FISH DETECTION
LBP CASCADE CLASSIFIER

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AQUARIUM AR
THE OUTLINE

1. RESEARCH OBJECTIVES
   a. AR for aquarium
   b. System requirement
2. PREVIOUS RESEARCHES
3. THE PROPOSAL
4. EVALUATION
5. CONCLUSION

AQUARIUM AR
THE OBJECTIVES

AR FOR AQUARIUM

_ AR: overlaying object's information on real time video feed

_ AR for Aquarium

- Overlaying fish information in real time
- Low computational Cost

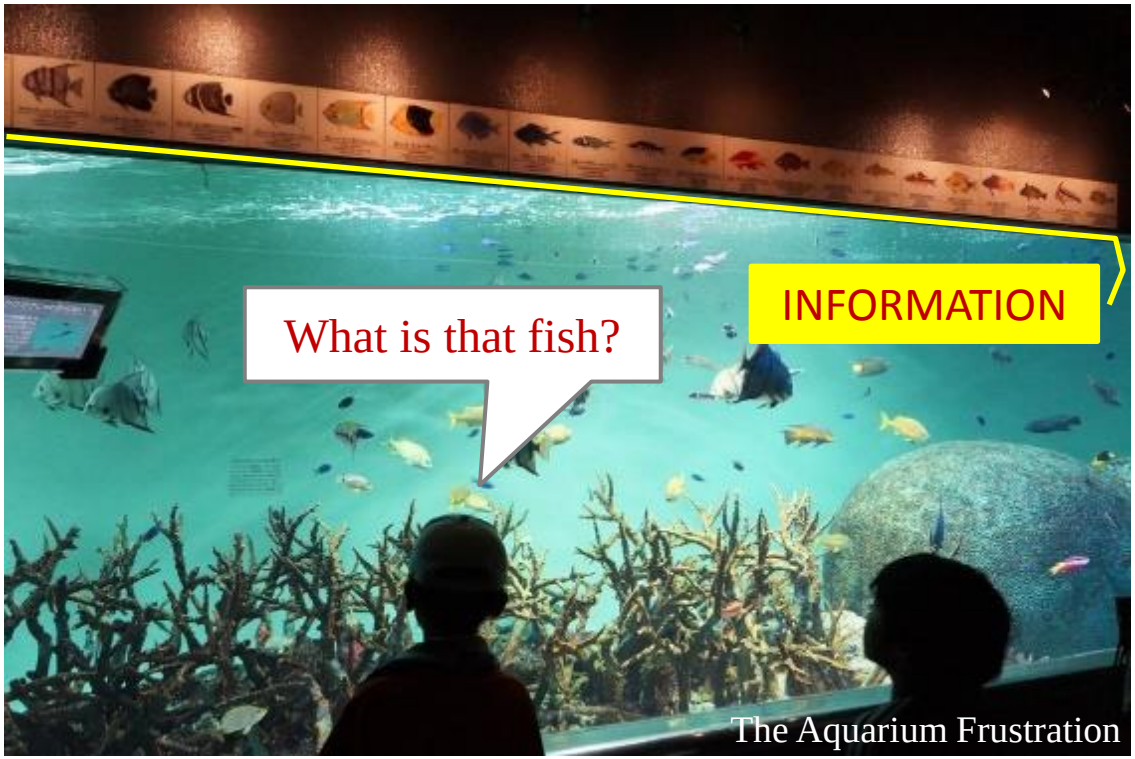


Image Courtesy of Tokyo Sea-Life Park

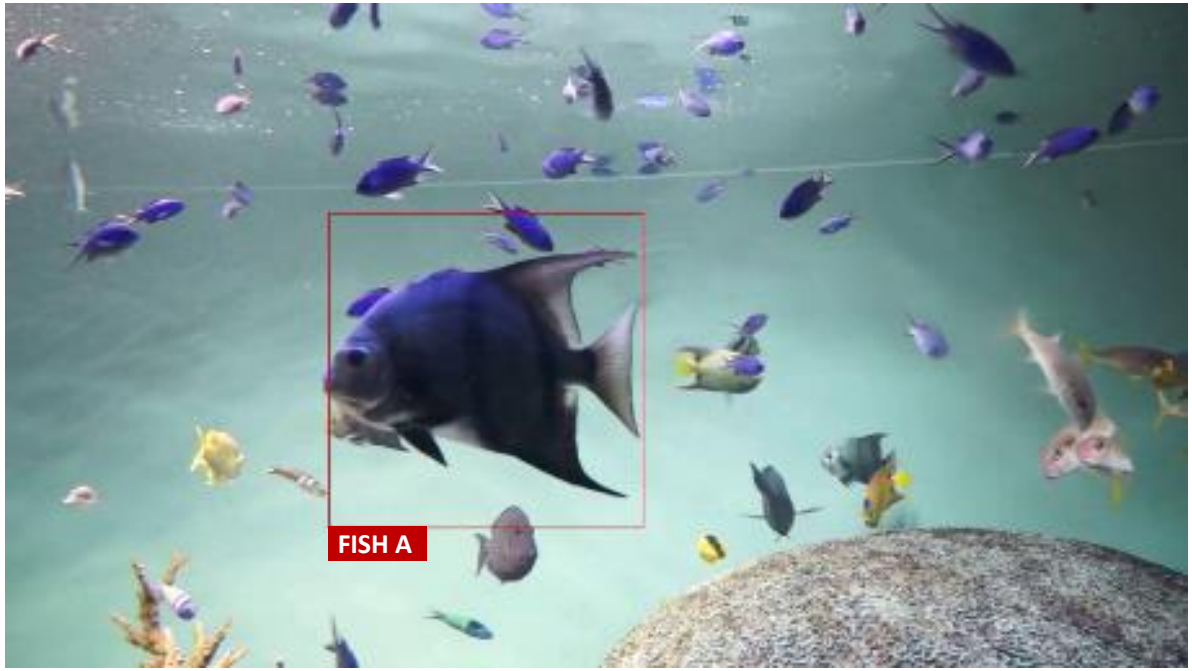
AQUARIUM AR
THE OBJECTIVES

AR FOR AQUARIUM

_ AR: overlaying object's information on real time video feed

_ AR for Aquarium

- Overlaying fish information in real time
- Low computational Cost
- Simple sample collection



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AQUARIUM AR RESEARCH

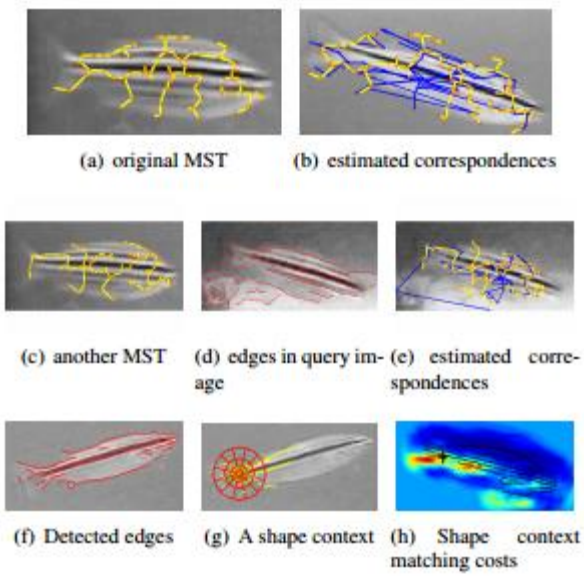
PREVIOUS RESEARCHES

_ Fish discrimination

_ Based on complex texture features of the fish

_ Operate under relatively ideal environment

_ Computational costly



(a) original MST (b) estimated correspondences

(c) another MST (d) edges in query image (e) estimated correspondences

(f) Detected edges (g) A shape context (h) Shape context matching costs

In IAPR Conference on Machine Vision Applications 2007

AQUARIUM AR RESEARCH

THIS RESEARCH

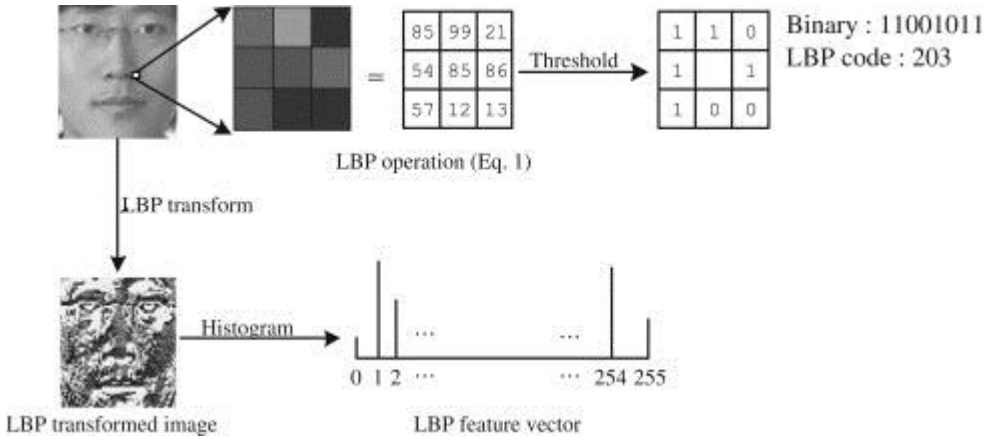
_ Fish detection and discrimination

_ Based on simple LBP features

_ Image processing pipeline to enhance detection performance

_ Operate under less ideal environment

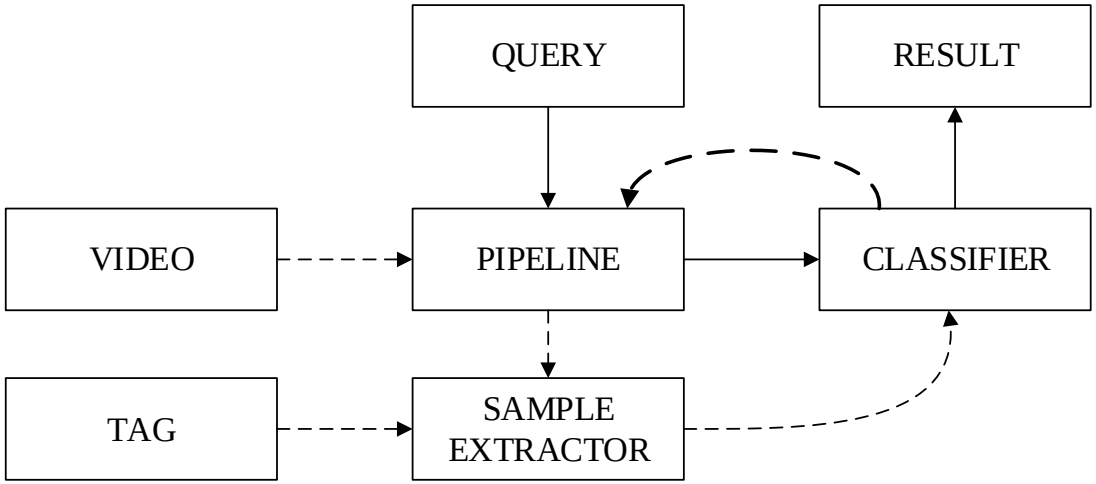
_ Low computational demand



Bongjin Jun et.al. “A compact local binary pattern using maximization of mutual information for face analysis” IAPR 2007

AQUARIUM AR
RESEARCH

FRAMEWORK OF PROPOSED SYSTEM



AQUARIUM AR
RESEARCH

SAMPLES COLLECTION

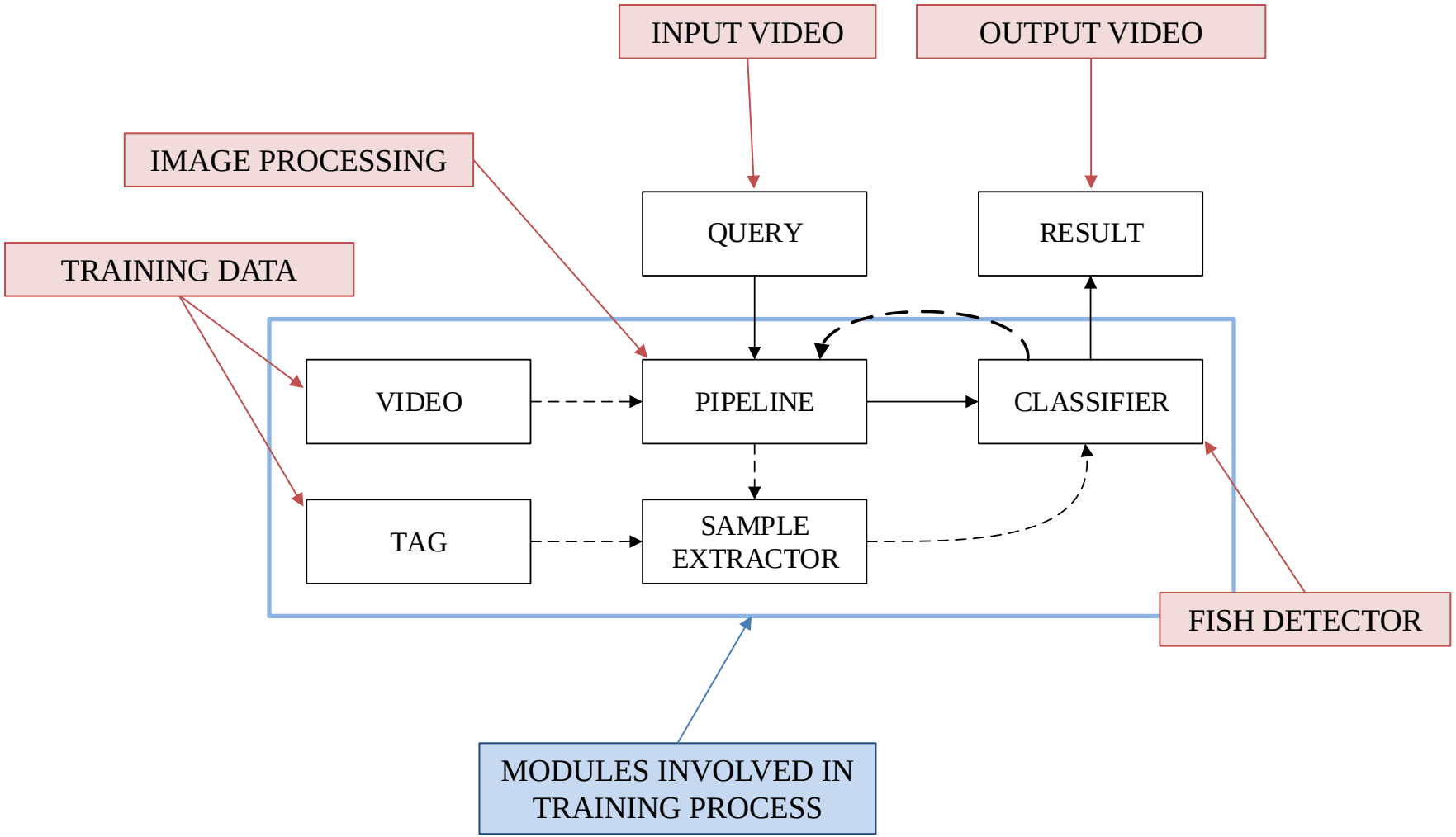
_ Manually tagging process

_ Custom software developed for tagging

_ Around 400 tags an hour

_ No special installment required

Image Courtesy of Tokyo Sea-Life Park


INPUT VIDEO
OUTPUT VIDEO
IMAGE PROCESSING
QUERY
RESULT
TRAINING DATA
VIDEO
PIPELINE
CLASSIFIER
TAG
SAMPLE EXTRACTOR
FISH DETECTOR
MODULES INVOLVED IN TRAINING PROCESS

AQUARIUM AR
THE PROJECT

THE PIPELINE

_ Highlight dominate color of the fish

_ More or less a fundamental form of background removal

_ Inconsistent output, but a strong complement to cascade classifier

$$P(h) = \iint P(h, l, s)\, dl\, ds$$

$$P(h) = P_p(h) - P_n(h)$$

$$H(h) = T(P(h), 0) = \begin{cases} P(h) & \text{if } P(h) > 0 \\ 0 & \text{if } P(h) \leq 0 \end{cases}$$

$$H(h) = \frac{H(h) - \min(H(h))}{\max(H(h)) - \min(H(h))}$$

$$O(x, y) = H(I_h(x, y))$$

AQUARIUM AR
THE EXPERIMENT

Image Courtesy of Tokyo Sea-Life Park

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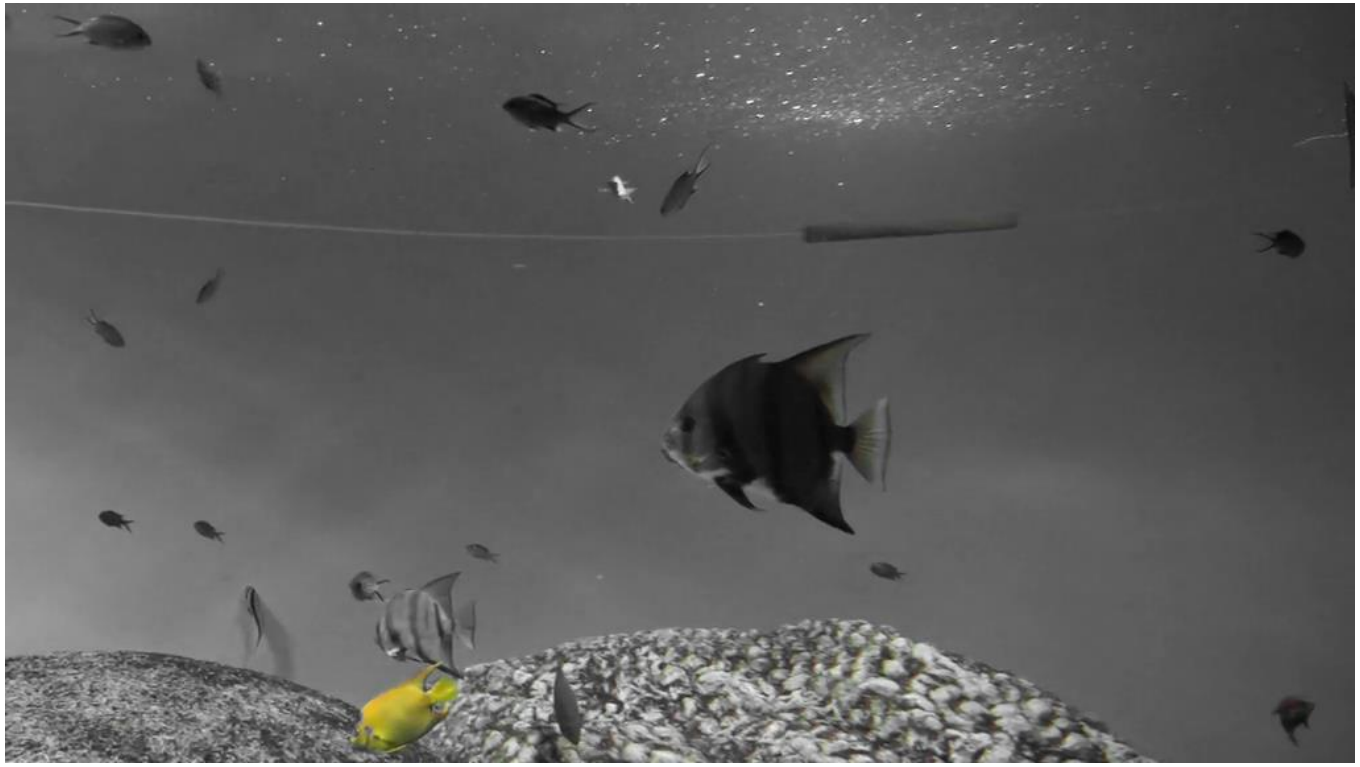

Image Courtesy of Tokyo Sea-Life Park

AQUARIUM AR
THE EVALUATION

DATA & TRAINING

_ Two species of fish

_ First species dominated by gray tone



_ Second species dominated by colorful red and yellow tone

_ Two footages, training and evaluation

_ 600 positive and 250 negative tags for each species in each footages

_ 25 stages of cascade classifier using the LBP feature

AQUARIUM AR
THE EVALUATION

EVALUATION

- The cascade classifier is applied on each positive and negative sample extracted from the evaluation footage.
- Test A is the result of fish detection using proposed processing pipeline on gray colored fish without falling back.
- Test B is the standard implementation with only 15 stages of the cascade classifier training which requires the similar amount of time required for training the proposed implementation.

	Proposed	Standard	A	B
True Positive	443	388	393	580
False Negative	157	212	207	20
False Positive	0	0	83	169
True Negative	250	250	167	81
Training Time (second)	227	472	23	17

Higher accuracy

	Proposed	Standard	A	B
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Training Time (second)	227	472	23	17

Lower Training Time

(Hence, faster detection speed)

Proposed Pipeline

(No falling back)

	Proposed	Standard	A	B
True Positive	443	388	393	580
False Negative	157	212	207	20
False Positive	0	0	83	169
True Negative	250	250	167	81
Training Time (second)	227	472	23	17

High False Positive

(Hence, low reliability)

Standard Implementation

(15 stages of classifier back)

	Proposed	Standard	A	B
True Positive	443	388	393	580
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False Positive	0	0	83	169
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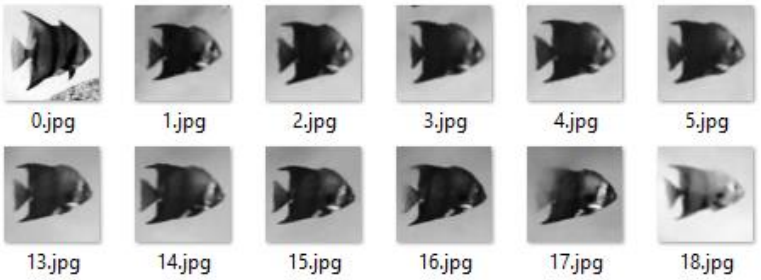
High False Positive

(Hence, low reliability)

Original video feed

TRAINING



Are fishes (Positive)

Are not fishes (Negative)

DETECT

Detect and mark target

Image Courtesy of Tokyo Sea-Life Park

AQUARIUM AR
CONCLUSION

CONCLUSION

- Samples are collected by manually tagging process

  (Relatively fast by using customized software)

- Image processing pipeline enhances the performance of cascade classifier

  (Fall back required for gray tone fishes)

- Compelling detection rate and accuracy

FUTURE WORKS

- More efficient mechanism for orientation invariance
- Fish tracking to handle difficult poses

{GITS – Waseda University}

12 – 09 - 2013

THANK YOU

Dang Hoang Anh – Kameyama Lab