The Applications of Brain Computer Interface

Chin-Teng Lin

Distinguished Professor, Co-Director
Computational Intelligence and Brain Computer Interface (CIBCI) Lab
Centre for Artificial Intelligence (CAI)
University of Technology Sydney

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EDTAS 1

Data → Information → Knowledge → Intelligence

↓ Digital Disruption

Big Data → Social Media → Cognition → Crowd/Machine Intelligence

↓

Cyber Brain:
Social-Human-Machine Integration

Future : CyberBrain

Machine System: **Physical states**

↓

Human-Machine Systems: **Human (cognitive) states**

↓

Social Human-Machine Systems: **Environment states**

Brain Computer Interface (BCI)

The study of brain and behavior at work.

Goal:
Augmenting Human Performances

Enhancing Mind-Body in Health and Wellbeing

R. Parasuraman & M. Rizzo (2008)
Neuroergonomics: The Brain at Work,
Oxford University Press, USA.

Core Tech

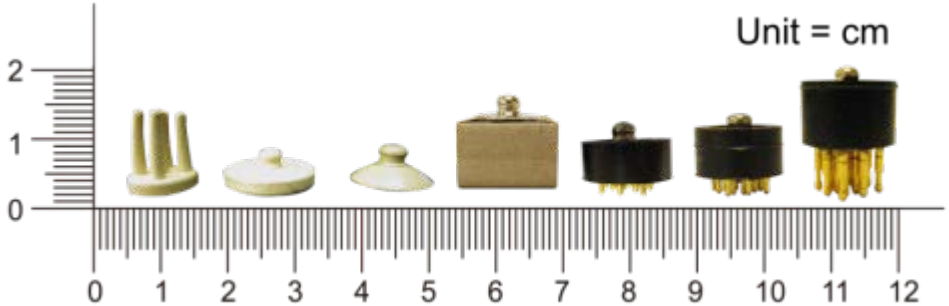
AI System

- Machine Learning
- Neural Networks
- Adaptive BCI
- Personalized

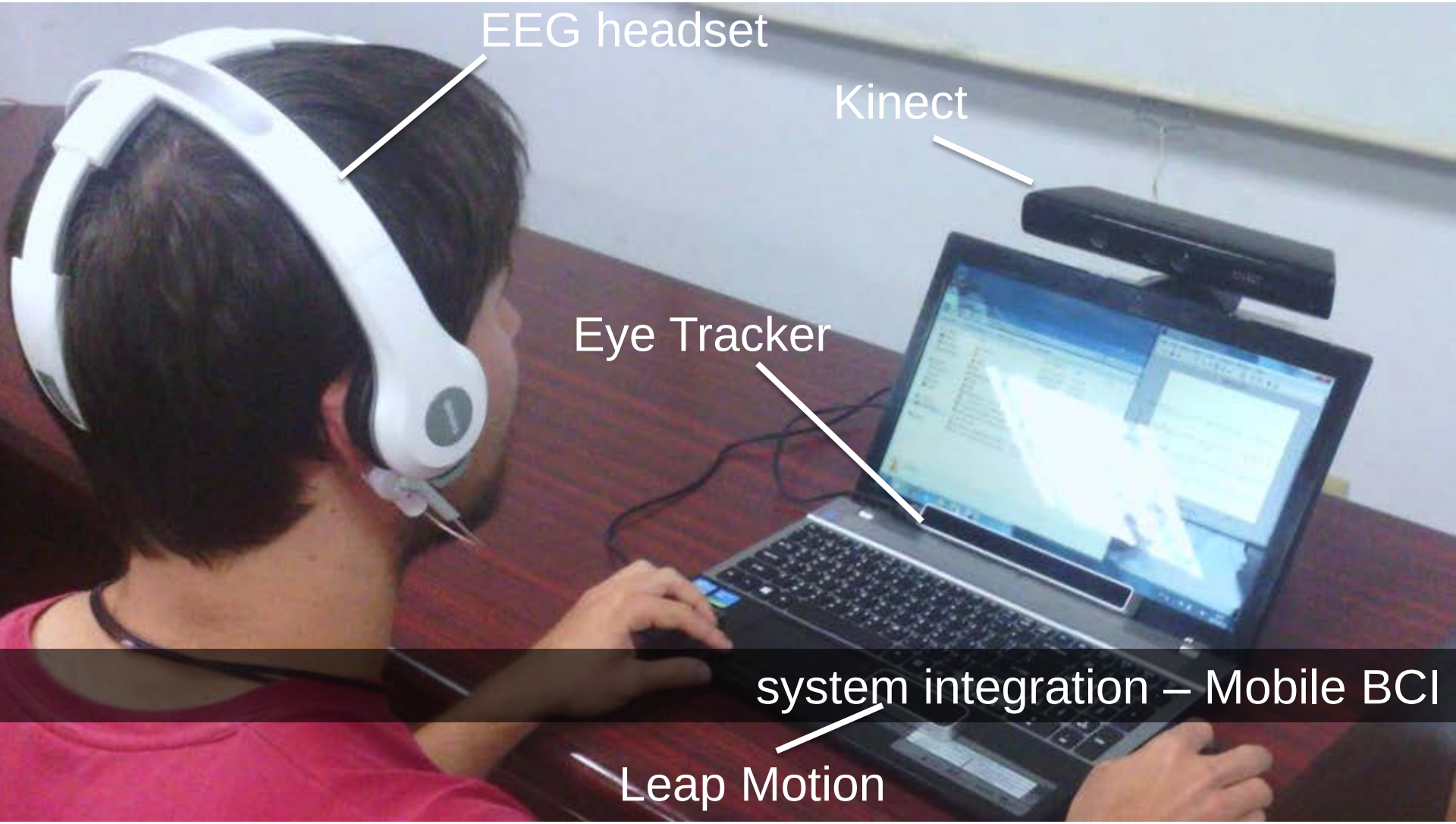
Wearable Device

- Dry Sensor
- Biomedical Amplifier
- Artifact Removal
- Neurofeedback

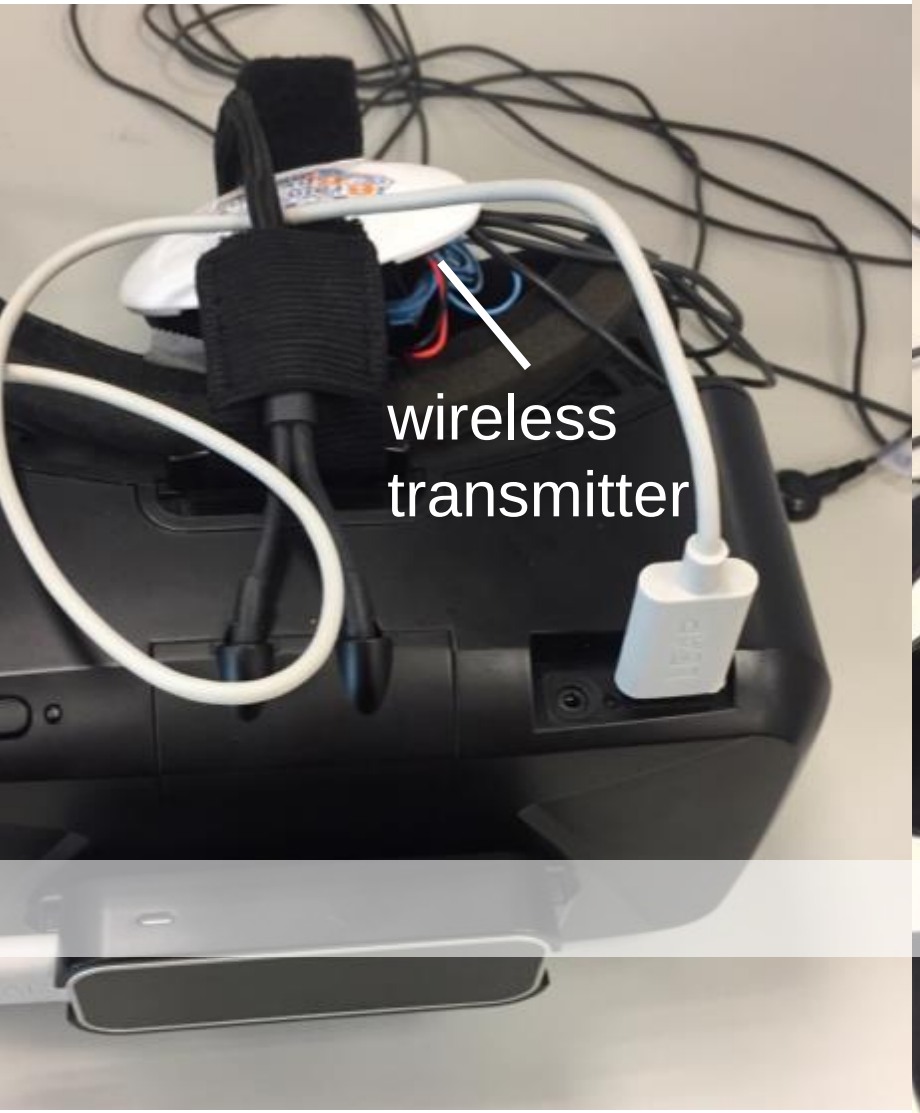
Wireless Wearable EEG Sensing Devices



portable dry sensors-based EEG device



system integration – Mobile BCI

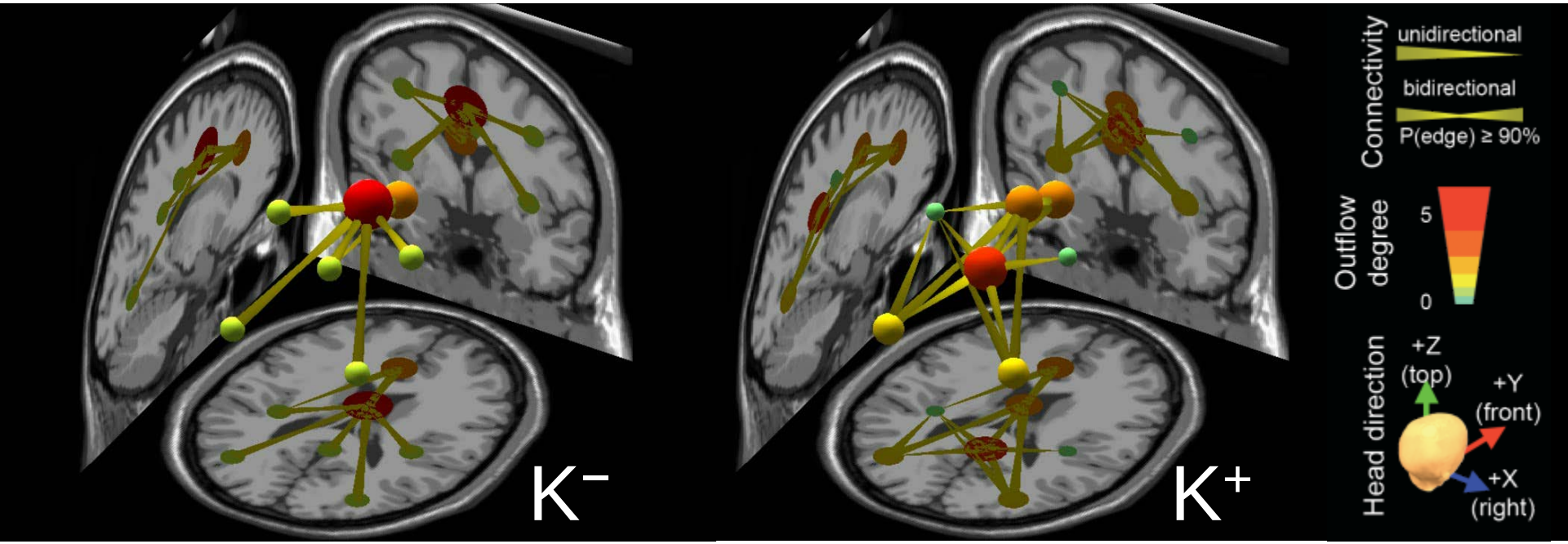


system integration – VR + EEG

EEG Signal Processing and Machine Learning

Brain Connectivity

Attention (K^-) and Mind-Wondering (K^+)



BCI Applications in Smart Living

1. **Daily-life Applications (Neuro-ergonomics)**
   To augment human performance by studying the brain and behavior at work

2. **Clinical Applications (Chronic Cognitive Neural Diseases)**
   To apply BCI for elder healthcare and patients with sleep disorder, depression, migraine, epilepsy, etc.

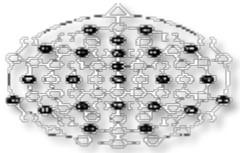
Intelligent IOT (*i*IOT)

- **Vision, Innovation, Creativity, and Imagination**

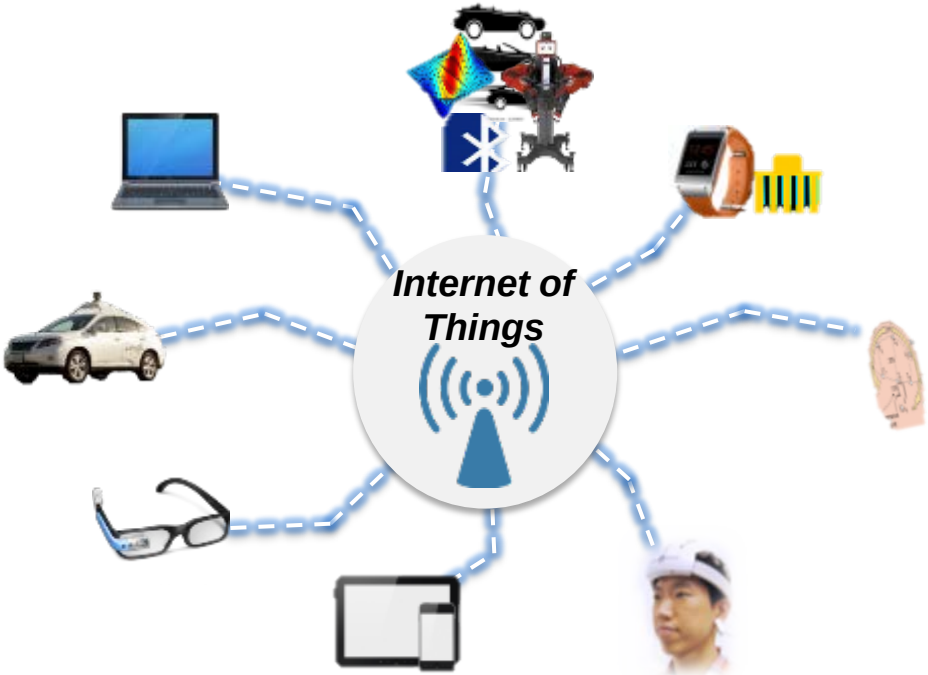
Cloud Computing

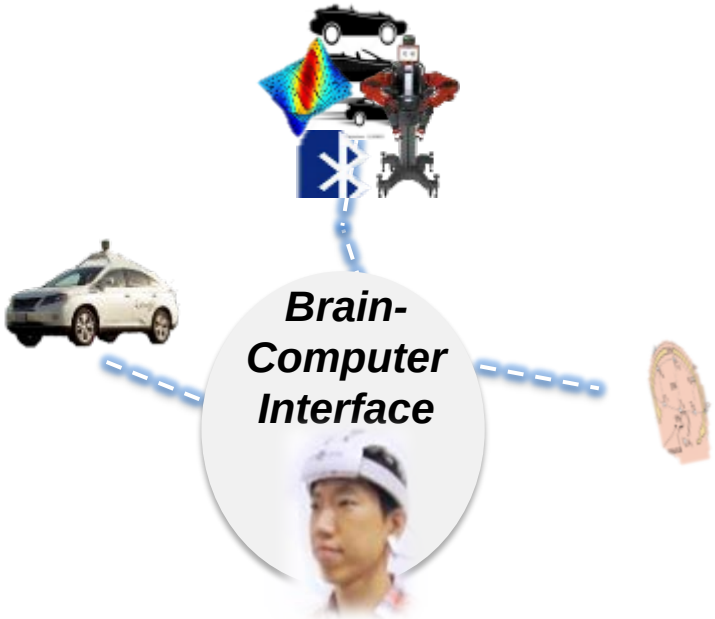
Big Data

Brain Initiative



Sensors
& Electronics





23:00
Sleep Quality
07:00
Health Evaluation
21:00
Game Interaction
08:00
Brain-Controlled Driving
BCI
24 Hours
19:00
Environment Control
09:00
Emotion Detection
15:00
Drowsiness Alarm
12:00
Meditation Instructor

Brain Training

Drowsiness Alarm

U-Wake

Wearable fatigue detection

East to setup. Connect to your phone via Bluetooth.
20hrs continuing operation.
No burden to your head with only 20g weight.
No harm to your brain.

Neuro-Marketing: BCI-VR Shopping

Environment Control

Feeding Assistance

Watching

Movie

Video

TV

Video Call

User-defined Options

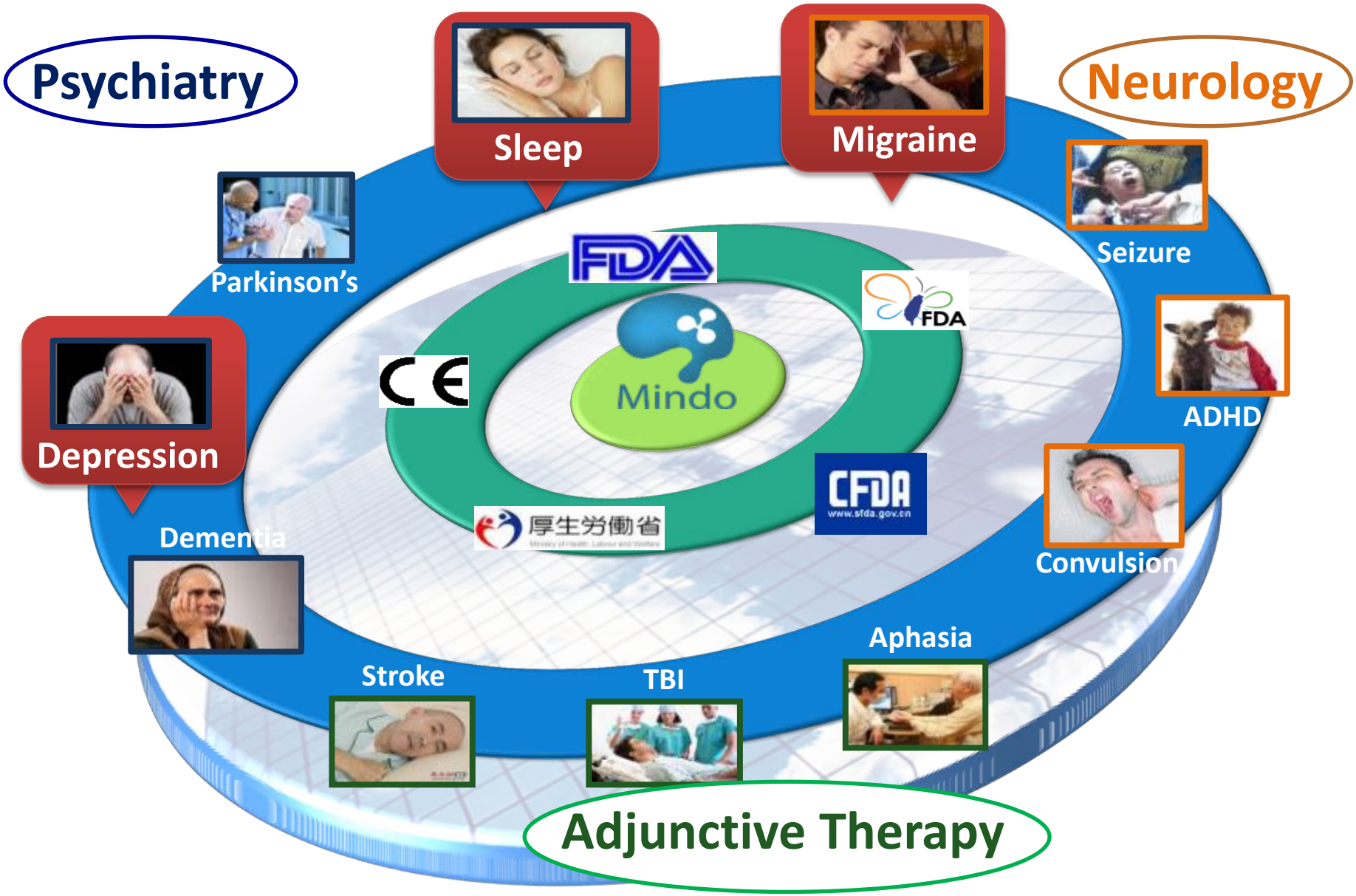
WC

Rest

Go out

Sleep Quality Enhancement

Clinical Applications

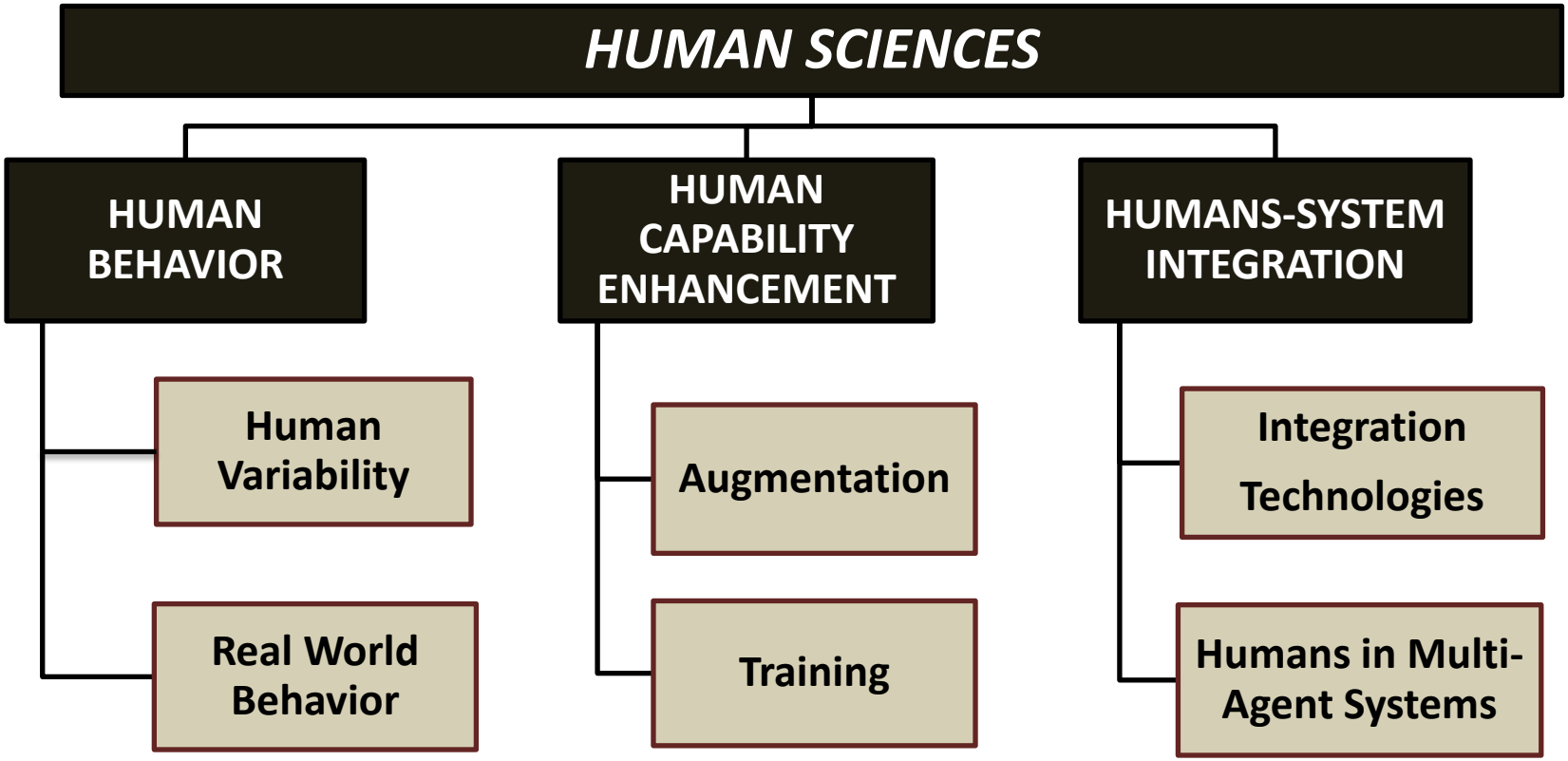


Migraine Hunter

A personalized biofeedback system for pain relief

Hunter Platform

BCI Applications in Defence



AR/VR BCI-based Solider Resilience Training

Advanced VR and Multi-Biosignal System

AR/VR Goggle

Oculus Rift / HTC Vive / Android phone based goggle for Scenario presentation

Biosignal System

WiFi integrated 72ch system (w/ 64ch EEG + 8 differential channels) streaming on LSL

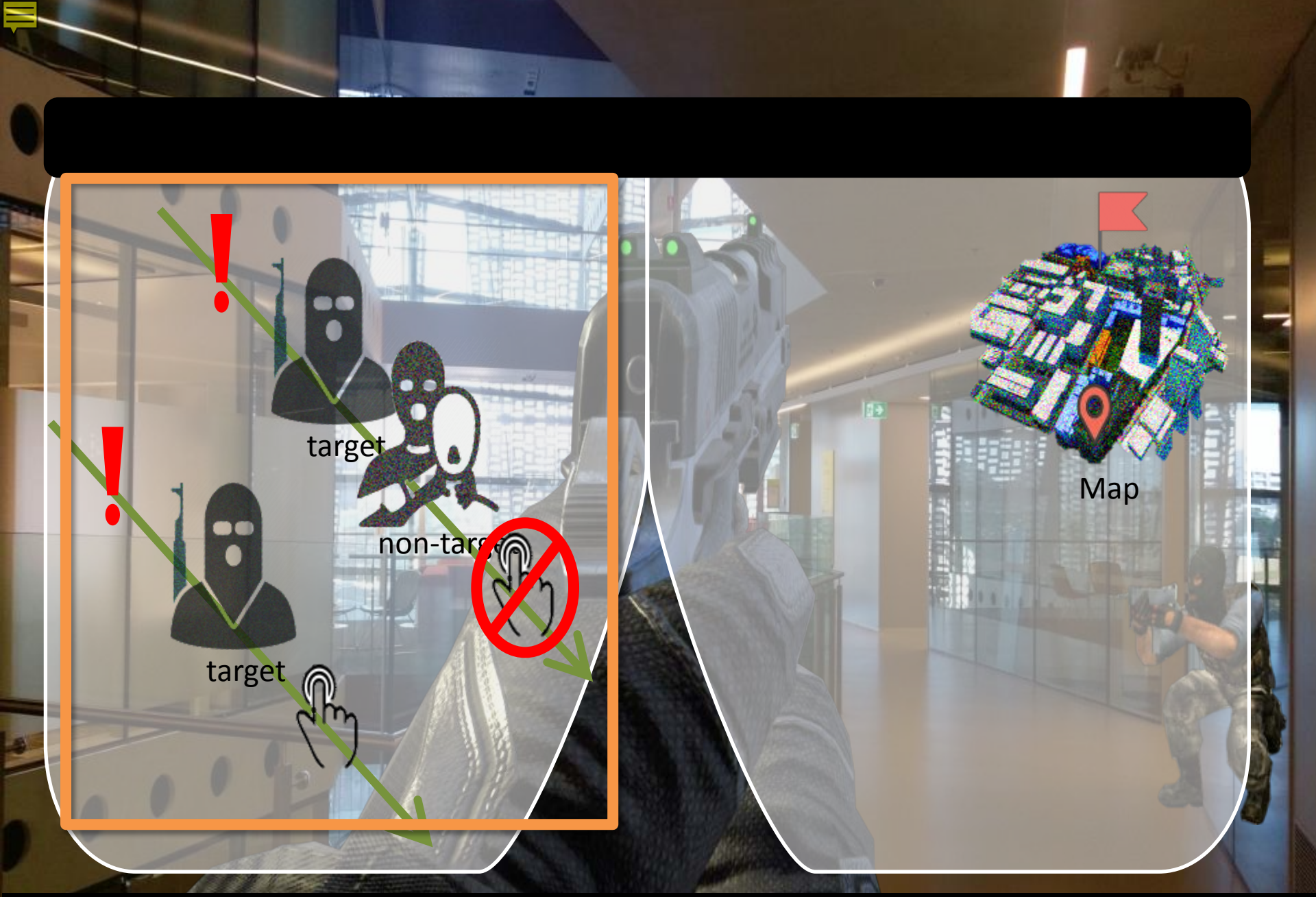
Gesture Control

Leap motion gesture control and synchronized display on Unity based scenario

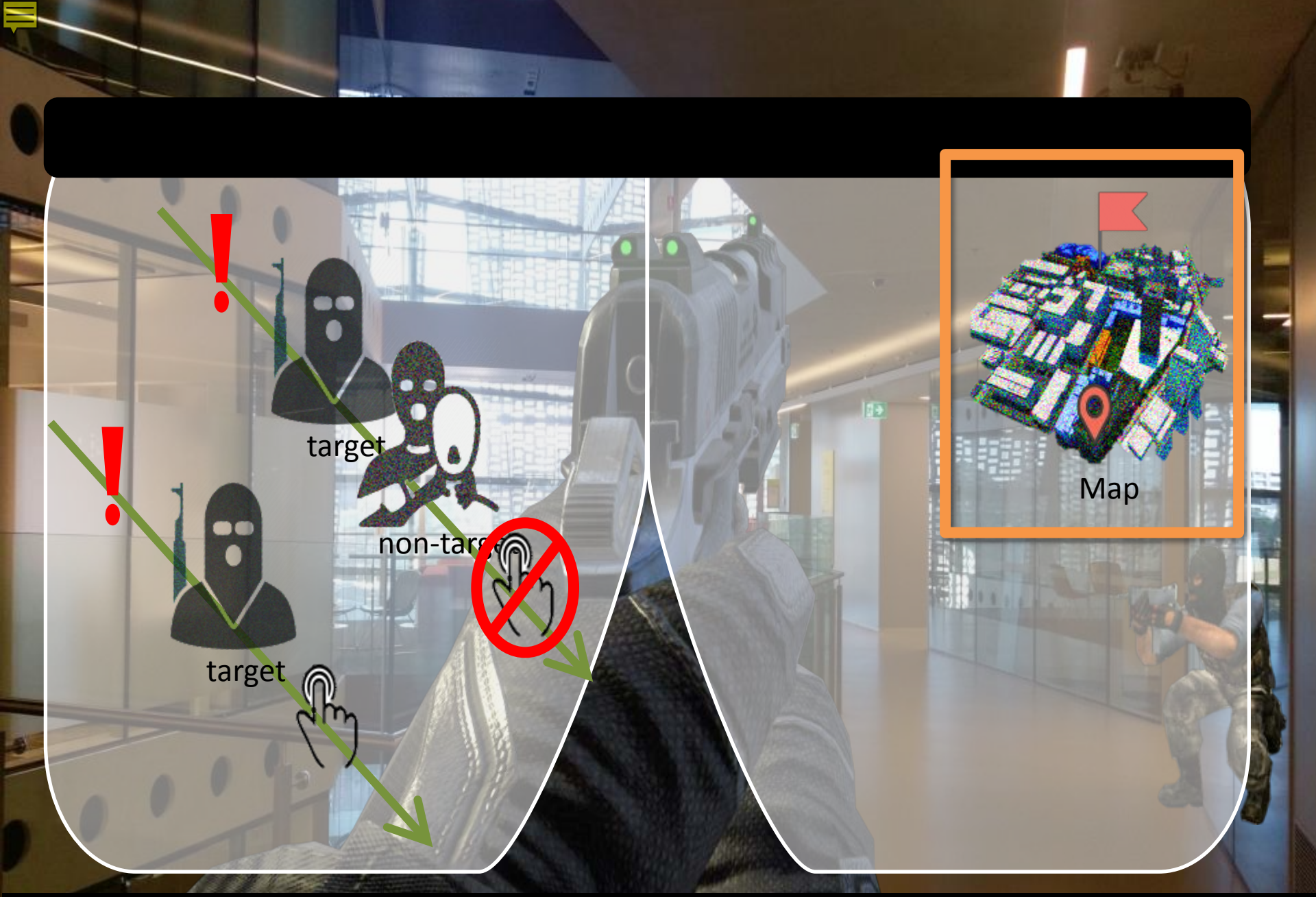
AR Headset
Eye tracking
Subject behaviours
Brain imaging device
Armband
Heart rate
Skin Temperature
Skin Blood perfusion
Blood oxygenation
Wrist band
Heart rate
Temperature
Galvanic skin response

IMMERSION - Virtual Training Environments

dual task: search and engage



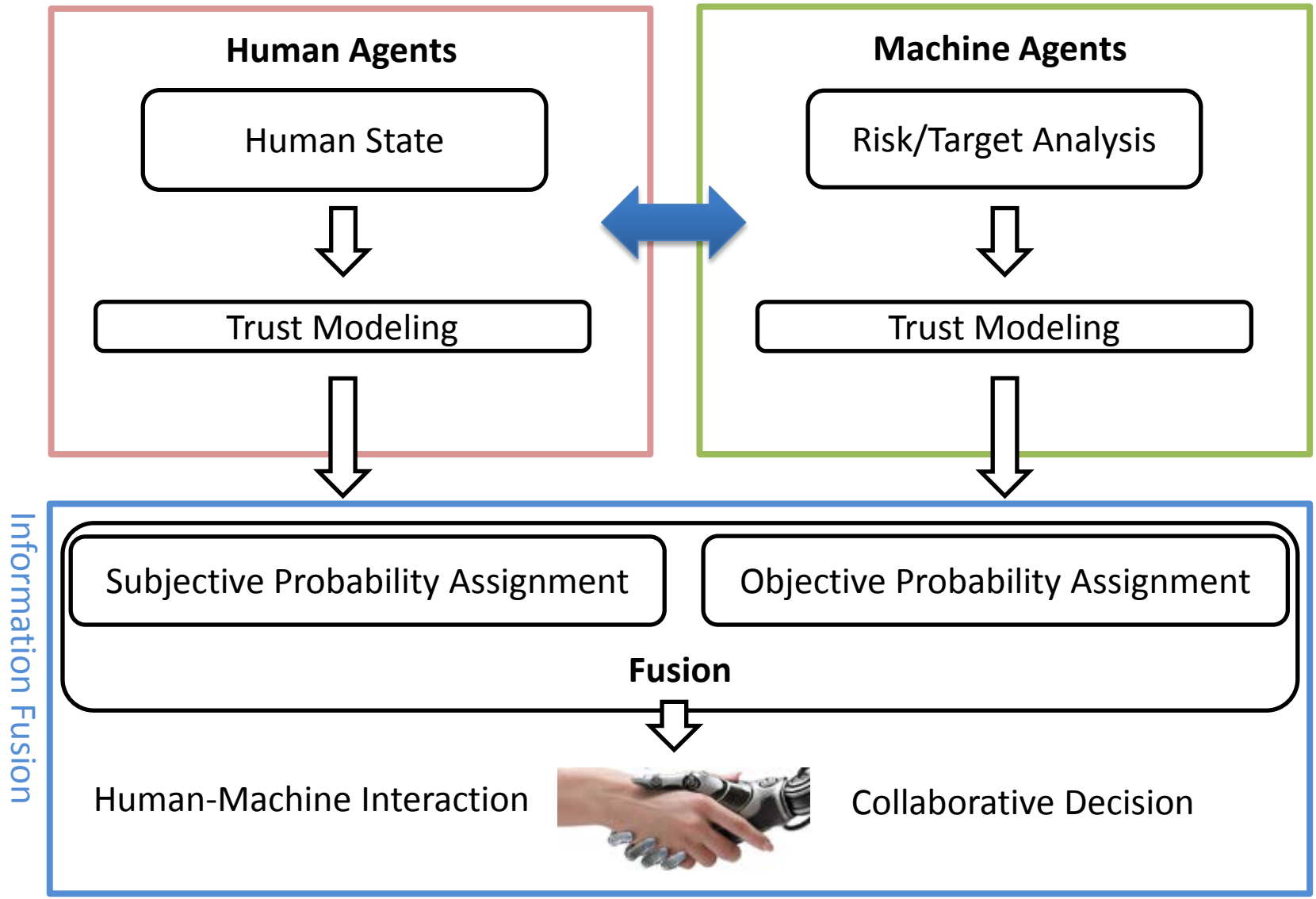
primary task: threat-engagement shooting task

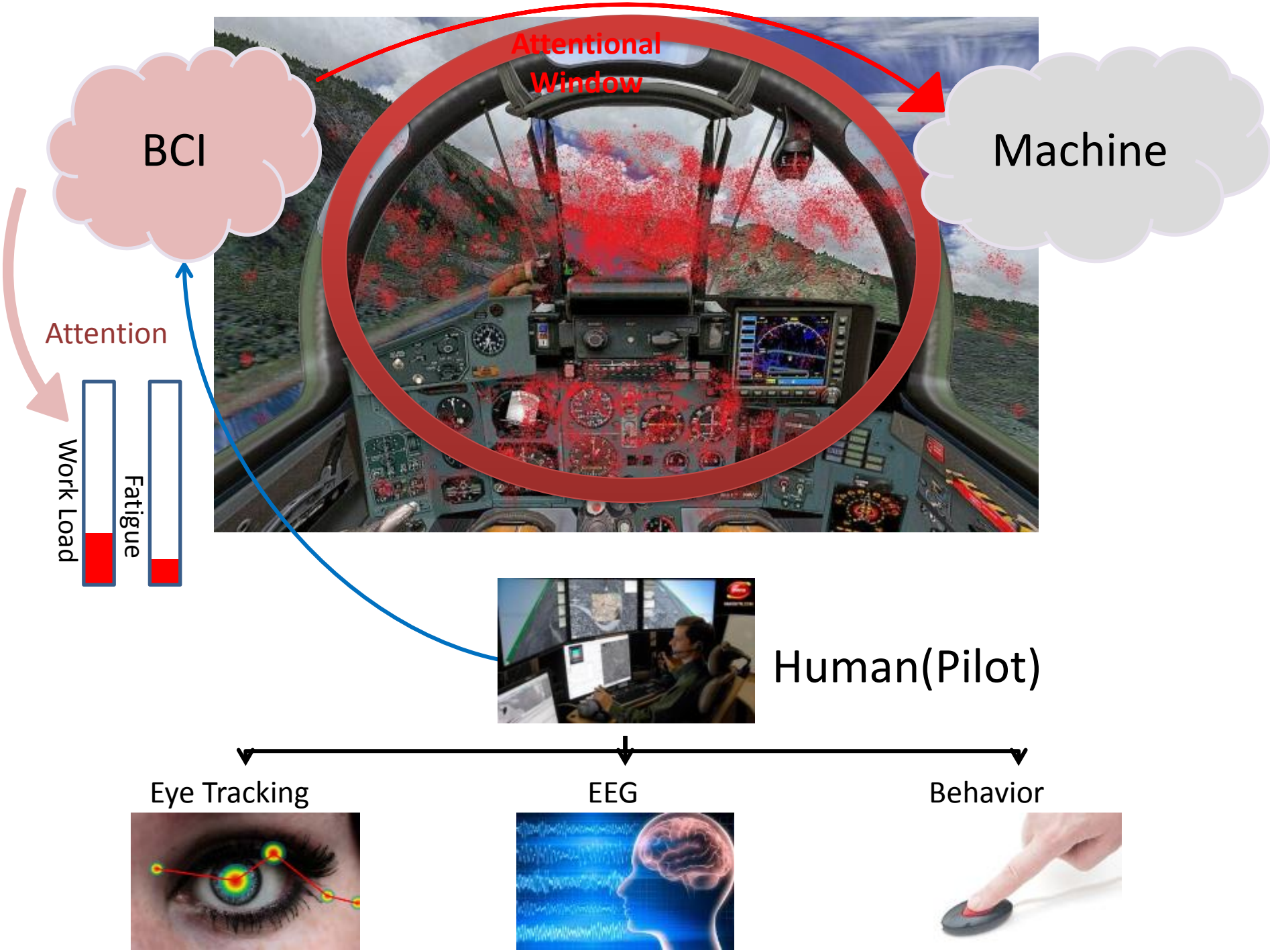


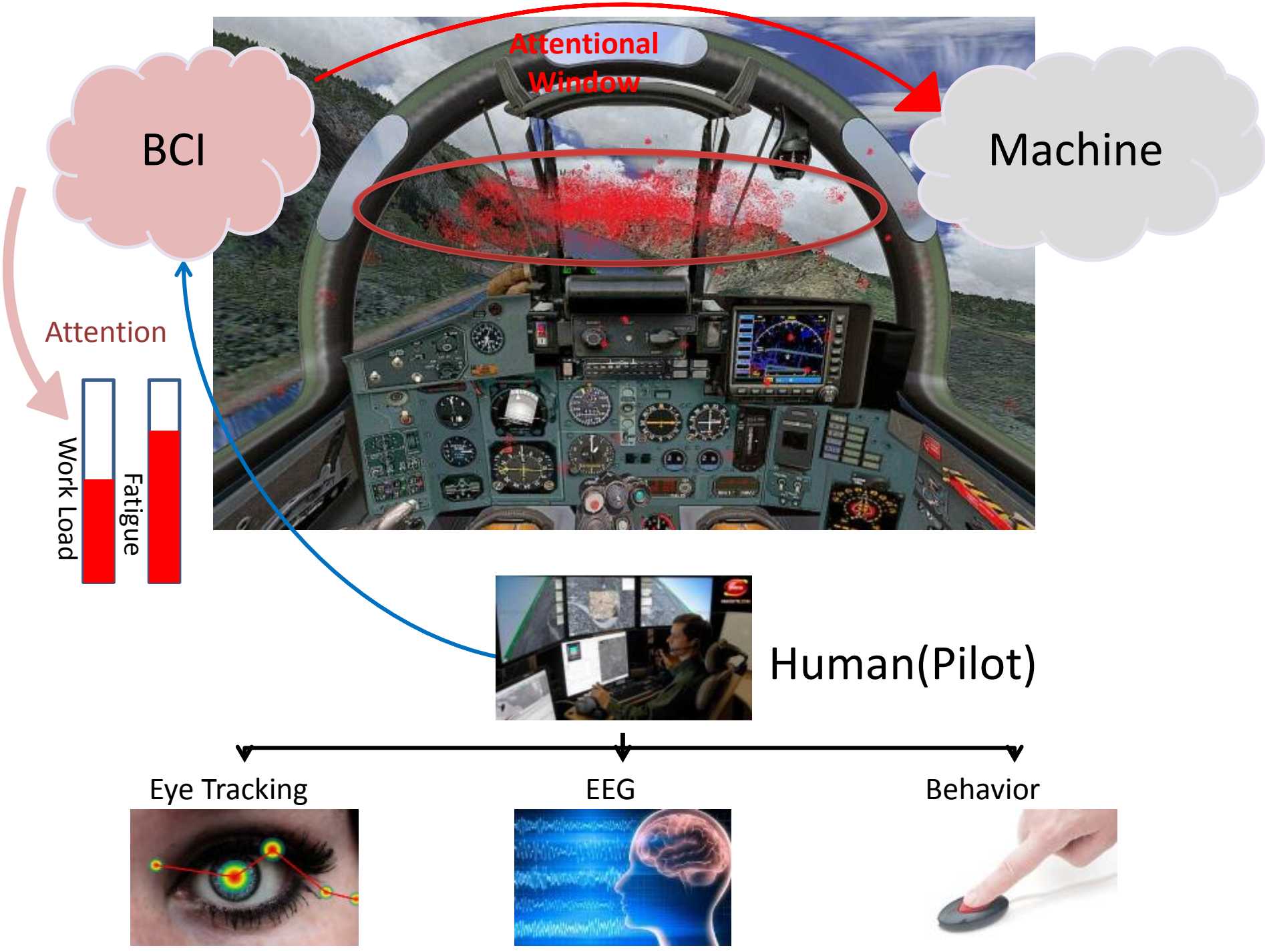
secondary task: navigation

Human Machine Autonomous Systems for Situation Awarness

Mutually Adaptive Human-Machine Interface Technologies




Attentional Window
BCI
Machine
Attention
Work Load
Fatigue
Human(Pilot)
Eye Tracking
EEG
Behavior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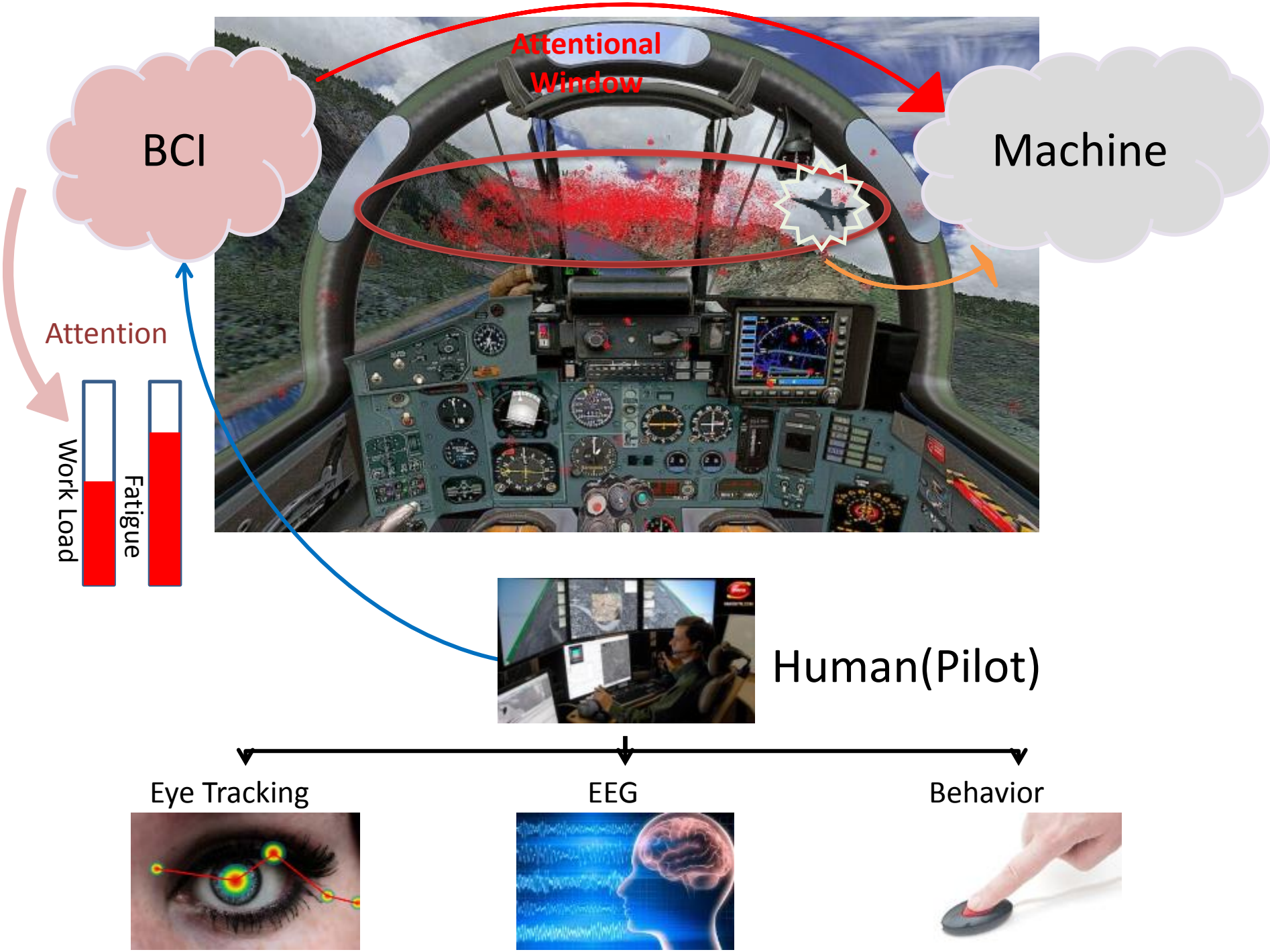
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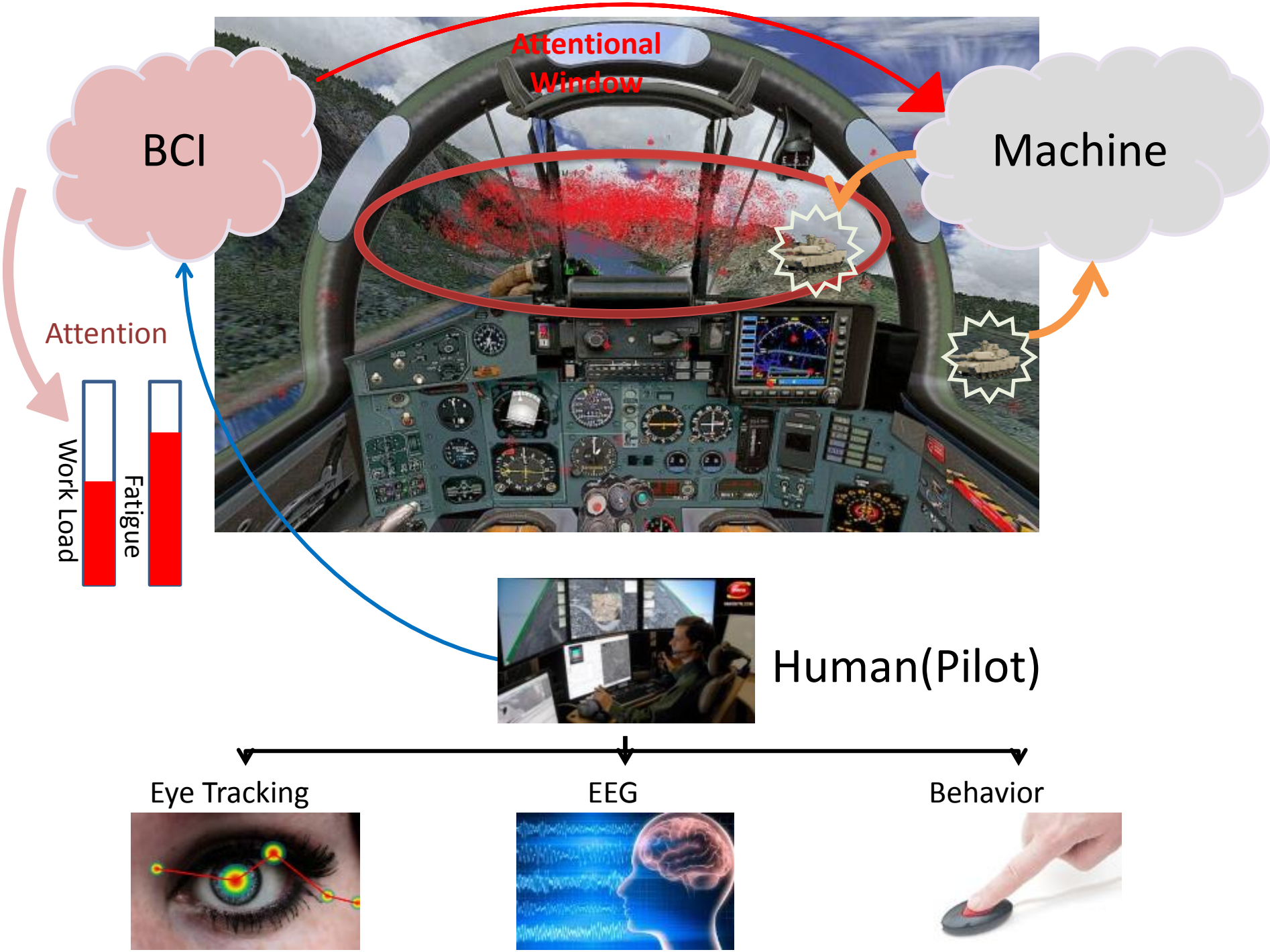
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Brainstorming