Immersive training applications: how to improve safety and health at work, cognitive skills and physical abilities
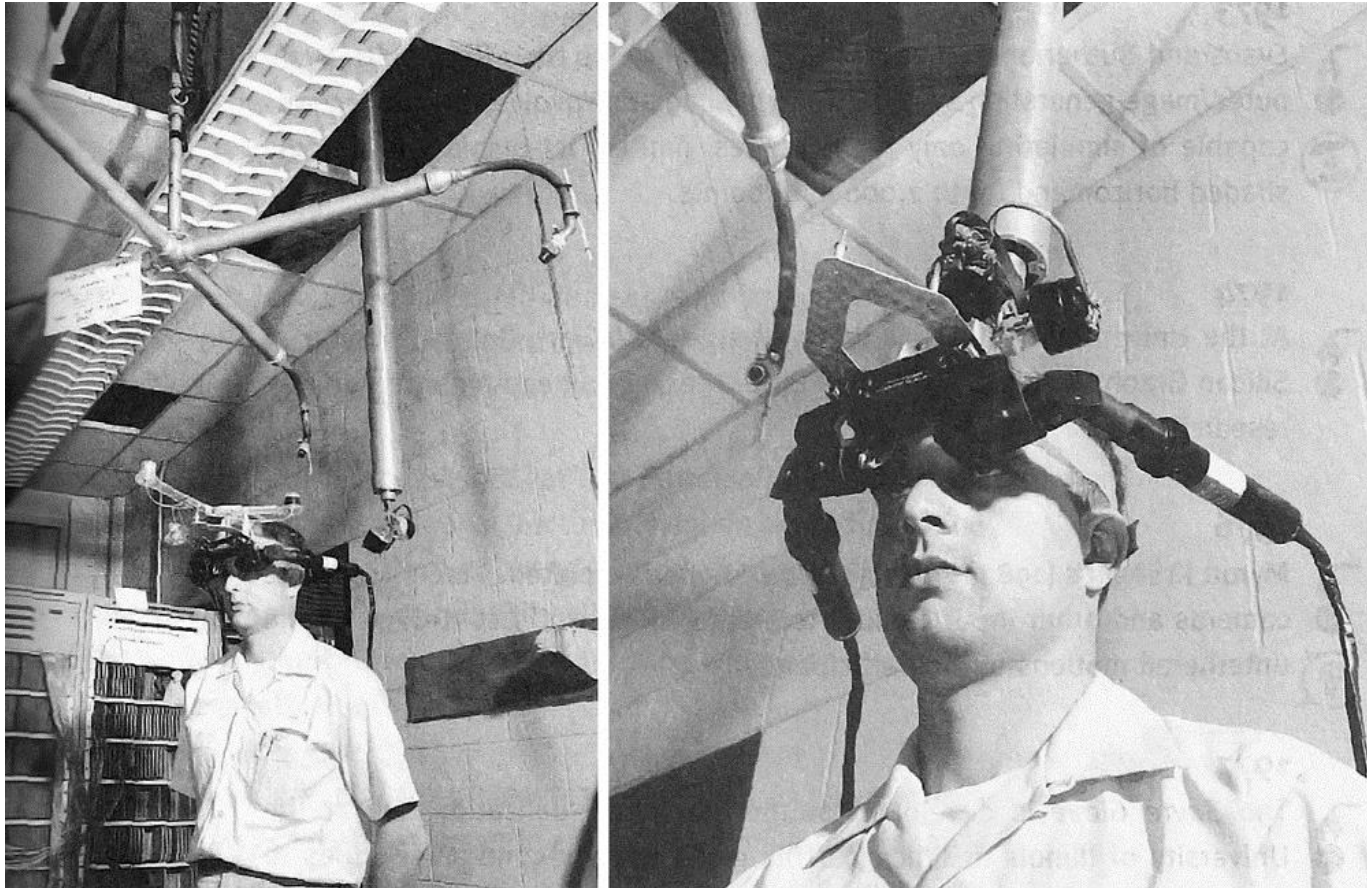
dr hab. inż. Andrzej Grabowski, prof. CIOP-PIB

"Novel technological innovations for occupational safety and health"

Central Institute for Labour Protection - National Research Institute,

Warsaw, 15 October 2019

Virtual reality
- half a century earlier

Damokles Sword, 1968 r.

Telepresence and teleoperation

Telepresence and teleoperation

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Application of VR systems for safety training

The use of high immersive virtual reality systems enables:

- achieving a high degree of realism of the simulation

- simulation of various scenarios under controlled conditions

- facilitate the memorization of information and consolidate skills using realistic, interactive simulations

**Example of virtual reality training introduced to practice**

Benefits resulting from the use of virtual reality techniques to support training

- acceleration of the training process,
- reduction of training costs,
- increasing the effectiveness of training,
- making the form of the training more attractive,
- engaging muscle memory to improve developing the skill of working safely and efficiently
- enabling the transfer of „tacit knowledge" (knowledge based on experience)
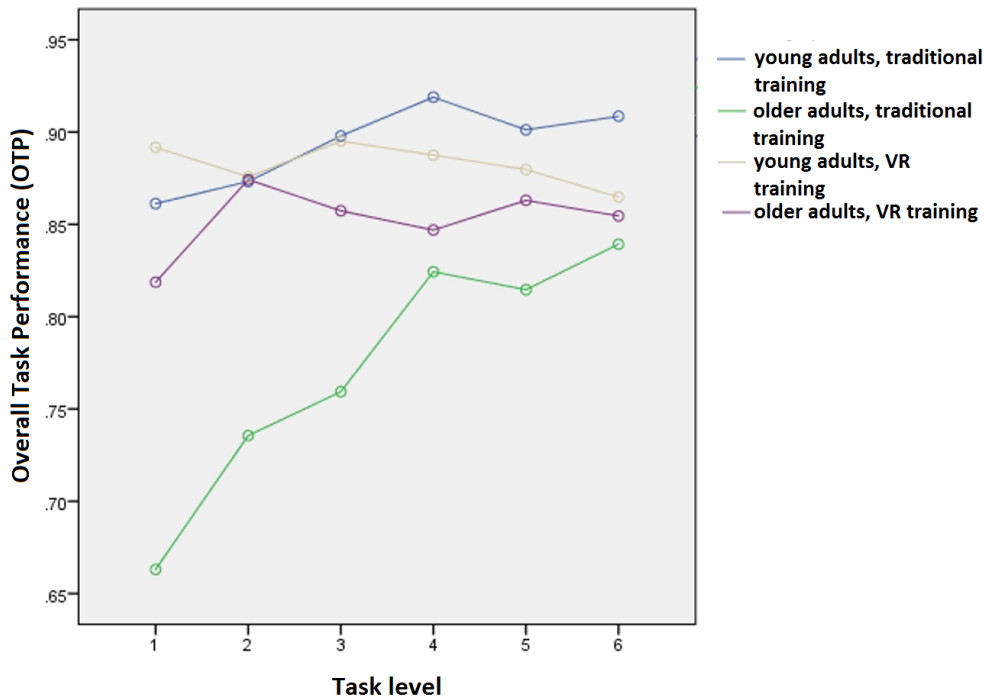
Cognitive skills

A group of elderly (55+) who participated in traditional training performed a manual task with less correctness than other volunteers.
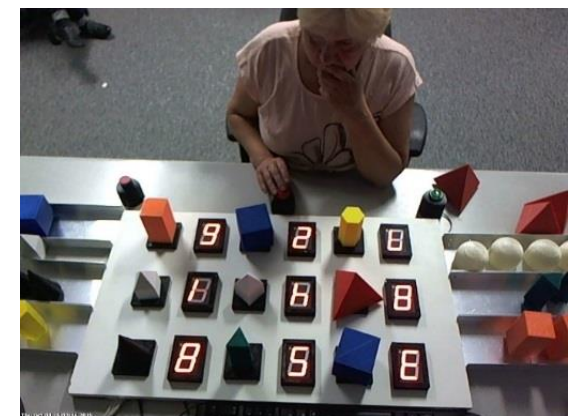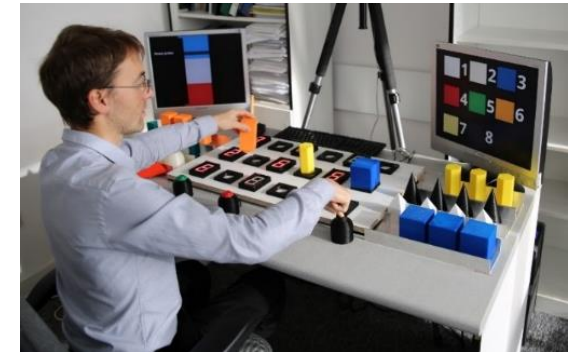
The group of elderly who participated in VR training did not significantly differ in the correctness of task performance from both groups of young people.
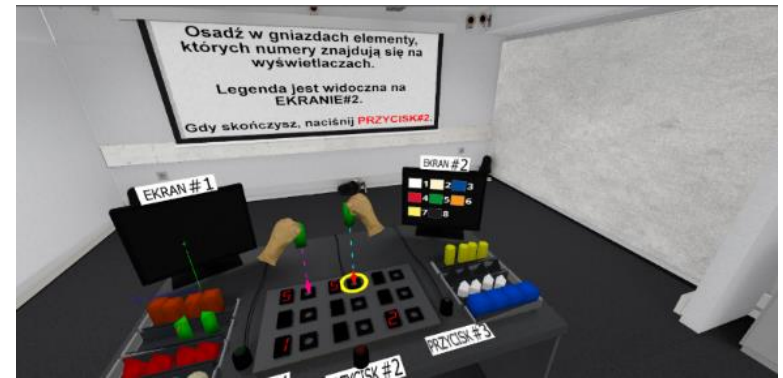
An image observed by a person in a virtual environment

120 volunteers participated in the study.

Simplified workplace simulator

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Training simulation in CAVE

Training simulation in CAVE

VR-based team training

VR-based team training

VR-based team training

VR-based team training

VR-based team training

Training container

Container placed in The Central School of the State Fire Service in Częstochowa

After virtual training more realistic simulators can be used in training process

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Training container

Container placed in The Central School of the State Fire Service in Częstochowa

After virtual training more realistic simulators can be used in training process

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1. Initial training in the CAVE simulator
(20 scenarios)

2. Practical training in the virtual environment
(20 scenarios)

Subsequent training stages

**3. Practical training in the training container**

Innovative training tools for firefighters in the field of internal fires were developed using a training container and virtual simulators. The training container is equipped with a fire chamber with a set of burners and sensors to monitor environmental parameters in the space covered by the fire. The virtual simulators: (1) CAVE and (2) immersive virtual reality simulation – based simulator with the motion capture system and HMDs, complement each other at various training stages. An ICT simulation tool is integrated with the simulators and training container in order to facilitate the evaluation of the training process.
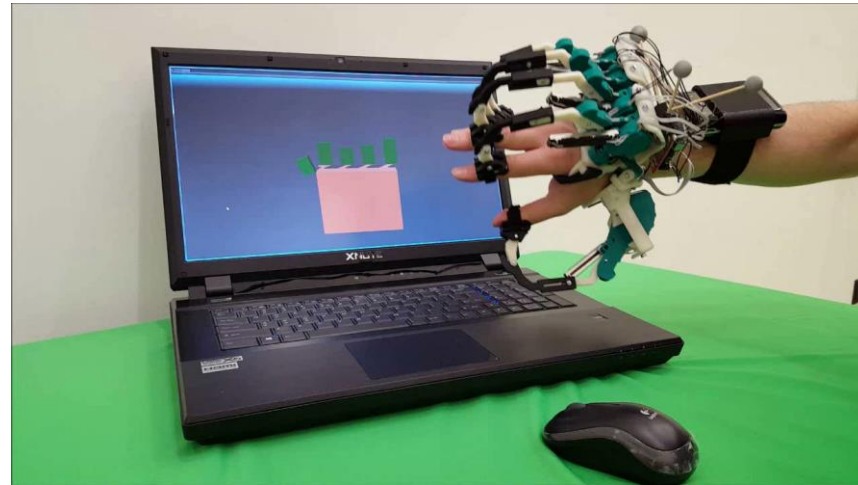
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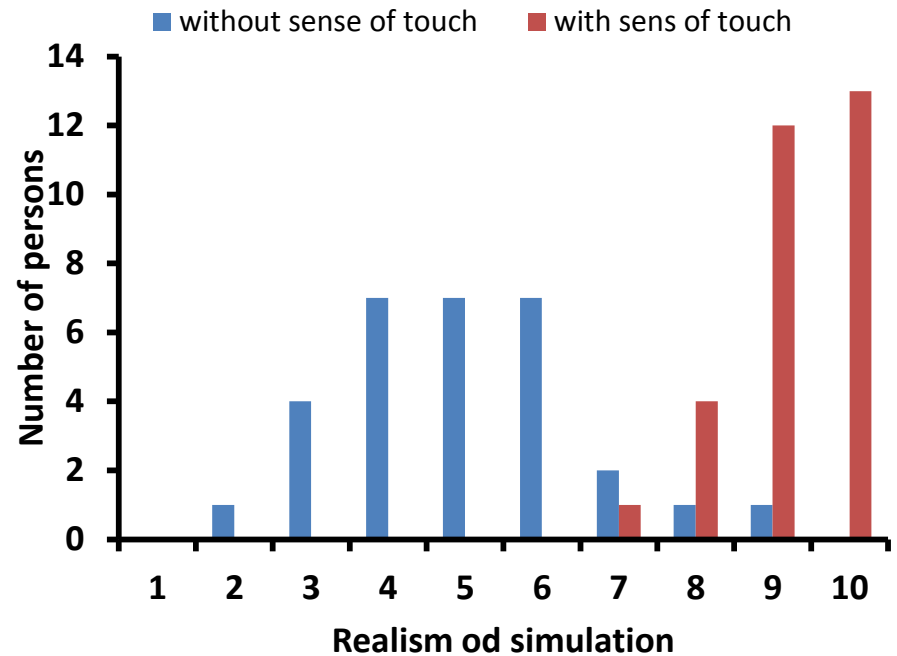# Various mechatronic devices dedicated to research or training

nozzle
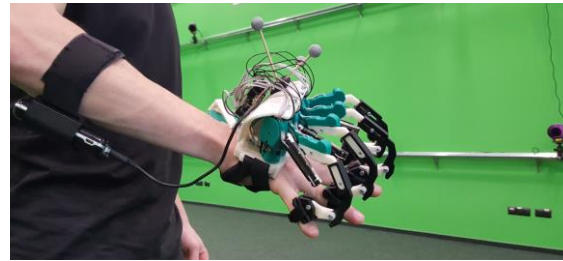
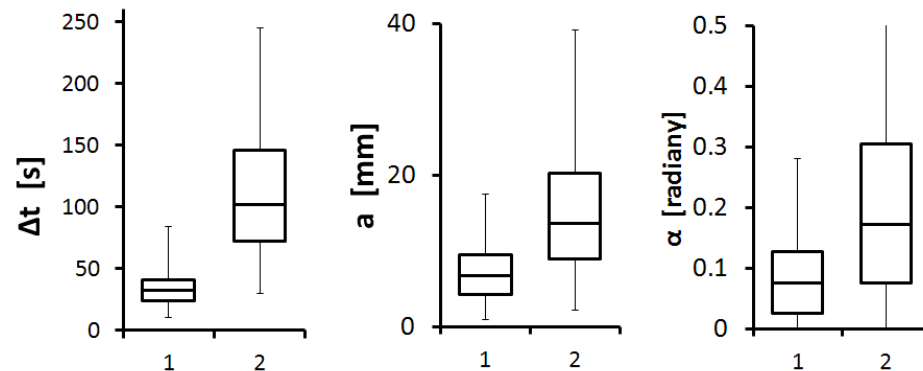glove with force feedback

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The involvement of the sense of touch during the simulation - the impact on realism and precision of the task

The involvement of the sense of touch during the simulation - the impact on realism and precision of the task

	Δt [s]	a [mm]	α [radians]
With sense of touch (1)	36 ± 1	7.8 ± 0.4	0.097 ± 0.003
Without sense of touch (2)	113 ± 8	16.2 ± 0.8	0.32 ± 0.03

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Example of low-cost simulator

Vehicle simulator simulator

Development and implementation of innovative, comprehensive support system for training operators of mobile mining equipment (SMG) for efficient and safe operation in the underground copper mines

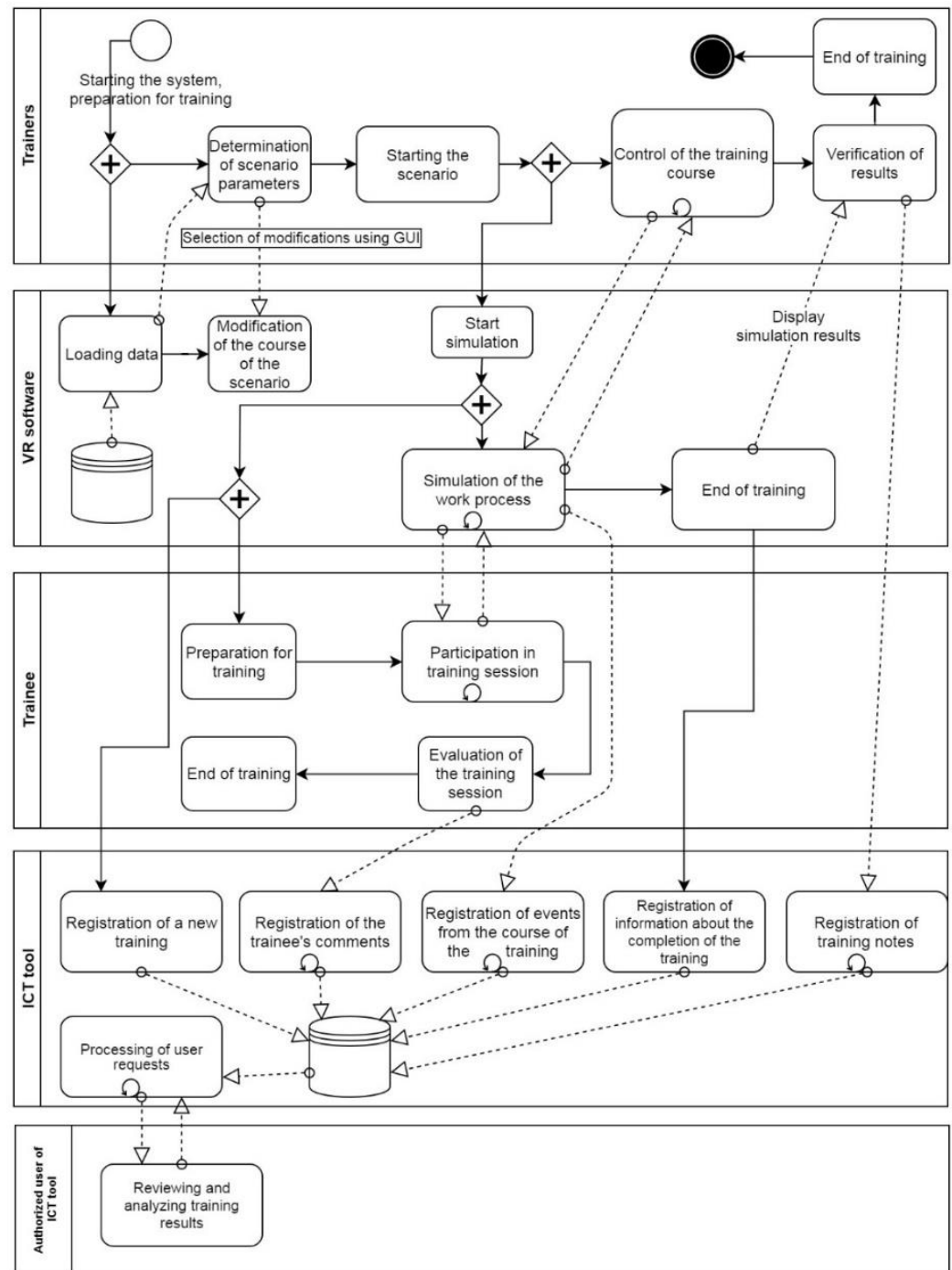# 1. Pure virtual environment

2. Simulator with real console

3. On-ground training in real machine

How to improve training process?

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Rehabilitation games
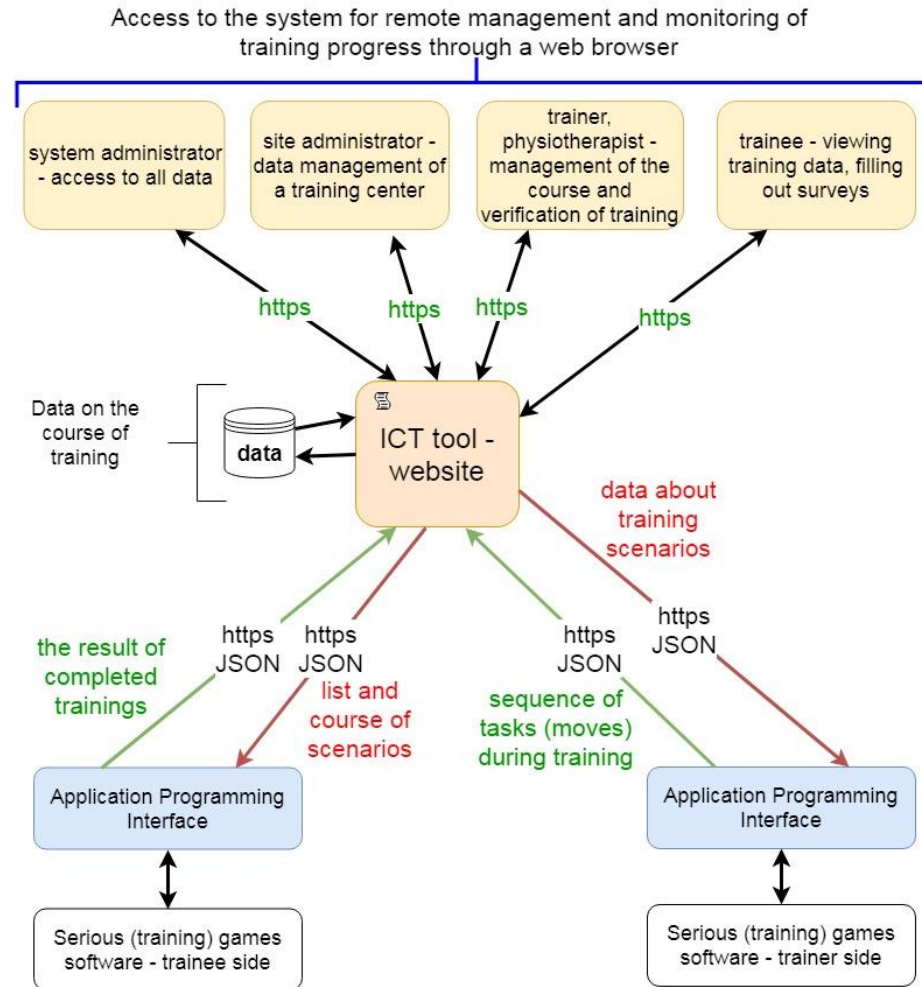
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How to improve training proces?

Diagram of data transmission between different users of the supporting the training process system.

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Thank You For Attention!

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