iteration can improve this missed detection (black arrow).

B. Implementation in mobile-CASA

Computer-Assisted Sperm Analysis (CASA) has been developed to be used as a tool for a sperm quality measurement, but this software is very costly and hardly to access by general farmer. Although most researchers have developed commercial and free CASA, a few of the software is not available on mobile devices. This work presents the first version of mobile computer assisted sperm analysis (CASA) system named mobile-CASA. The mobile-CASA uses for mobile devices such as AI boards or small microcontrollers. The tiny and effective detection model can embed in mobile devices.

DISCUSSION

The experiment results show that our proposed tend to reduce the workload of the domain expert while maintaining a very high annotation quality and detection accuracy. The sufficient dataset, deeper layer of training model, and AI&Expert annotation contribute to improving mAP from 0.65 to 0.95. This result is consistent with numerous studies have shown that data quality is crucial to enable successful

machine learning. Especially, object detection requires high-quality annotated data to improve deep learning detection results [7, 8]. In agree with the data annotation using the domain expert is labor-intensive, and expensive process, they concluded that the best way to reduce the annotation time is possible to automate using artificial intelligence to complete this process [9-12].

CONCLUSION

This study tends to impact on the bioinformatics research because the system can apply to the real-world data. In addition, the proposed framework and method can embed in a portable single-board circuit mobile device to inspect boar sperm in farms. However, there is a limitation. Other sperm morphology such as sperm tail will analyze the quality of boar sperm. The sperm mobility analysis will perform in the future work.

ETHICS STATEMENT

This study was approved by the Animal Research Ethics Committee, Rajamangala University of Technology Tawan-ok with RMUTTO-ACUC-2-2022-0014.

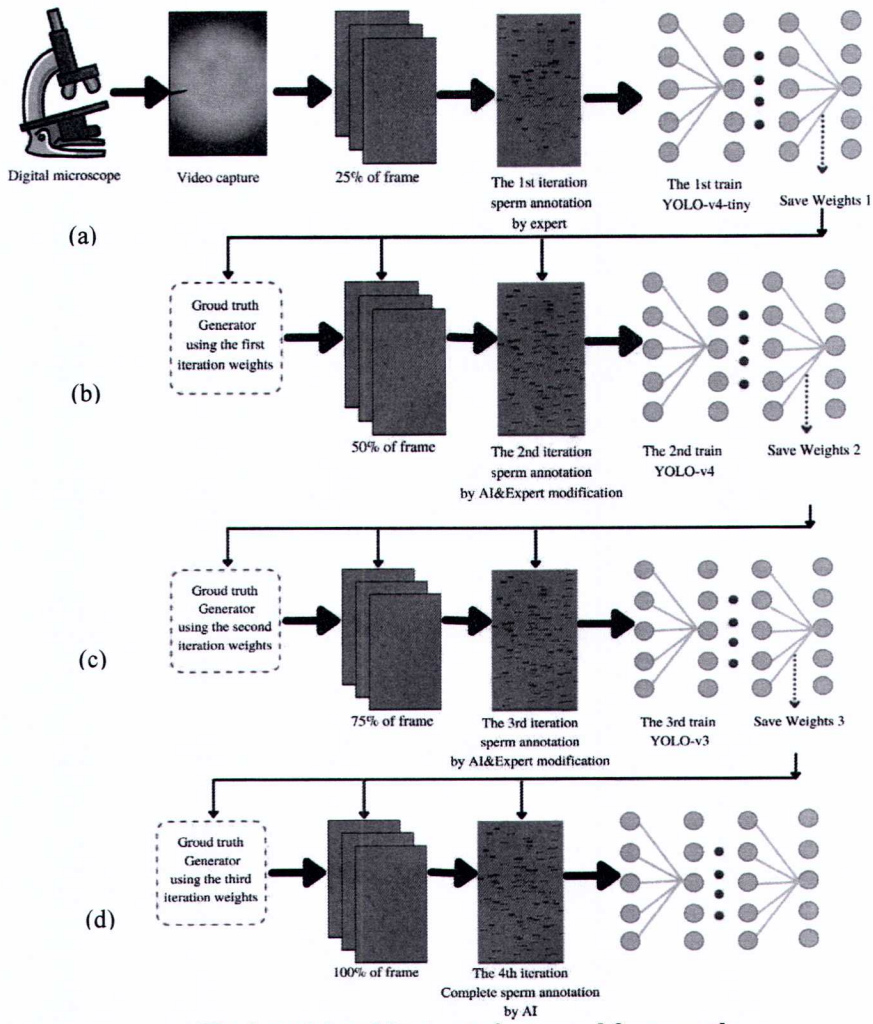
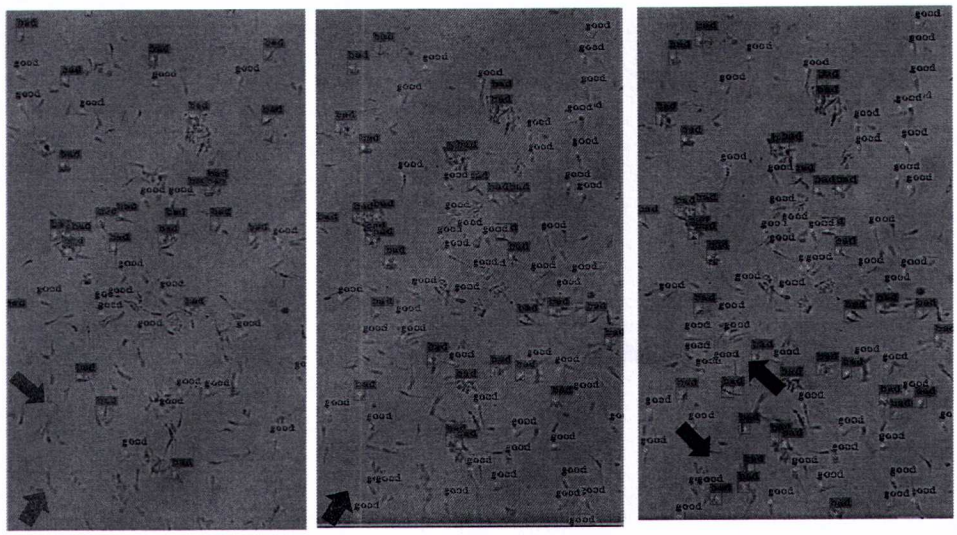


Fig. 1 model architecture of proposed framework

Table 1. Performance comparison for each iteration on testing dataset.

Iteration	%frame	Method	Training model	mAP@0.5	Recall
1st iteration	25%	Expert	YOLOv4-tiny	0.65	0.66
2nd iteration	50%	AI& Expert	YOLOv4	0.75	0.76
3rd iteration	75%	AI& Expert	YOLOv3	0.83	0.84
4th iteration	100%	AI	YOLOv3	0.95	0.95



(a) (b) (c)

Fig. 2 (a) the area in red arrow represents the missed detection, (b) and (c) the area in black arrow represents the complement boar sperm that improve using our framework

ACKNOWLEDGMENT

We are grateful to in-house deep learning software (CiRA CORE) developed by College of Advanced Manufacturing Innovation King Mongkut's Institute of Technology Ladkrabang

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แบบฟอร์มใบรับรอง

ใบรับรองการอนุมัติให้ดำเนินการเลี้ยงและใช้สัตว์

ID# RMUTTO-ACUC-2-2022-0014

ชื่อข้อเสนองานวิจัย

(ภาษาไทย) การสร้างคำอธิบายประกอบภาพแบบกึ่งอัตโนมัติสำหรับจำแนกอสุจิสุกรโดยใช้การเรียนรู้เชิงลึก

(ภาษาอังกฤษ) A semi-automated annotation for boar sperm classification using deep convolution neuron network

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(มหาวิทยาลัย/กรม) มหาวิทยาลัยเทคโนโลยีราชมงคลตะวันออก

(กระทรวง)

สถานที่ดำเนินการเลี้ยงและใช้สัตว์ ฟาร์มสุกร 4 หมู่ 5 ตำบล ห้วยขวาง อำเภอ กำแพงแสน จังหวัด นครปฐม

ข้อเสนอแนะจากคณะกรรมการ

ข้อเสนอการวิจัยนี้ได้ผ่านการพิจารณาจากคณะกรรมการควบคุมดูแลการใช้สัตว์ทดลองแล้ว เห็นว่ามีความสอดคล้องกับจรรยาบรรณการใช้สัตว์เพื่องานทางวิทยาศาสตร์ สภาวิจัยแห่งชาติ จึงเห็นสมควรให้ดำเนินการเลี้ยงและใช้สัตว์ ตามข้อเสนอการวิจัยนี้ได้

ลงนาม.....

(นายอนันต์ พาร์รรถพาณิช)

ประธานคณะกรรมการควบคุมดูแลการใช้สัตว์ทดลองของหน่วยงาน

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