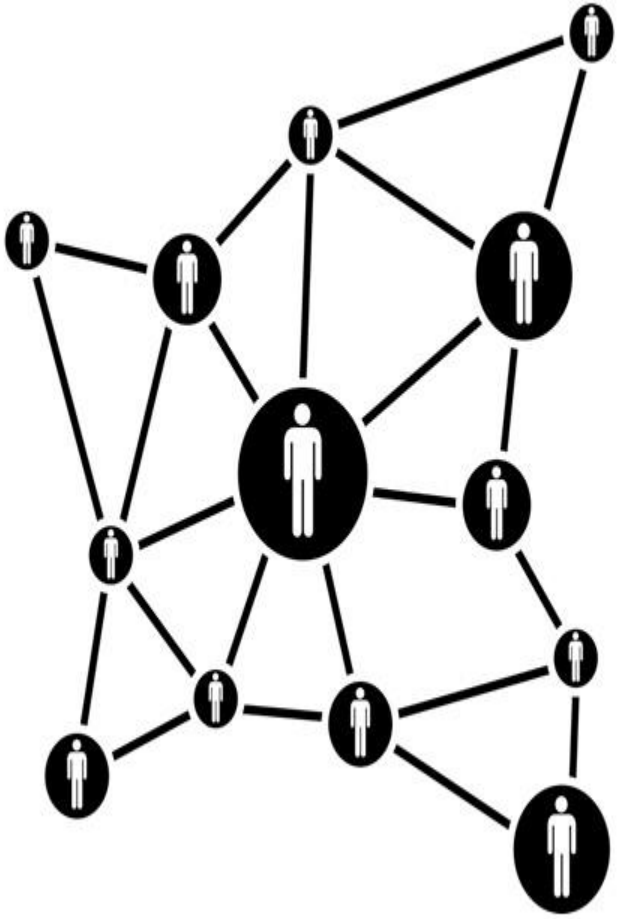
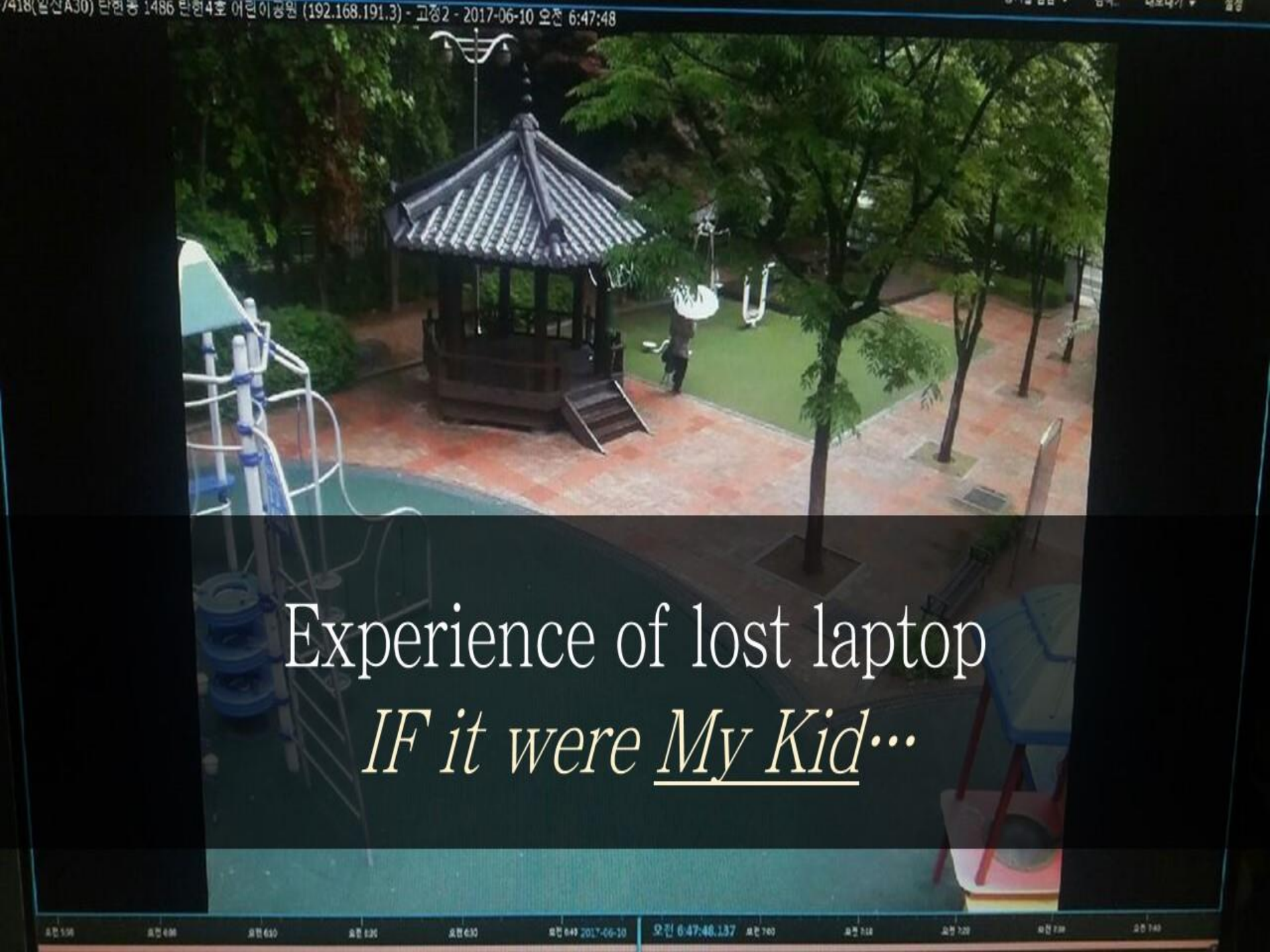
IOT DATA ALCHEMIST HACKATHON

REAL-TIME HUMAN TRACKING SYSTEM



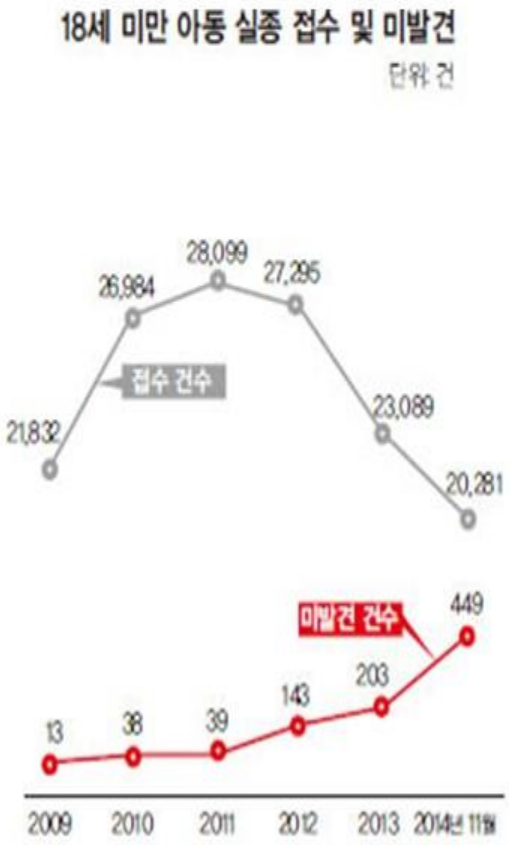
INDIE-VIDUAL
Shishi, 정기수, 조은희

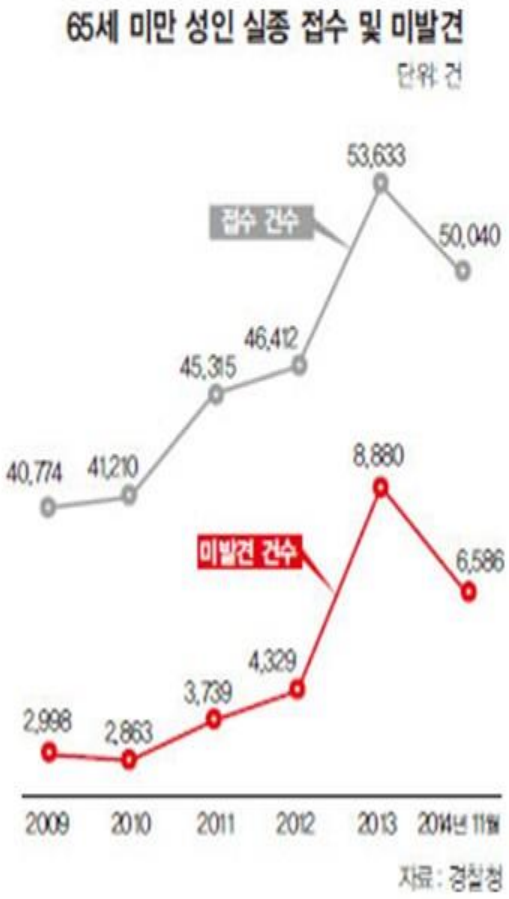

Experience of lost laptop
IF it were My Kid…

Even Right now··· new missing cases are being occurred

Adult missing persons are regarded as simple runaway from home and they are exposed to crime

The disappearance problem is a social issue that has not been solved yet and it is becoming a bigger issue due to the increase in the number of patients with dementia in the aged society.





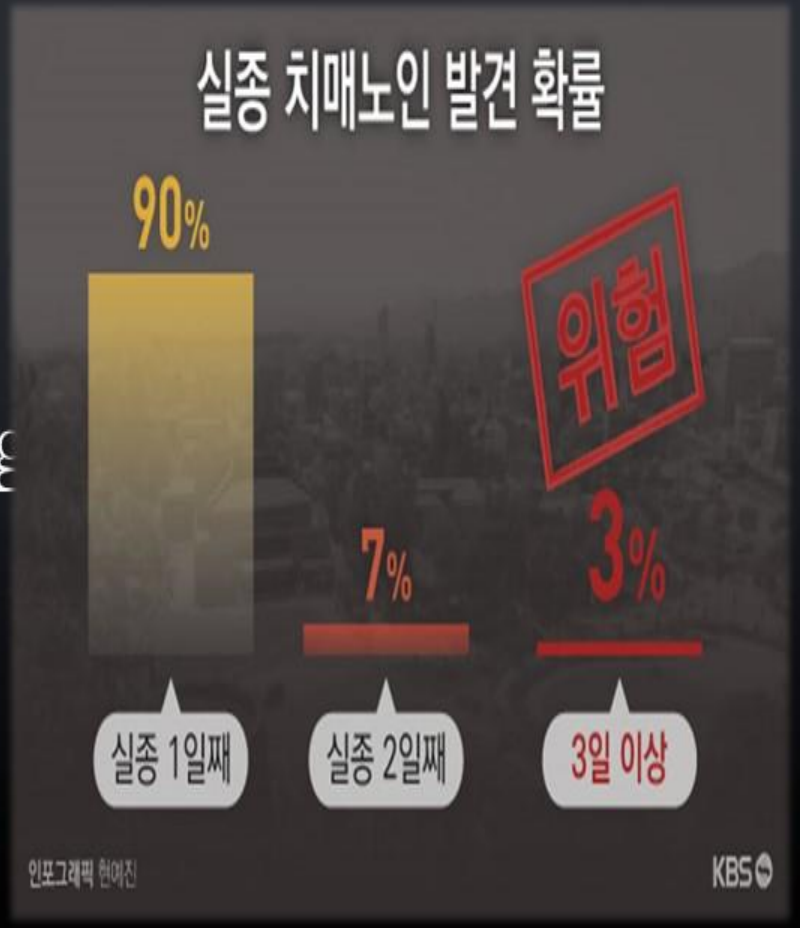
이재윤 기자 / 20130502
@yonhap_graphics(트위터)

The most important thing in the disappearance case is
'fast finding'.

GOLDEN TIME
Within 24 hours

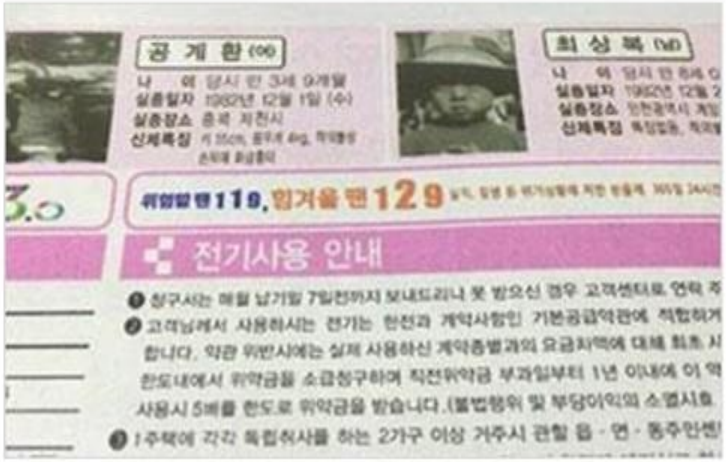
Probability of not finding a missing

After 12 hours 58%
After 24 hours 68%
After a week 89%



On the day when the "LEE young-hak Incident" occurred recently, 4 missing persons were reported to Seoul District Police. However, none of them investigated and two of them were killed on this day.

Currently, the long-dated missing issues are not resolved because the police are relying solely on police workforce and low efficiency methods.



The National Assembly also recognizes the seriousness of the disappearance problem and trying to include adults in the Missing Children Act. However, the National Police Agency is suffering from limitations in the workforce.

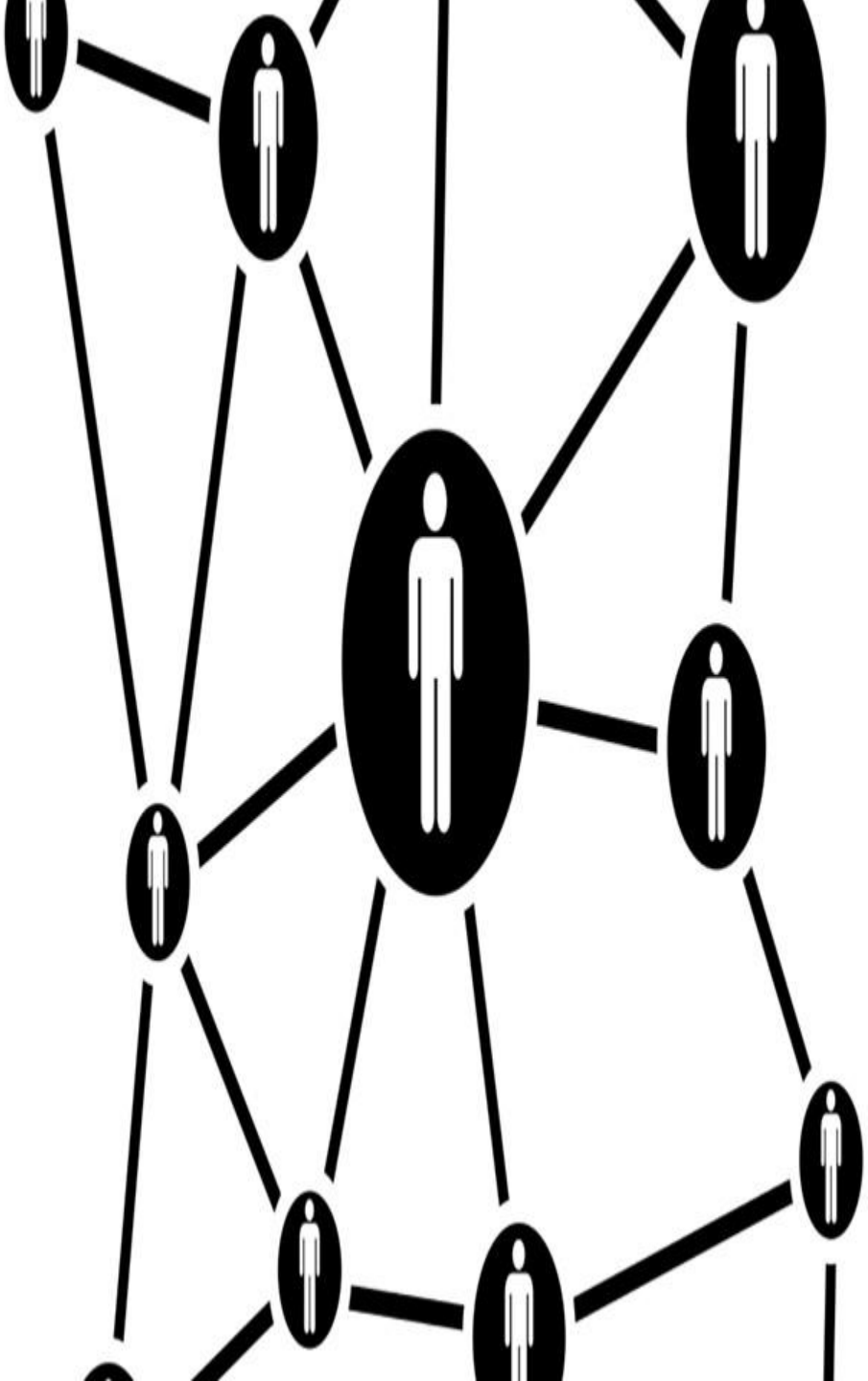
홍길동님을
찾았습니다.

매칭률 90%

찾는 사람이
맞습니까?

YES NO

REAL-TIME HUMAN TRACKING SYSTEM



There was good feedbacks on the idea of finding missing persons using a mobile phone

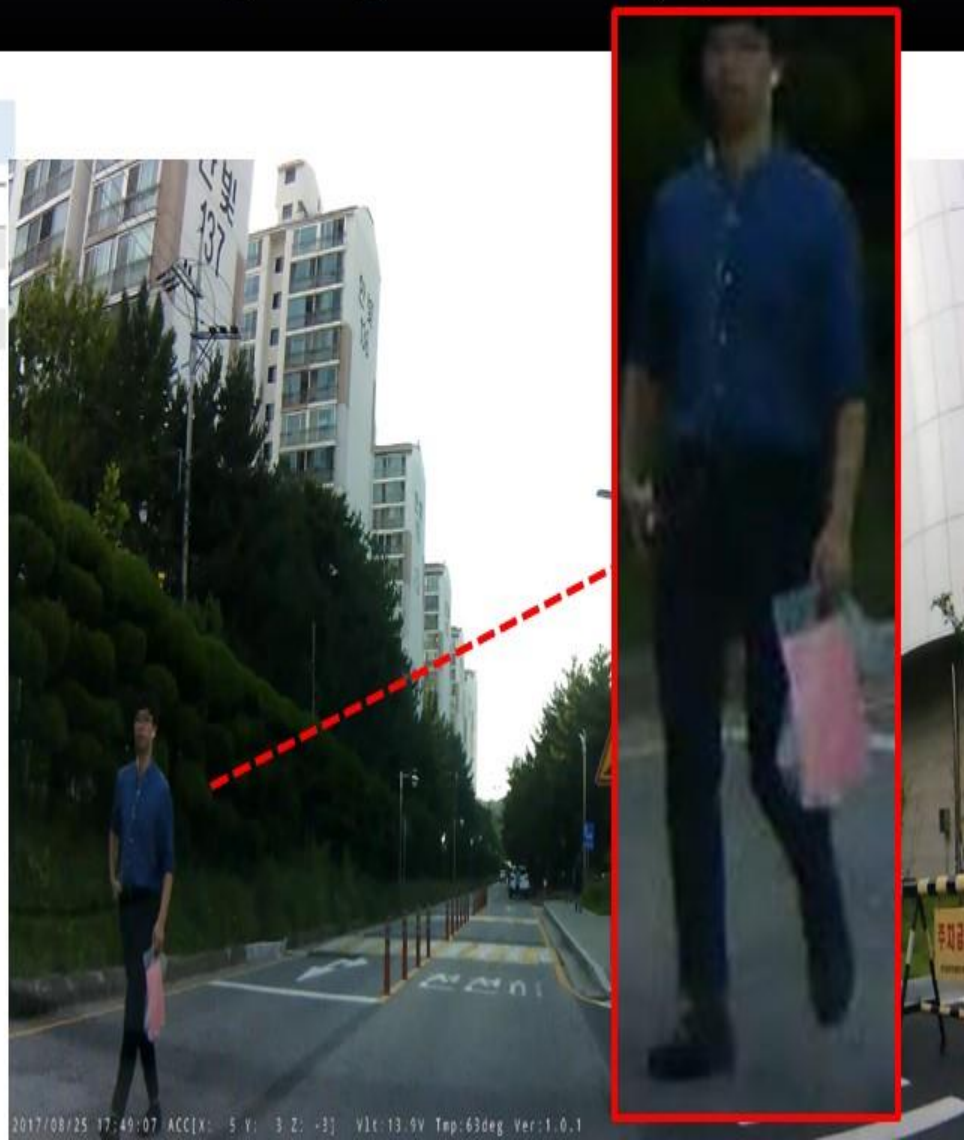
We have tried to analyze the image of mobile Urban Sensing Data by using driving image and GPS information, but faced difficulty to apply face recognition technology because of fast moving image and blurry pixel.

Data Introduction

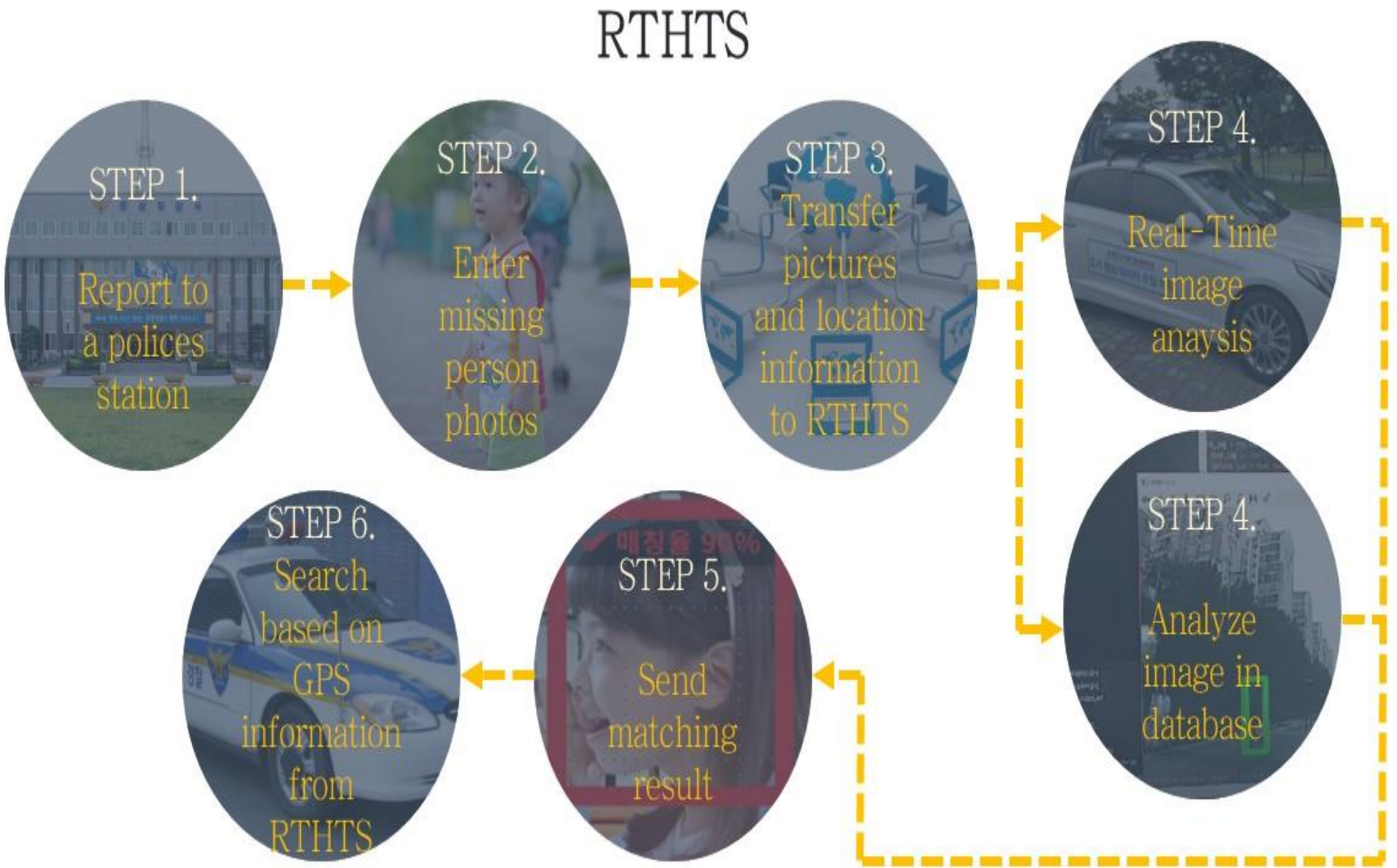
Field	data	Output Type
TIME	time	Output in year-month-day hour: minute: second
LNG	longitude	Korea longitude
LAT	latitude	Korea latitude
Image data	Black box	Four black boxes around the road collect images around the road
Image data	Webcam	Four webcams around the road capture images around the road

2). 6 major metropolitan cities Mobile Urban Sensing Data Introduction

소개	
Explanation	Based on the 6 metropolitan cities, the vehicle for the sensing collects the air, traffic, life, and flow environment data of the city center for 8 hours a day for 3 months
keyword	32 elements (Air Quality, Fine dust, Humidity, VOC, NO2, SO2, Noise, Vibration…)
Collection area	Daejeon, Daegu, Busan, Ulsan, Gwangju, and Incheon. When a vehicle equipped with a sensor module travels eight hours a day, it collects 32 kinds of sensing data



Overall operating process



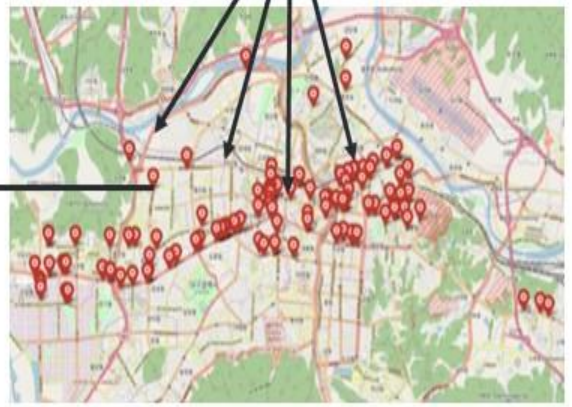
Real-time tracking system configuration diagram

User Application

latitude : 35.xxx
longitude : 129.xxx
datetime : 2017.11.11 13:00

Systems Management Server

Status of image collection vehicles



Vehicle with image analysis module

Real-time tracking system configuration diagram

User Application

latitude : 35.xxx
longitude : 129.xxx
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Systems Management Server

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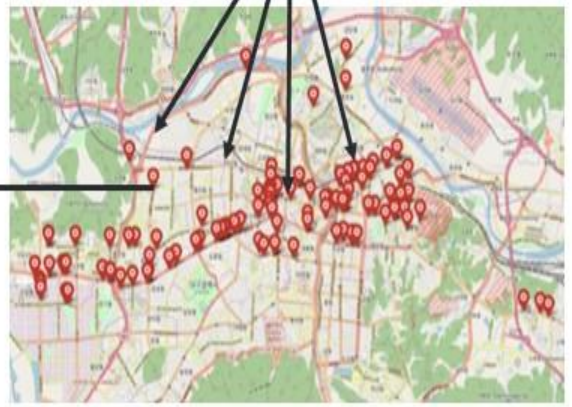
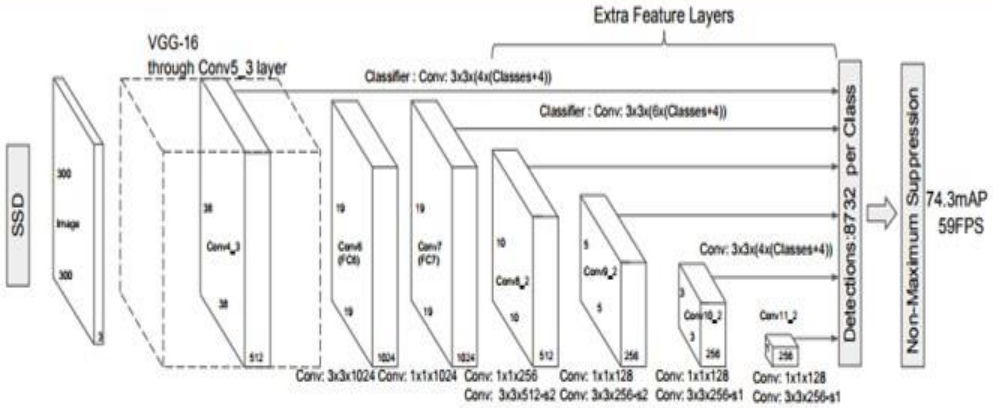
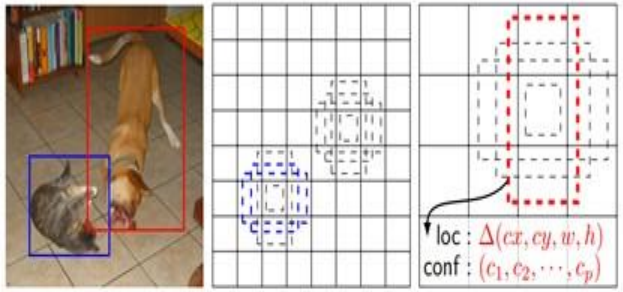


Vehicle with image analysis module

Main algorithms - human detection

Deep learning model for human detection - SSD(Single Shot MultiBox Detector)





(a) Image with GT boxes (b) 8 × 8 feature map (c) 4 × 4 feature map

Used data set - MSCOCO(Common Objects In Context

Method	data	mAP	aero	bike	bird	boat	bottle	bus	car	cat	chair	cow	table	dog	horse	mbike	person	plant	sheep	sofa	train	tv
Fast [6]	07	66.9	74.5	78.3	69.2	53.2	36.6	77.3	78.2	82.0	40.7	72.7	67.9	79.6	79.2	73.0	69.0	30.1	65.4	70.2	75.8	65.8
Fast [6]	07+12	70.0	77.0	78.1	69.3	59.4	38.3	81.6	78.6	86.7	42.8	78.8	68.9	84.7	82.0	76.6	69.9	31.8	70.1	74.8	80.4	70.4
Faster [2]	07	69.9	70.0	80.6	70.1	57.3	49.9	78.2	80.4	82.0	52.2	75.3	67.2	80.3	79.8	75.0	76.3	39.1	68.3	67.3	81.1	67.6
Faster [2]	07+12	73.2	76.5	79.0	70.9	65.5	52.1	83.1	84.7	86.4	52.0	81.9	65.7	84.8	84.6	77.5	76.7	38.8	73.6	73.9	83.0	72.6
Faster [2]	07+12+COCO	78.8	84.3	82.0	77.7	68.9	65.7	88.1	88.4	88.9	63.6	86.3	70.8	85.9	87.6	80.1	82.3	53.6	80.4	75.8	86.6	78.9
SSD300	07	68.0	73.4	77.5	64.1	59.0	38.9	75.2	80.8	78.5	46.0	67.8	69.2	76.6	82.1	77.0	72.5	41.2	64.2	69.1	78.0	68.5
SSD300	07+12	74.3	75.5	80.2	72.3	66.3	47.6	83.0	84.2	86.1	54.7	78.3	73.9	84.5	85.3	82.6	76.2	48.6	73.9	76.0	83.4	74.0
SSD300	07+12+COCO	79.6	80.9	86.3	79.0	**76.2**	57.6	87.3	88.2	88.6	60.5	85.4	**76.7**	**87.5**	**89.2**	84.5	81.4	55.0	81.9	**81.5**	85.9	78.9
SSD512	07	71.6	75.1	81.4	69.8	60.8	46.3	82.6	84.7	84.1	48.5	75.0	67.4	82.3	83.9	79.4	76.6	44.9	69.9	69.1	78.1	71.8
SSD512	07+12	76.8	82.4	84.7	78.4	73.8	53.2	86.2	87.5	86.0	57.8	83.1	70.2	84.9	85.2	83.9	79.7	50.3	77.9	73.9	82.5	75.3
SSD512	07+12+COCO	**81.6**	**86.6**	**88.3**	**82.4**	76.0	**66.3**	**88.6**	**88.9**	**89.1**	**65.1**	**88.4**	73.6	86.5	88.9	**85.3**	**84.6**	**59.1**	**85.0**	80.4	**87.4**	**81.2**

What is COCO?

COCO is a large-scale object detection, segmentation, and captioning dataset. COCO has several features:

- Object segmentation
- Recognition in context
- Superpixel stuff segmentation
- 330K images (>200K labeled)
- 1.5 million object instances
- 80 object categories
- 91 stuff categories
- 5 captions per image
- 250,000 people with keypoints

Main algorithms - human detection

Tuning Deep Learning Architecture for Performance: MobileNet

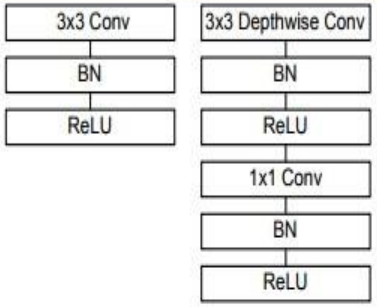


Figure 3. Left: Standard convolutional layer with batchnorm and ReLU. Right: Depthwise Separable convolutions with Depthwise

Model name	Speed	COCO mAP	Outputs
ssd_mobilenet_v1_coco	fast	21	Boxes
ssd_inception_v2_coco	fast	24	Boxes
rfcn_resnet101_coco	medium	30	Boxes
faster_rcnn_resnet101_coco	medium	32	Boxes
faster_rcnn_inception_resnet_v2_atrous_coco	slow	37	Boxes

Table 13. COCO object detection results comparison using different frameworks and network architectures. mAP is reported with COCO primary challenge metric (AP at IoU=0.50:0.05:0.95)

Framework Resolution	Model	mAP	Billion Mult-Adds	Million Parameters
SSD 300	deeplab-VGG	21.1%	34.9	33.1
	Inception V2	22.0%	3.8	13.7
	MobileNet	19.3%	1.2	6.8
Faster-RCNN 300	VGG	22.9%	64.3	138.5
	Inception V2	15.4%	118.2	13.3
	MobileNet	16.4%	25.2	6.1
Faster-RCNN 600	VGG	25.7%	149.6	138.5
	Inception V2	21.9%	129.6	13.3
	Mobilenet	19.8%	30.5	6.1

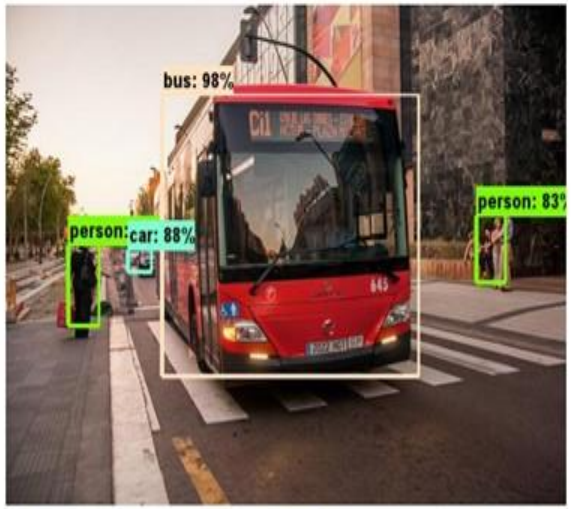


Figure 6. Example objection detection results using MobileNet SSD.

Main algorithms - Image matching

Feature Extraction

- GMS (Grid-based Motion Statistics for Fast, Ultra-robust Feature Correspondence)
- SIFT (Scale-Invariant Feature Trasform

Difficult to extract feature points due to noise and resolution problems

Sample data : 대전시 - 2017-08-25(FRI) - Car1 - blackbox front - Rec_20170825_174904_D.avi

Main algorithms - Image matching

Histogram Comparison

- Correlation
- Chi-Square
- Intersection
- Bhattacharyya distance

Correlation equation

$$d(H_1, H_2) = \frac{\sum_I (H_1(I) - \bar{H}_1)(H_2(I) - \bar{H}_2)}{\sqrt{\sum_I (H_1(I) - \bar{H}_1)^2 \sum_I (H_2(I) - \bar{H}_2)^2}}$$

Correlation shows the best performance.
We decided to set the threshold to 92 ~ 95% when compared with Target.

Sample data : 대전시 - 2017-08-25(FRI) - Car1 - blackbox front - Rec_20170825_174904_D.avi

Further improvement

Automatic image matching threshold setting

- Error detection according to threshold
- Automatically set the histogram of the extracted histogram by machine learning

Bounding box optimization

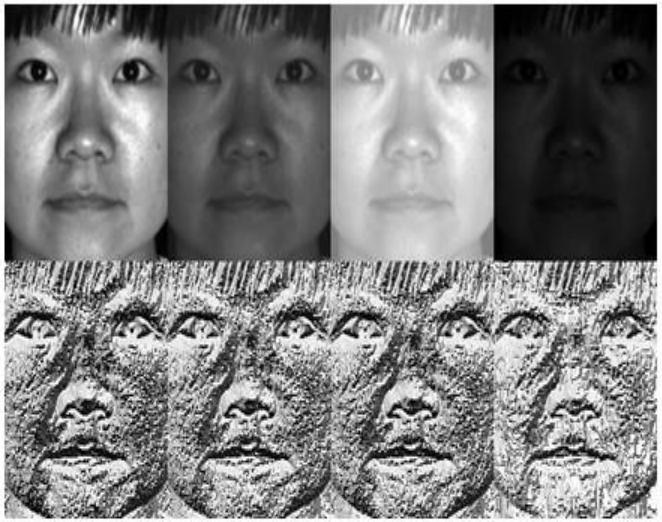
Only the target object is obtained accurately through background removal.

Home CCTV allows you to find missing persons by comparing full-length photos.

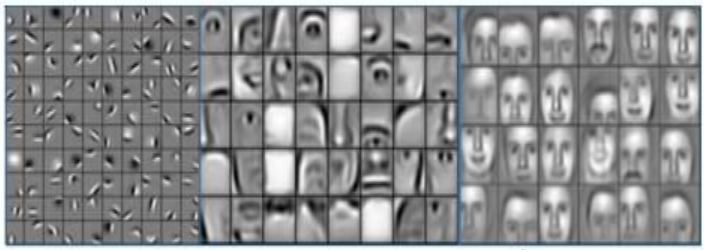
Further improvement

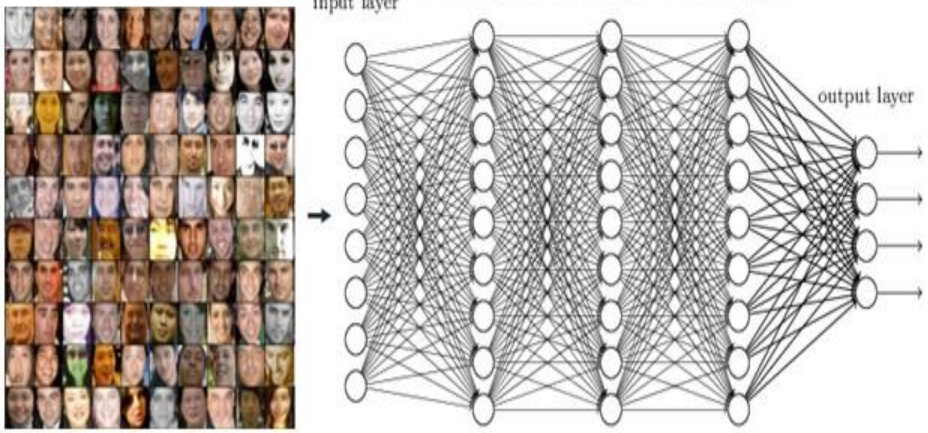
face recognition technology

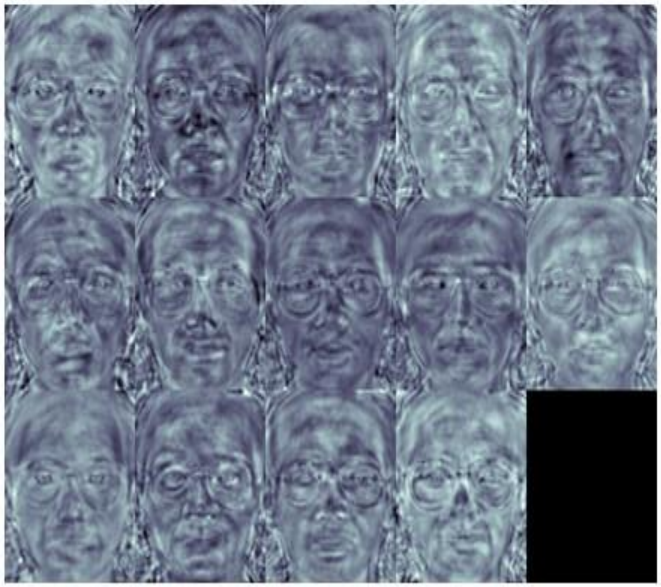
- Eigenface, Fisherface, LPB
- Deep learning



Deep neural networks learn hierarchical feature representations



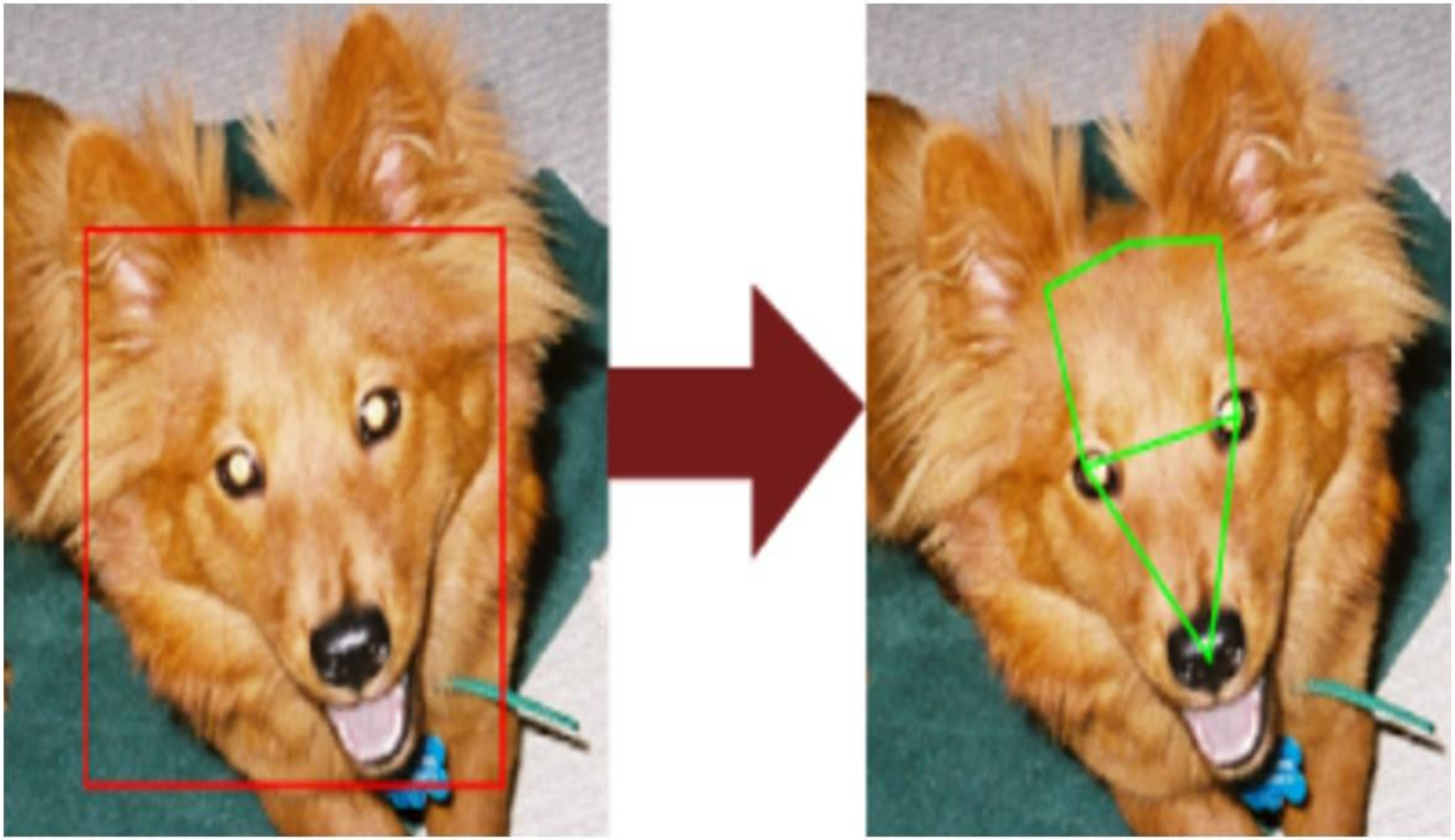


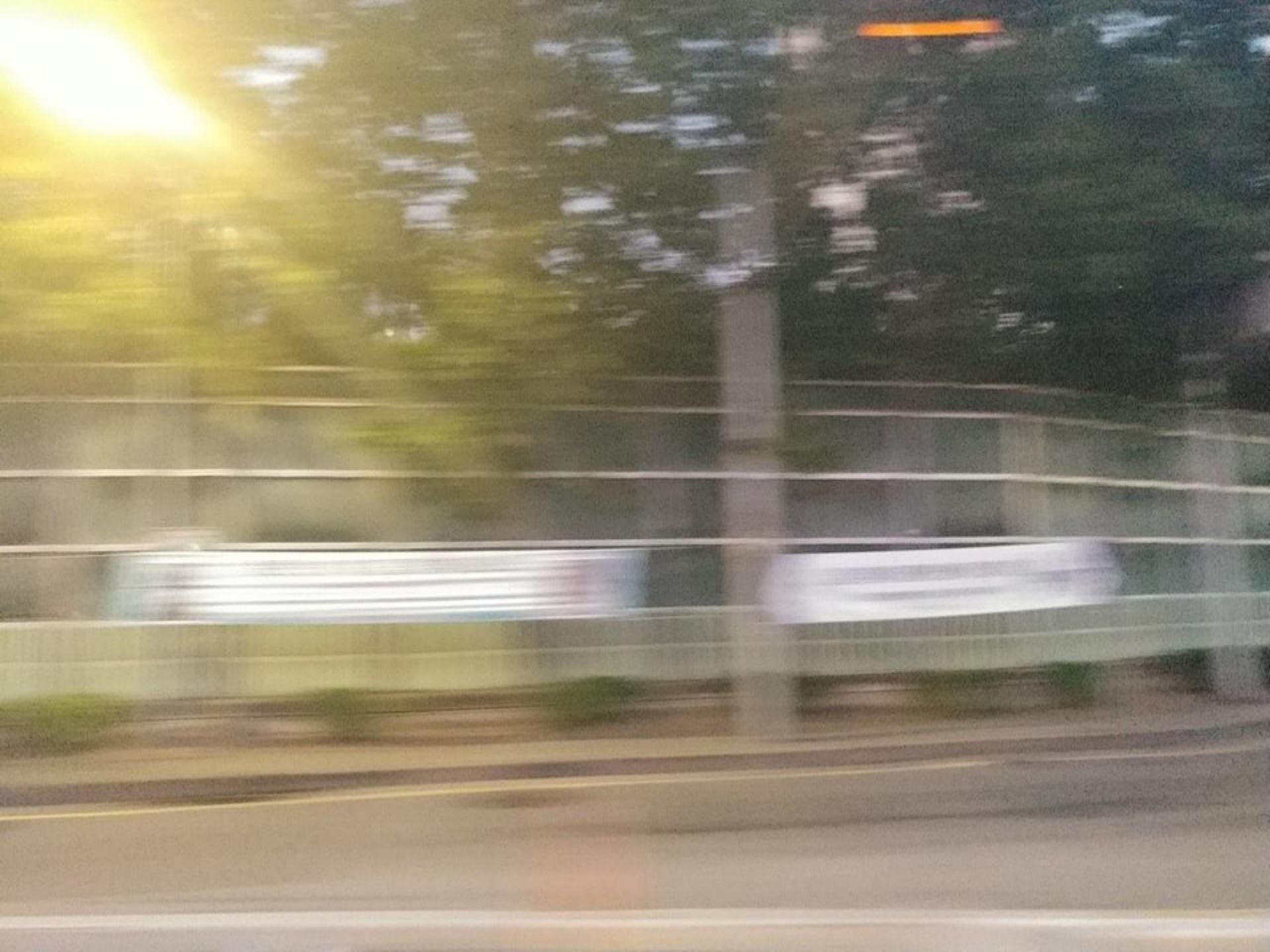


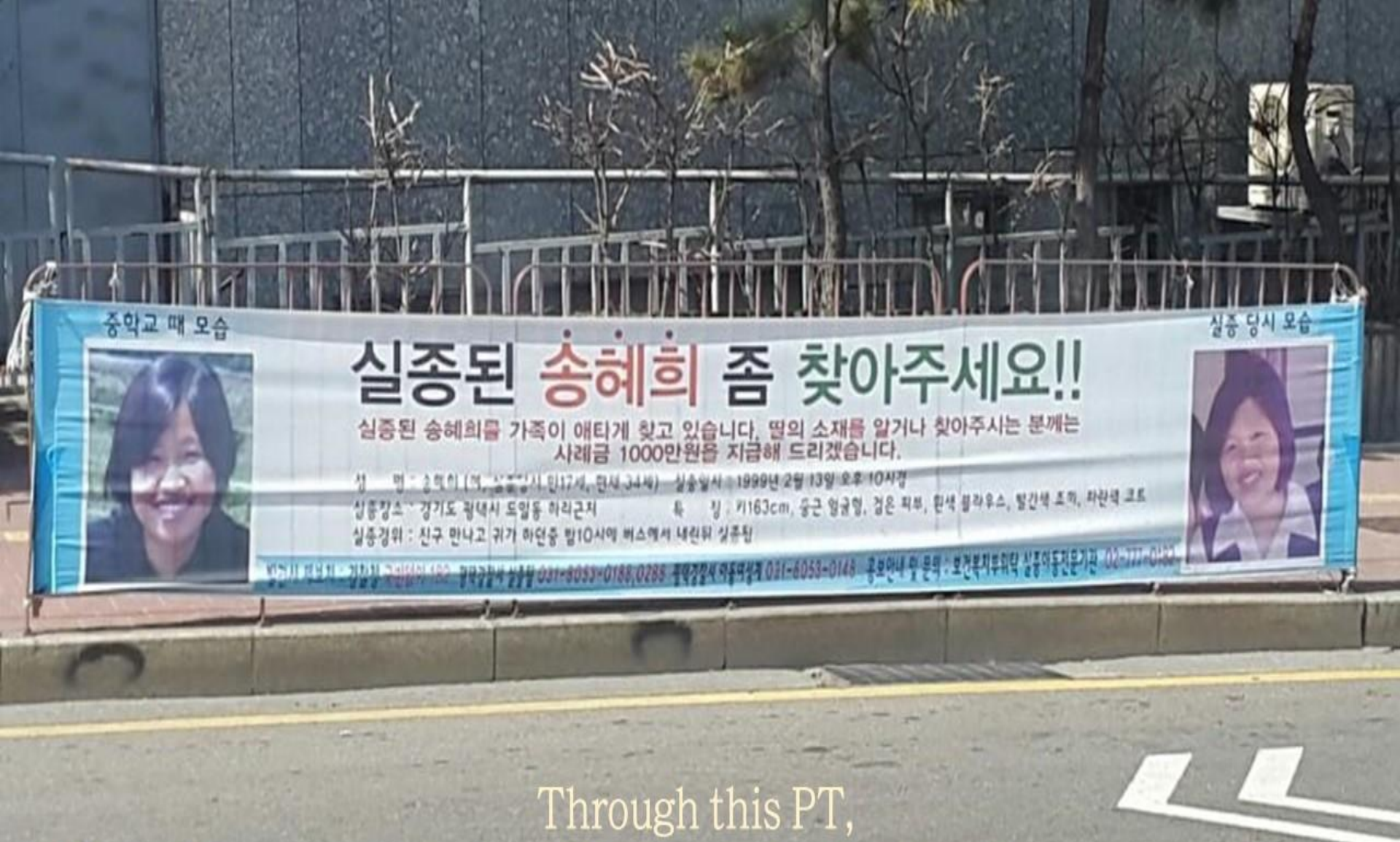
When the animal disappears, the range of movement is wide.

quick response is most important.

Facial recognition and feature point extraction technology using deep learning enables tracking of companion animals.







Through this PT,
I hope that many people will be interested in the disappearance issue
and will be able to return to their families in a day.


The age of super connective, artificial intelligence changes
the fate of a family.