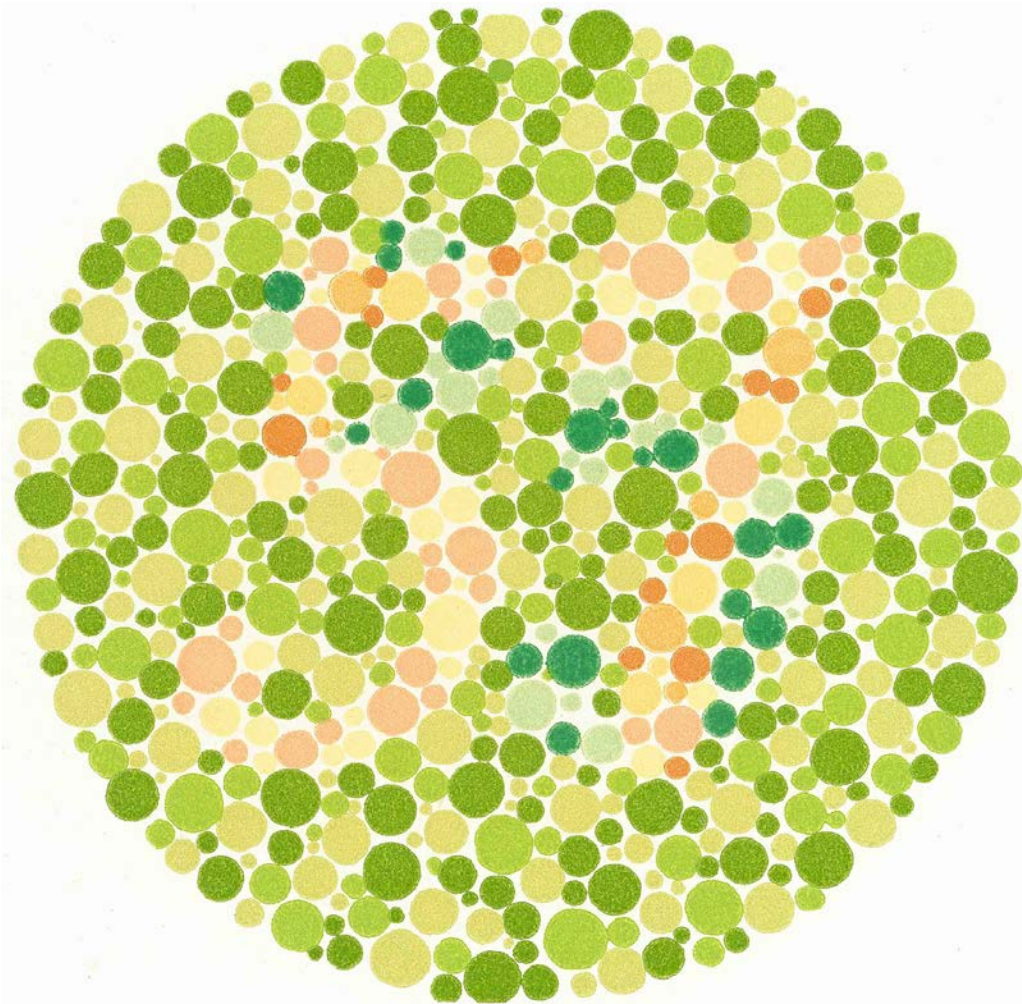
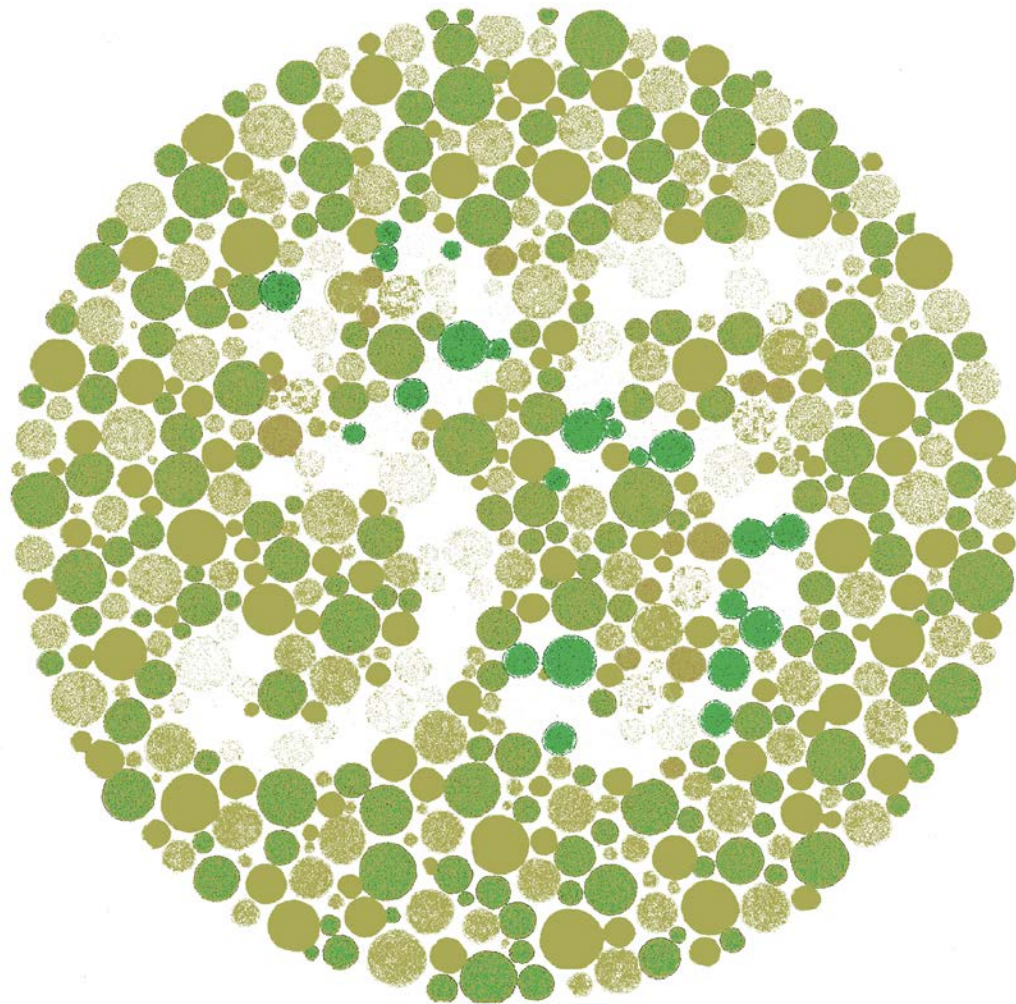


Oing: OpenING the third eye of the lecturer

This noisy image has
a hidden signal...



That can be visualized
with a simple adjustment.





Noisy classroom scene



The distracted

Motivation

Things to think while presenting:

- What to speak next?
- Is the audience following my presentation?
- What is the content of next slides?
- How much time left?
- How am I looking right now?



Uh...uh...
I'm sorry... uh...

Research Question

What if we can help lecturers improve
the quality of presentation,
at the moment?



Research Question

MEASURE How can the **attention** of the audience be measured in real-time?

IMPROVE How can the attention of the audience be **regained** immediately?



Solution

MEASURE

Use a single off-the-shelf camera and a **face detection algorithm** to catch attention signals

IMPROVE

Guide lecturer to certain **position** via a **masked image** of the classroom



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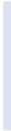
Stage 1

Preliminary Study
& Data Collection



Stage 2

Acquire Attention Signals



Stage 3

Design a feedback
based on
attention signals

The First Stage

Preliminary study & Data collection



An education researcher's approach

Most research only focus on teachers, leaving students not analyzed

1. Focus on teacher's "protocol" on lecturing
2. The analysis needs time and effort of graduate students

Classroom Behavior Coding Protocol

We've analyzed protocols:

- Reformed Teaching Observation Protocol (RTOP; [Sawada et al., 2002](#))
- Observation and Analytic Protocol ([Weiss et al., 2003](#))
- Behavioral Observation of Students in School (BOSS; Shapiro, [2004](#))
- Teaching Dimensions Observation Protocol (TDOP; [Hora et al., 2013](#))

Common sign of attention:

Taking notes/looking at the lecturer or lecture material

Interview with CELT @ KAIST

Interview with Center for Excellence in Learning and Teaching (CELT) @ KAIST

- Record lecture and observe the lecture flow and strategy
- They don't investigate nor care about students
- Using space well would make students more attentive, but professors are not good at it

Data Collection

Consecutive pictures during class

Real classes (KAIST, undergraduate course, 30~50 students)

Consented for capturing pictures

Data size

Class #1: 4,257 pictures, 35,830 faces

Class #2: 2,687 pictures, 37,150 faces

Class #3: 1,582 pictures, 12,604 faces

* 1 picture (4000 x 3000 pixels) per second



The Second Stage

Acquiring attention signals from the sequence of pictures



Attention Signal



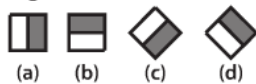
Face is the key

Acquire Attention Signals
from detected faces

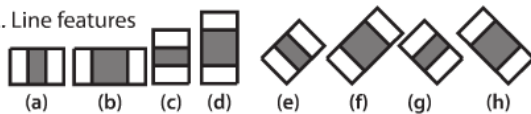
Face Detection

OpenCV Haar feature-based classifier

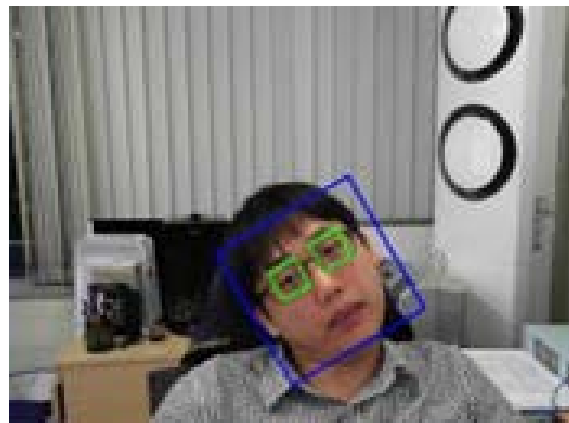
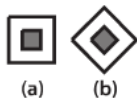
1. Edge features



2. Line features



3. Center-surround features



Face Detection Is Not Enough!



Face is detected but not attentive

Label 30K faces



Image: G0011602.jpg

Index: 532/5239



Face pan: 21.53681426527832

Face roll: -3.976952791213989

Face tilt: -5.784944534301758

"Watching" Classifier

Features

Position (x, y)

Box size (box_x, box_y)

Angles (yaw, pitch, roll)

Emotion
(joy, anger, sorrow, surprise)

SVM Classifier

Accuracy: 0.37

Precision: 0.98

Recall: 0.06

F1: 0.12

Random Forest

Accuracy: 0.89

Precision: 0.87

Recall: 0.93

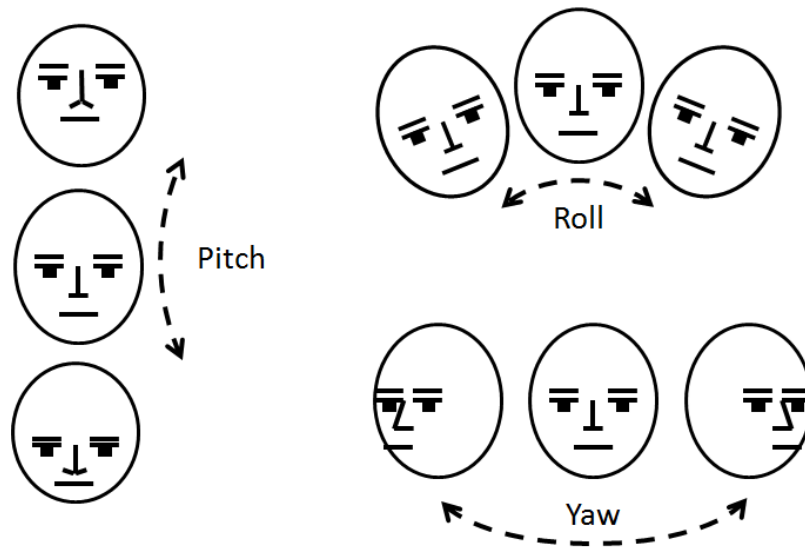
F1: 0.89

Used Grid search & Cross Validation to find the best random forest model parameters

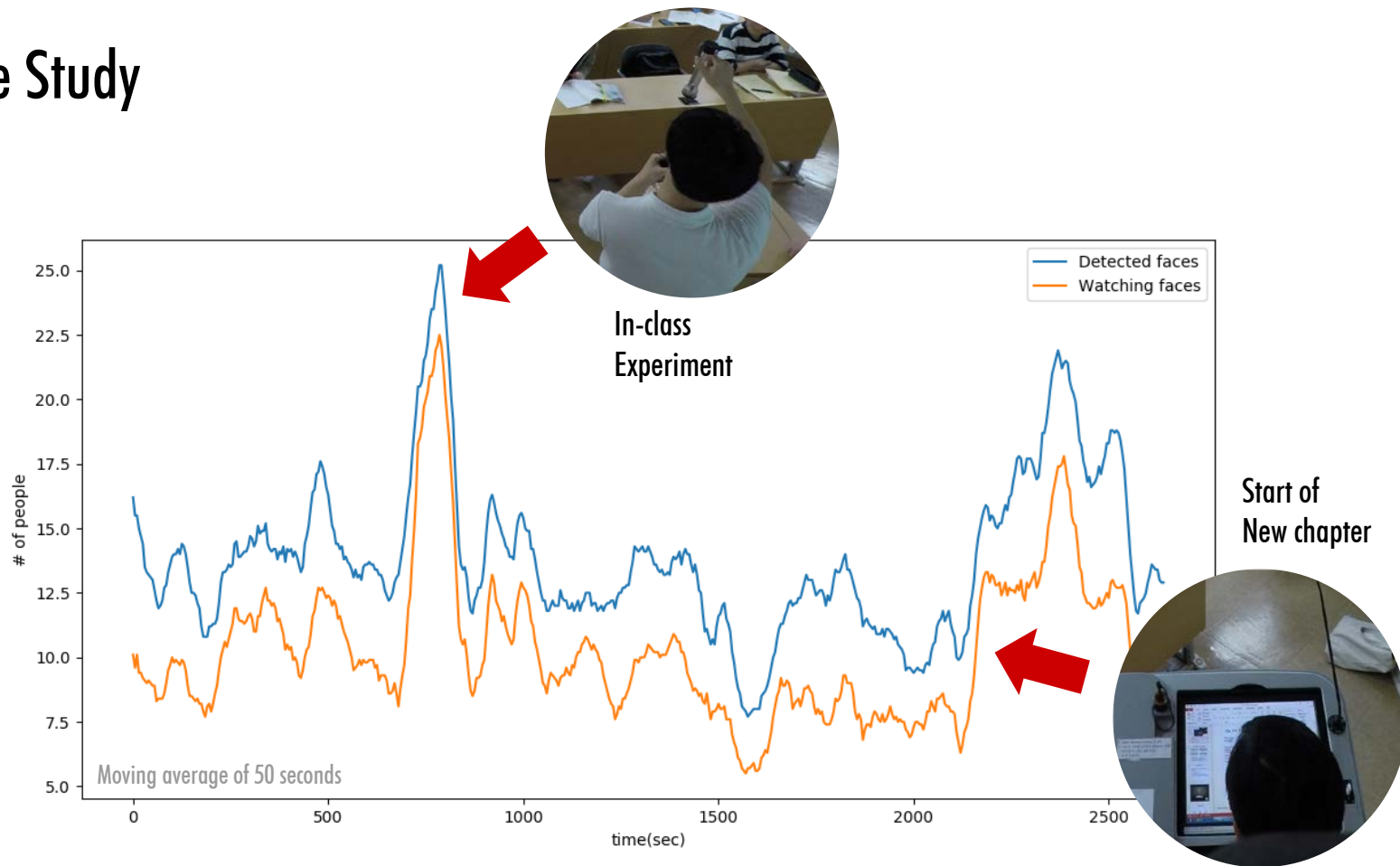
Random Forest (n_estimators=33, max_depth=9)

Feature importance from the Random Forest

Feature	Importance
x	0.116
y	0.352
box_x	0.124
box_y	0.118
yaw	0.083
roll	0.103
pitch	0.105



Case Study



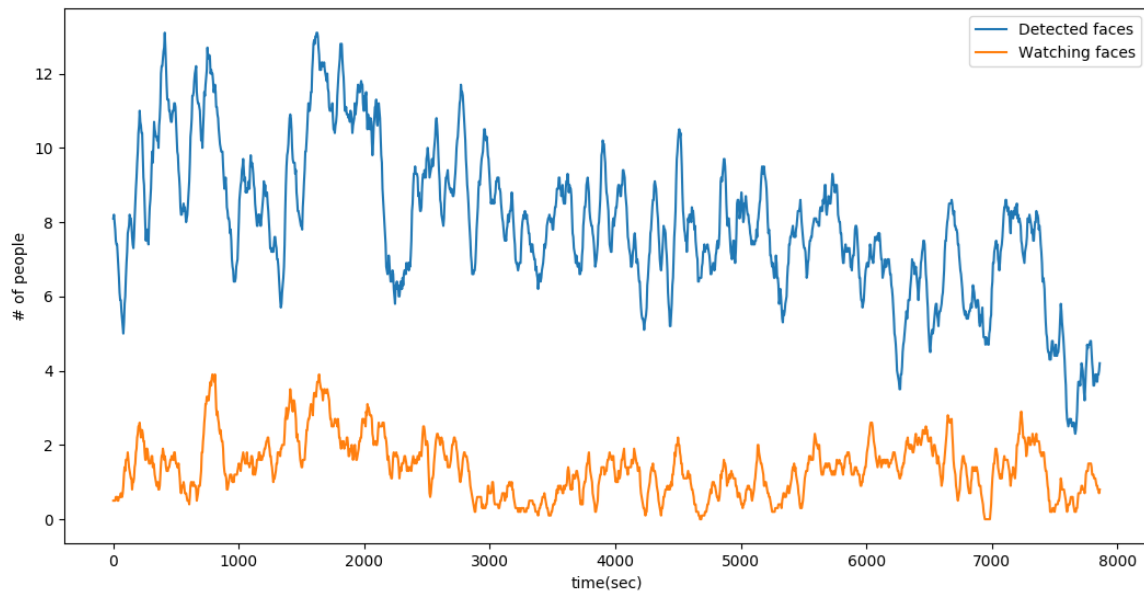
The Third Stage

Giving a feedback using an attention signals

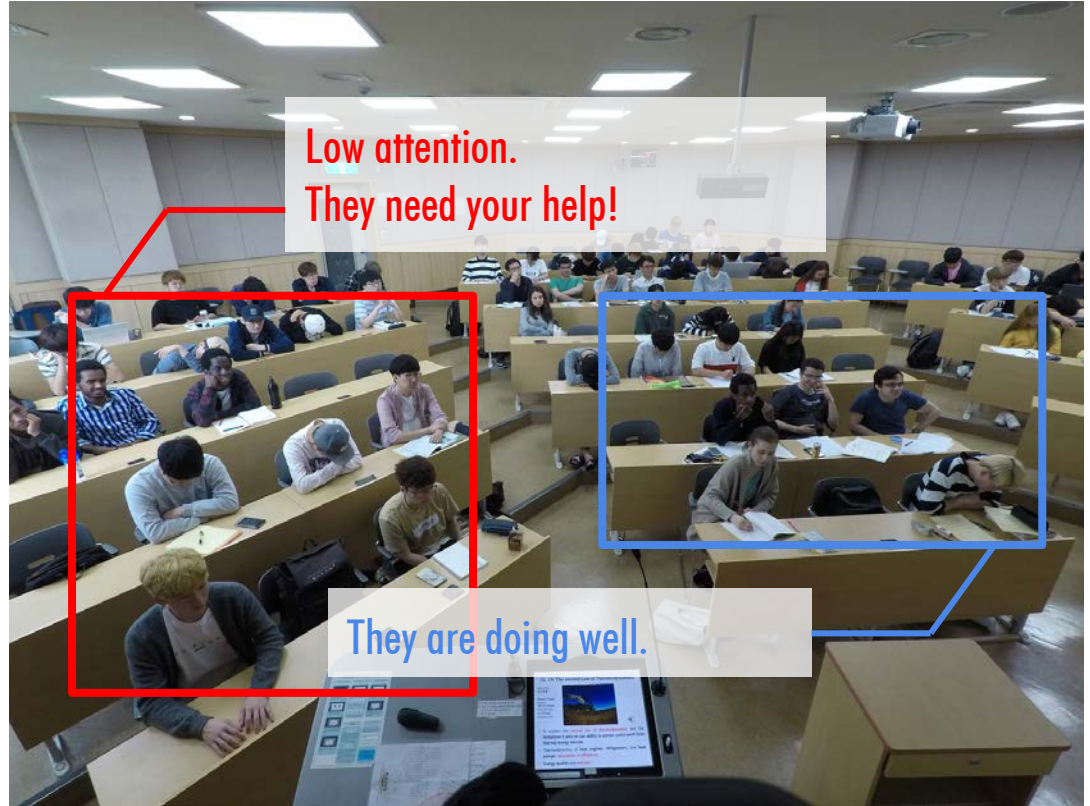


Attention Signals Are Noisy!

How can process the signals to make an “useful” feedback in “real-time”?



Attention Map (In The Future Work)



Attention Map : Highlighting **High-Attentive** Students

Highlight where

1. At least 1 attention signal during the last 2 minutes

However, lecturers are making eye-contact with highly attentive students

→ **Not a useful feedback!**

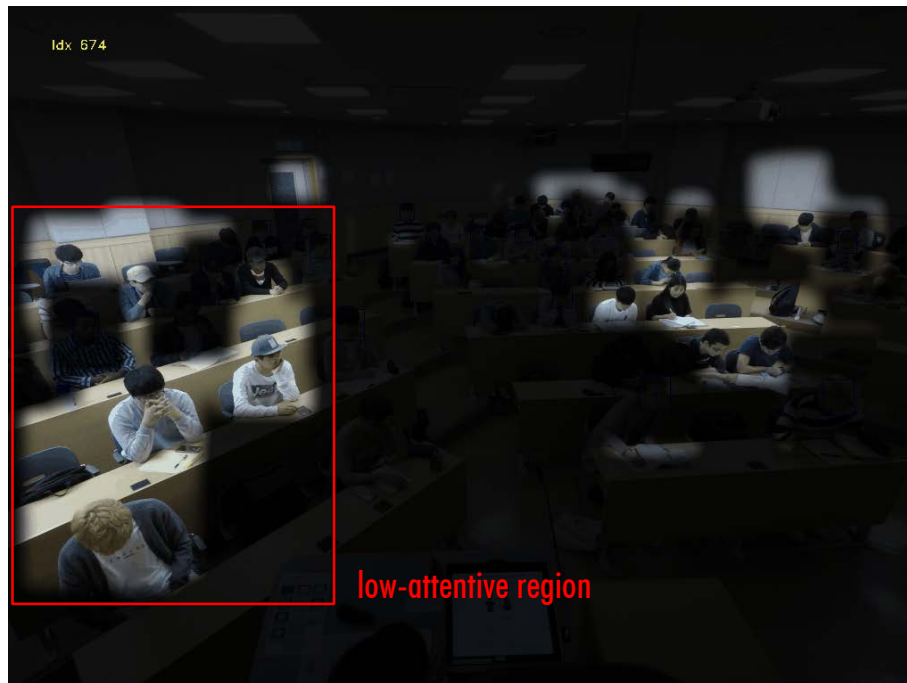


Attention Map : Highlighting Low-Attentive Students

Highlight where

1. At least 1 attention signal during the last 10 minutes
2. No attention signal during the last 3 minutes

Action: giving a notification for lecturer (e.g. via smartwatch) to pay attention in low-attentive region





Please ask some questions!