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My Research Career – Past, Present, and Future

Dr. Mika Luimula, Research Group Leader

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Biography

Dr. Mika Luimula works as a Research Group Leader of Futuristic Interactive Technologies and as a Principal Lecturer of Game and Interactive Technologies for Turku University of Applied Sciences. He holds a PhD in Information Processing Sciences and an MSc in Mathematics. He also holds an Adjunct Professorship at the University of Turku. In addition, he is a senior advisor to the board of Ade Ltd and to the board of XR Presence Ltd. His research interests include gamification, serious games, virtual reality, augmented reality, health informatics and location-aware systems. He has published around 140 scientific papers and his research group has won various awards in the abovementioned research areas.

Curriculum Vitae

Few notes:
Changing the field of science from mathematics to information processing sciences (final thesis from 2005)
Finding PhD topics from Oulu and Tampere – starting doctoral studies 2006)
Win-win situation between work and doctoral studies
Just five months sabbatical leave 2009

Education and training

- High-school diploma, Ylivieska high-school, Ylivieska, Finland, 1989
- Master of Science in Mathematics, University of Oulu, Finland, 1996
- Doctor of Philosophy, Information Processing Sciences, University of Oulu, Finland, 2010
- Adjunct Professor, Department of Information Technology, University of Turku, Finland, 2016
- Finnish Defense Forces, Artillery Telecommunication Officer, 1990; present rank is Sub-Lieutenant (vänrikki)

Most important work positions

- Research group leader in Futuristic Interactive Technologies, Faculty of Engineering and Business, Turku University of Applied Sciences 1/1/2016-
- Principal lecturer and senior research scientist in game development, Faculty of Engineering and Business, Turku University of Applied Sciences 3/15/2012-
- Head of Turku Game Lab and FIT Turku Competence Center, Faculty of Engineering and Business, Turku University of Applied Sciences 3/15/2012-
- Senior research scientist in mobile and ubiquitous computing, Ylivieska Unit, CENTRIA Research and Development, Central Ostrobothnia University of Applied Sciences 6/1/2010-3/14/2012
- Development manager in mobile and ubiquitous computing, Ylivieska Unit, CENTRIA Research and Development, Central Ostrobothnia University of Applied Sciences 8/1/2007-12/31/2009
- Lecturer in computer sciences, Ylivieska Unit, Central Ostrobothnia University of Applied Sciences, 8/1/1998-3/14/2012
- Full-time teacher in mathematics, Ylivieska Technical School, 21 months, in 1995-1998

Board memberships and affiliations

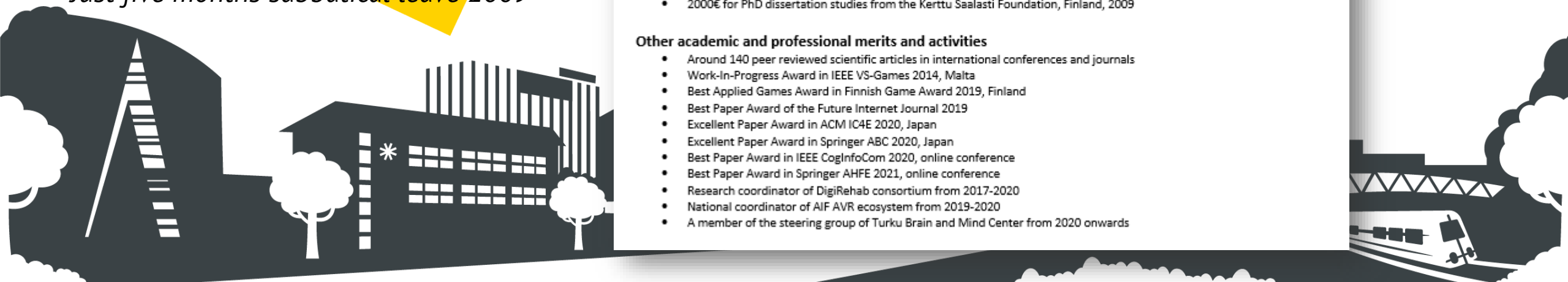
- A member of the board of GoodLife Technology Ltd, in 2015-2017
- Senior advisor to the board of Ade Ltd, in 2020-
- Senior advisor to the board of XR Presence Ltd, in 2021-

Grants

- Half-a-year grant (8000€) for PhD dissertation studies from the Kauno Kleemola Foundation / Finnish Cultural Foundation, Finland, 2009
- 2000€ for PhD dissertation studies from the Kerttu Saalasti Foundation, Finland, 2009

Other academic and professional merits and activities

- Around 140 peer reviewed scientific articles in international conferences and journals
- Work-In-Progress Award in IEEE VS-Games 2014, Malta
- Best Applied Games Award in Finnish Game Award 2019, Finland
- Best Paper Award of the Future Internet Journal 2019
- Excellent Paper Award in ACM IC4E 2020, Japan
- Excellent Paper Award in Springer ABC 2020, Japan
- Best Paper Award in IEEE CogInfoCom 2020, online conference
- Best Paper Award in Springer AHFE 2021, online conference
- Research coordinator of DigiRehab consortium from 2017-2020
- National coordinator of AIF AVR ecosystem from 2019-2020
- A member of the steering group of Turku Brain and Mind Center from 2020 onwards



Curriculum Vitae

Few notes:
RDI funding around 8M€
Main funding instrument Tekes / Business Finland (around 4M€)
Many Jufo 0 articles, UAS RDI activities not evaluated based on Jufo classification
Not active reviewer neither committee member

Most significant research projects

- Applied Research Platform for Autonomous Systems – Finnish Ministry of Education and Culture funded project 2021-2023 (400 000€)
- Smart Campus – Finnish Academy funded project 2021-2022 (85 000€)
- SMARTER – Business Finland funded project 2021-2022 (300 000€)
- Immersive Safe Oceans Technology – Business Finland funded project 2020-2022 (688 000€)
- VR Safety in Fire Protection 2 – Finnish Fire Protection Fund project 2020-2021 (151 000€)
- 360ViSi Simulation Training by Consumer 360° Video Tools – Erasmus+ 2020-2022 (155 000€)
- Digital Skills – EU/ESF funded project 2019-2021 (250 000€)
- Immersive Audio Box – Business Finland funded project 2019-2021 (511 000€)
- VR Safety in Fire Protection – Finnish Fire Protection Fund project 2018-2019 (96 000€)
- Business Ecosystems in Effective Exergaming – TEKES funded project 2017-2020 (587 000€)
- ACTIVAGE – EU/H2020 funded flagship project 2017-2020 (382 000€)
- The New Era of Learning – EU/ERDF funded project 2017-2020 (300 000€)
- Virtual Reality in Driving Inspection – New Inspection Tool and Training Solution for Driving – TEKES funded project 2015-2017 (326 000€)
- Fast Wow Effects Boosting SME Business – TEKES funded project 2015-2017 (446 000€)
- Gamified Solutions in Healthcare – TEKES funded project 2014-2016 (530 000€)
- Turku Game Lab – project funded by the federation of Finnish Technology Industries 2013-2016 (150 000€)
- Game Cluster – EU/ERDF funded project 2012-2013 (225 000€)
- CENTRIA Platform – EU/ERDF funded project 2010-2012 (883 000€)
- AVISTO – TEKES funded project 2009-2010 (217 000€)
- SensoTag – TEKES funded project 2007-2009 (256 000€)
- MobiSmart – EU/ERDF funded project 2007-2010 (600 000€)
- MobiMedia – EU/ERDF funded project 2005-2007 (411 000 €)

Selected Articles

- Izullah, F.R., af Schulten, A., Koivisto, M., Nieminen, V., Luimula, M., and Hämäläinen, H. Differential Interactions of Age and Sleep Deprivation in Driving and Spatial Perception by Male Drivers in a Virtual Reality Environment, Scandinavian Journal of Psychology, Vol. 62, Iss. 3, June, 2021, 11p.
- Ishii, S., Yokokubo, A., Luimula, M., and Lopez, G. ExerSense: Physical Exercise Recognition and Counting Algorithm from Wearables Robust to Positioning, Sensors, Vol. 21(1), Article 91, 2021, 16p.
- Markopoulos, E., and Luimula, M. Immersive Safe Oceans Technology: Developing Virtual Onboard Training Episodes for Maritime Safety, Future Internet Journal, Vol. 12. Nr. 5, 2020, 12p.
- Pieskä, S., Luimula, M., and Suominen, T. Fast Experimentations with Virtual Technologies Pave the Way for Experience Economy, Acta Polytechnica Hungarica, Vol. 16, Nr. 6, 2019, pp. 9-26.
- Hämäläinen, H., Izullah, F.R., Koivisto, M., Takio, F., and Luimula, M. The Right-side Perceptual Bias in Aging Determined in a Laboratory and during a Virtual Driving Task, Scandinavian Journal of Psychology, Vol. 59, 2018, pp. 32–40.
- Pyae, A., Liukkonen, T. N., Luimula, M., & Smed, J. Lessons Learned from Two Usability Studies of Digital Skiing Game with Elderly People in Finland and Japan. International Journal of Serious Games, 4(4), 2017, pp. 37-52.
- Hämäläinen, H. Rashid Izullah, F., Aho, A., Koivisto, M., Laine, T., Qvist, P., Peltola, A., Pitkäkangas, P., and Luimula, M. NeuroCar Virtual Driving Environment: Simultaneous Evaluation of Driving Skills and Spatial Perceptual-attentional Capacity, Acta Technica Jaurinensis, Vol. 10, No. 1Y, 2017, pp. 21-34.
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- Pyae, A., Luimula, M., Saarenpää, T., and Smed, J. When Japanese Elderly Play Finnish Exergames: A Cross-Cultural Study, An International Journal of Usability Studies, Vol. 11, Issue 4, August, 2016, pp. 131–152.
- Nakai, A., Pyae, A., Luimula, M., Hongo, S., Vuola, H., and Smed, J. Investigating the Effects of Motion-based Kinect Game System on the User's Cognition, An International Journal on Multimodal User Interfaces, Vol 9/4, 2015, pp. 403-411.
- Ihamäki, P. and Luimula, M. Players' Experiences in a Sports Geocaching game. In IHCI book, Emerging Research and Trends in Interactivity and the Human-Computer Interface, IGI Global, 2014 pp. 127-143.
- Pieskä, S., Luimula, M., Jauhiainen, J., and Spiz, V. Social Service Robots in Wellness and Restaurant Applications, Journal of Communication and Computer, Volume 10, 2013, 116-123.
- Jämsä, J., Luimula, M., Pieskä, S., and Saukko O. Indoor Positioning Using Symmetric Double-Sided Two-Way Ranging in a Welding Hall, Journal of Vibroengineering, Volume 14, Issue 1, 2012, 27-32.
- Luimula, M. Development and evaluation of the location-aware platform: Main characteristics in adaptable location-aware systems. Doctoral dissertation. Oulu University. Acta Universitatis Ouluensis. 2010.
- Luimula, M., Sääskilahti, K., Partala, T., Pieskä, S., and Alaspää, J. Remote navigation of a mobile robot in a RFID-augmented environment. Personal and Ubiquitous Computing, Vol 14, 2010, 125-136.
- Sääskilahti, K., Sippola, O., Luimula, M., Yli-Hemminki, J. and Partala, T. Location-based communication techniques in parallel learning between the classroom and the field. The International Journal of Continuing Engineering Education and Life-Long Learning, 20(1), 2010, 21-39.

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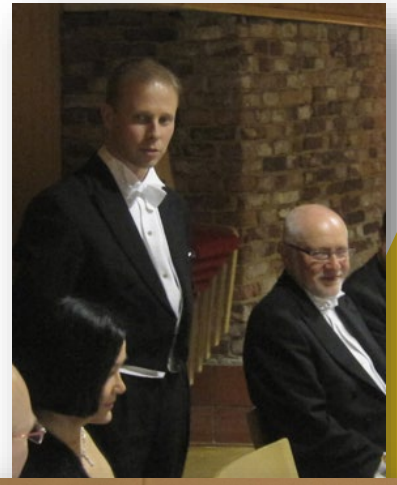
An Interesting Trip



My Research Career

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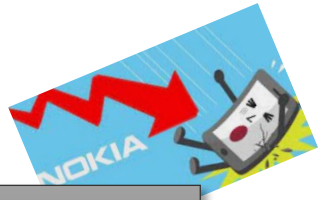
2006



2010

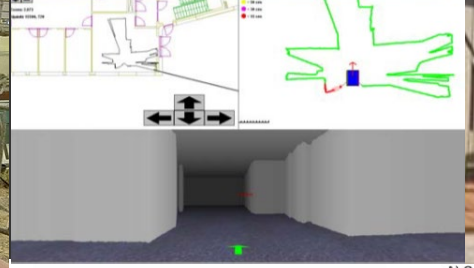
2019

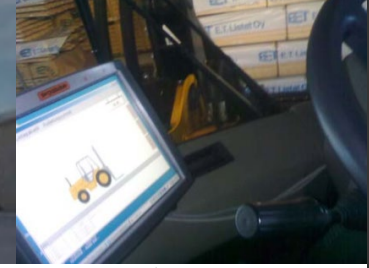
Starting as a researcher at Centria R&D

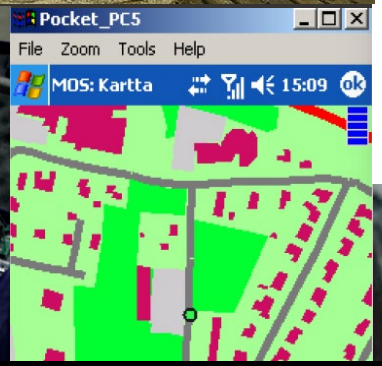
Defending my PhD thesis
Development Manager at Centria R&D

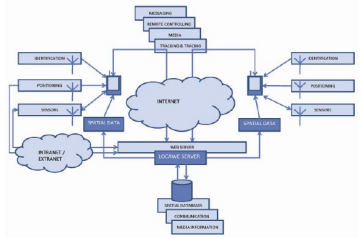
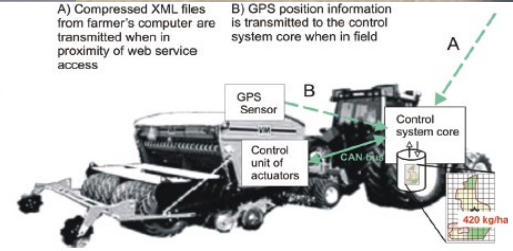
Adj. professorship at UTU
Leading FIT research group

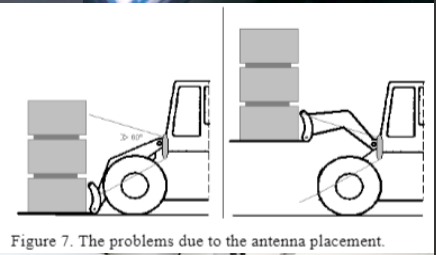


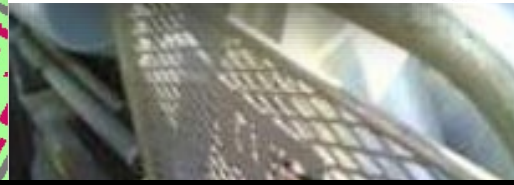





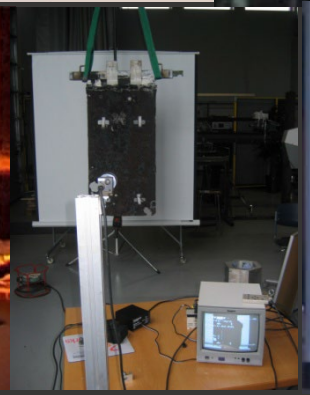









Research Activities at CENTRIA Research and Development

User Interfaces, Robust Conditions, Context Awareness, Industrial Cooperation, Healthcare, Robotics, Ubiquitous Computing, Architecture Design, Multidisciplinary, Constructive Applied Research, Rapid Prototyping, User Centric Design

Research Activities at Turku Universit of Applied Sciences

User Interfaces, Robust Conditions, Context Awareness, Industrial Cooperation, Healthcare, Robotics, Ubiquitous Computing, Architecture Design, Multidisciplinary, Constructive Applied Research, Rapid Prototyping, User Centric Design

Industrial Driven Research Activities

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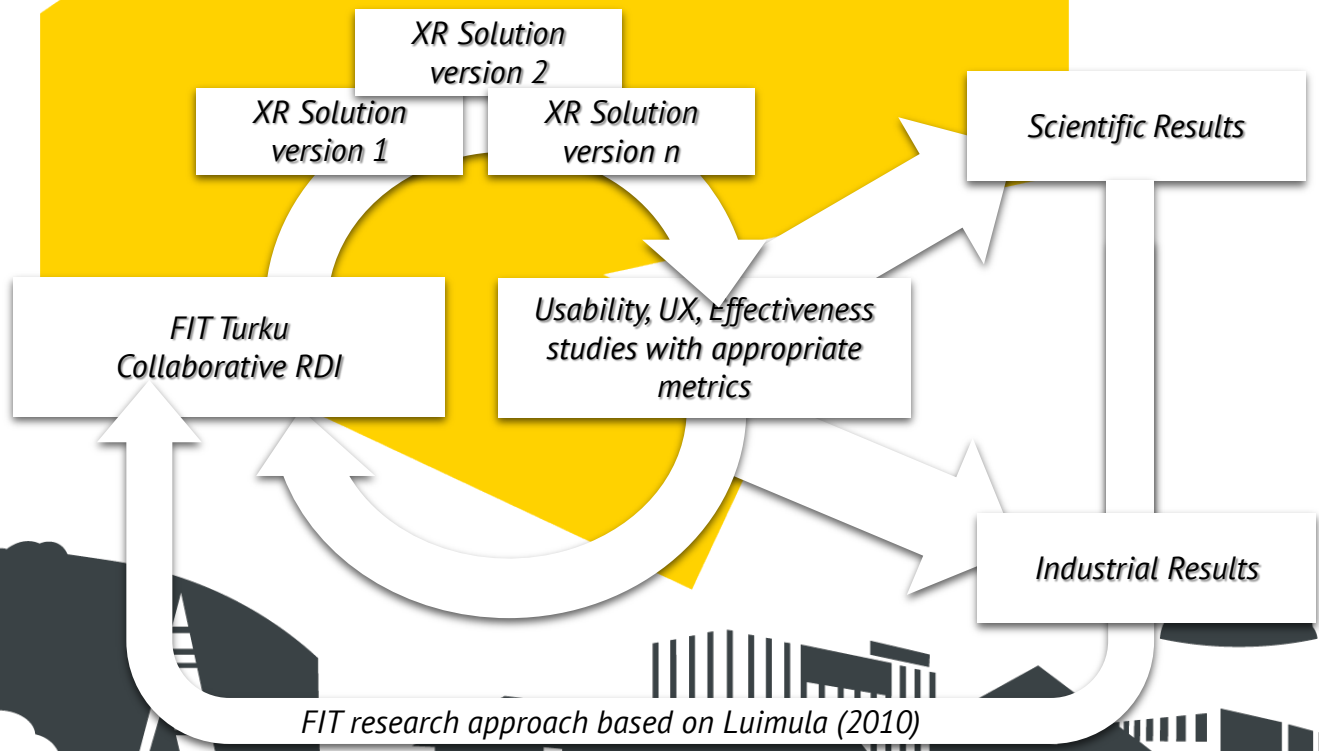
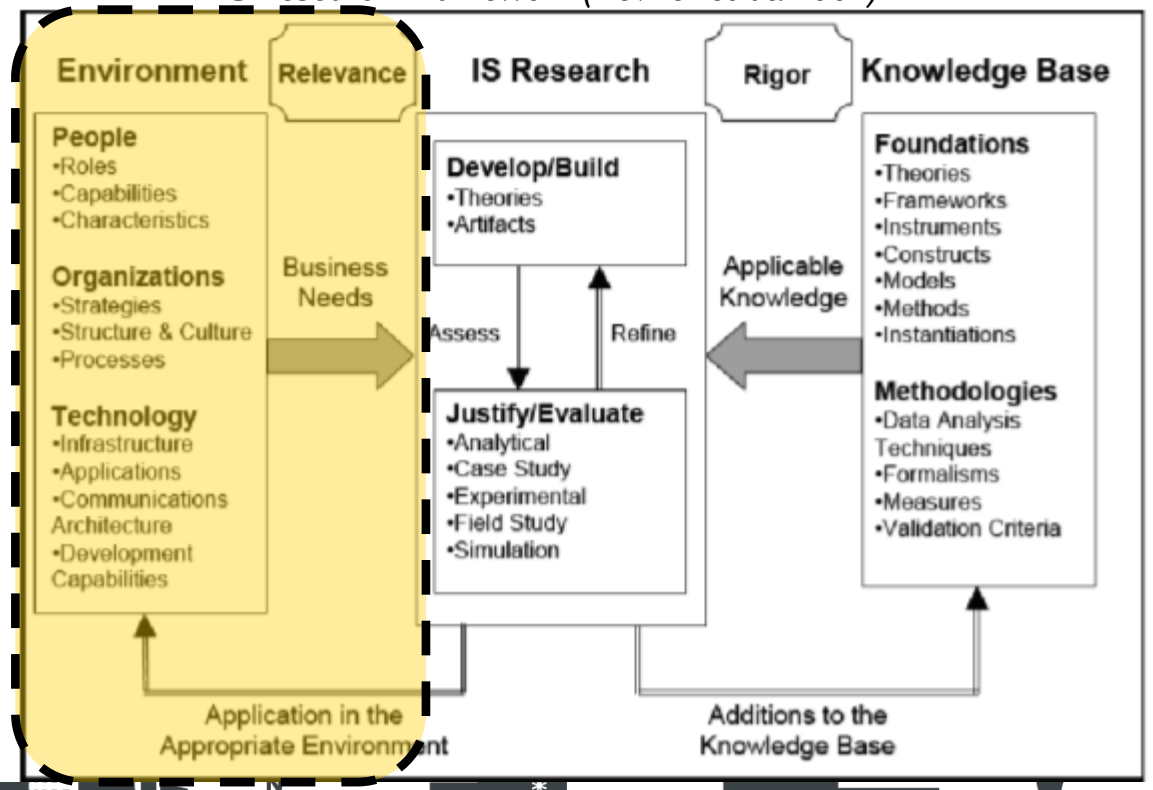


FIT research approach based on Luimula (2010)

IS Research Framework (Hevner et al. 2004)



4th stage (professorship)

1st stage (doctoral studies)

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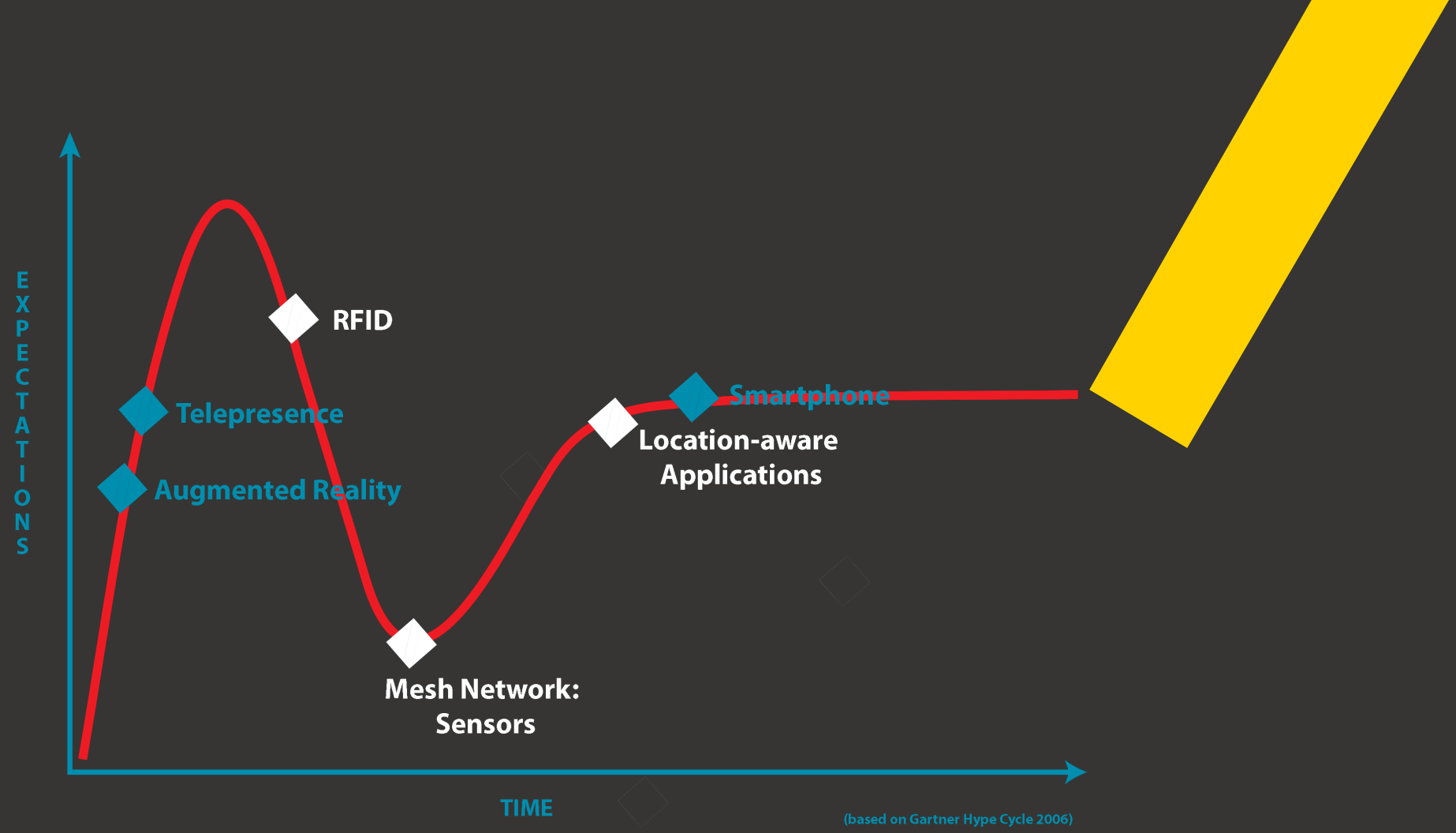

1st and 2nd Stages

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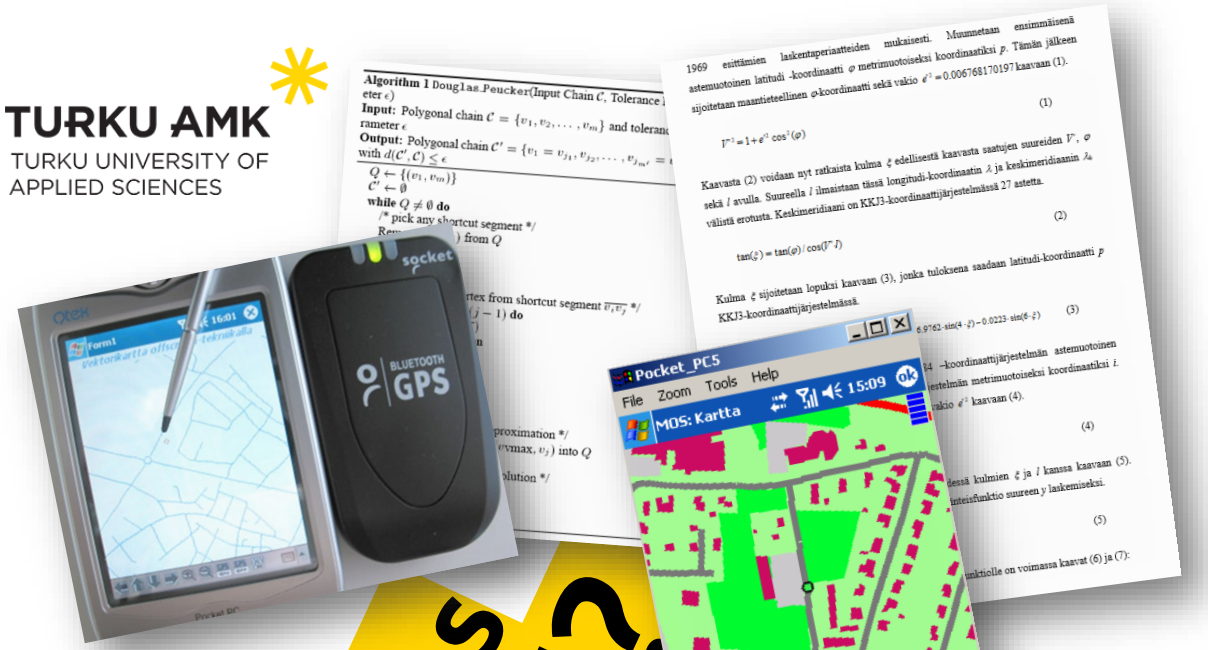
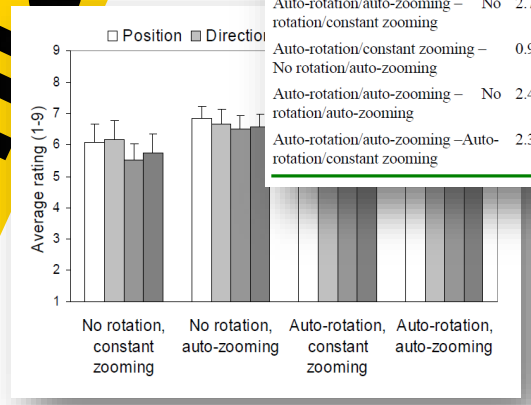


Mobile Maps in Finland?

Table 2. The Z-values of the pairwise comparisons (* p < 0.05, ** p < 0.01)

Pair	Pos	Dir	Ide	Ove
No rotation/auto-zooming – No rotation/constant zooming	2.5*	1.9	2.4*	2.3*
Auto-rotation/constant zooming – No rotation/constant zooming	2.1*	1.3	2.5*	2.4*
Auto-rotation/auto-zooming – rotation/constant zooming	2.7*	2.0*	2.8**	2.8**
Auto-rotation/constant zooming – No rotation/auto-zooming	0.9	0.9	0.5	0.6
Auto-rotation/auto-zooming – rotation/auto-zooming	2.4*	1.9	2.4*	2.4*
Auto-rotation/auto-zooming –Auto-rotation/constant zooming	2.3*	2.0*	2.2*	2.1*



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[6] Luimula, M., Sääskilahti, K., Partala, T. and Saukko, O. A field comparison of techniques for location selection on a mobile device. In: Conference Proceedings of the Wireless Applications and Computing 2007, International IADIS Conference, July 6- 8, 2007, Lisbon, Portugal, 141-146.

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[9] Lehtimäki, T., Partala, T., Luimula, M. and Verronen, P. LocaweRoute: an advanced route history visualization for mobile devices. Conference Proceedings of the ACM Advanced Visual Interfaces 2008. May 28-30, 2008, Naples, Italy, 392-395.

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Before doctoral dissertation

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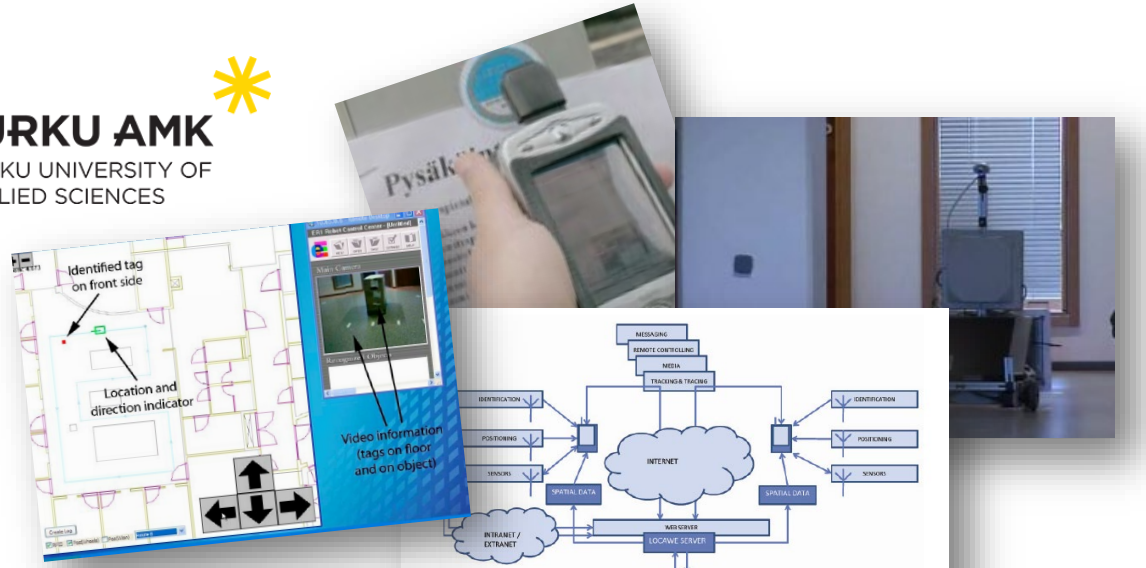
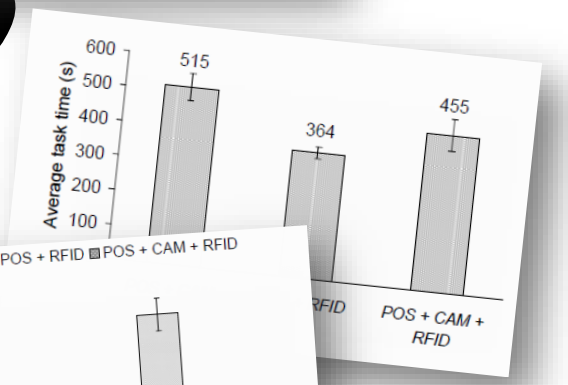
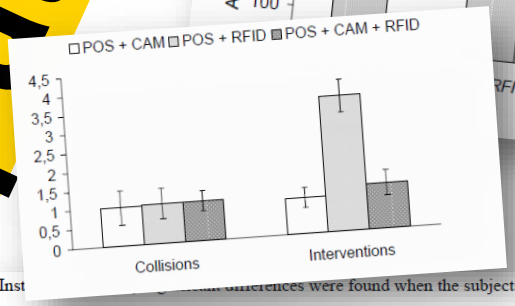


Ubiquitous Computing





Inst ... differences were found when the subjects were asked to evaluate the remote control support of each interface component separately. The average ratings were: camera view 7.7, position information 6.5, and RFID identification 5.9. This analysis showed a significant effect of user interface component on remote control support ratings $\chi_F^2 = 14.9$, $p < 0.01$. The pairwise tests showed that the subjects rated the camera view

[1] Partala, T., Luimula, M., and Saukko, O. 2006. Automatic rotation and zooming in mobile roadmaps. In: Proceedings of the 8th International ACM Conference on Human-Computer interaction with Mobile Devices and Services, MobileHCI '06, September 12-15, 2006, Helsinki, Finland, 255-258.

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Before adjunct professorship

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Industrial Cooperation

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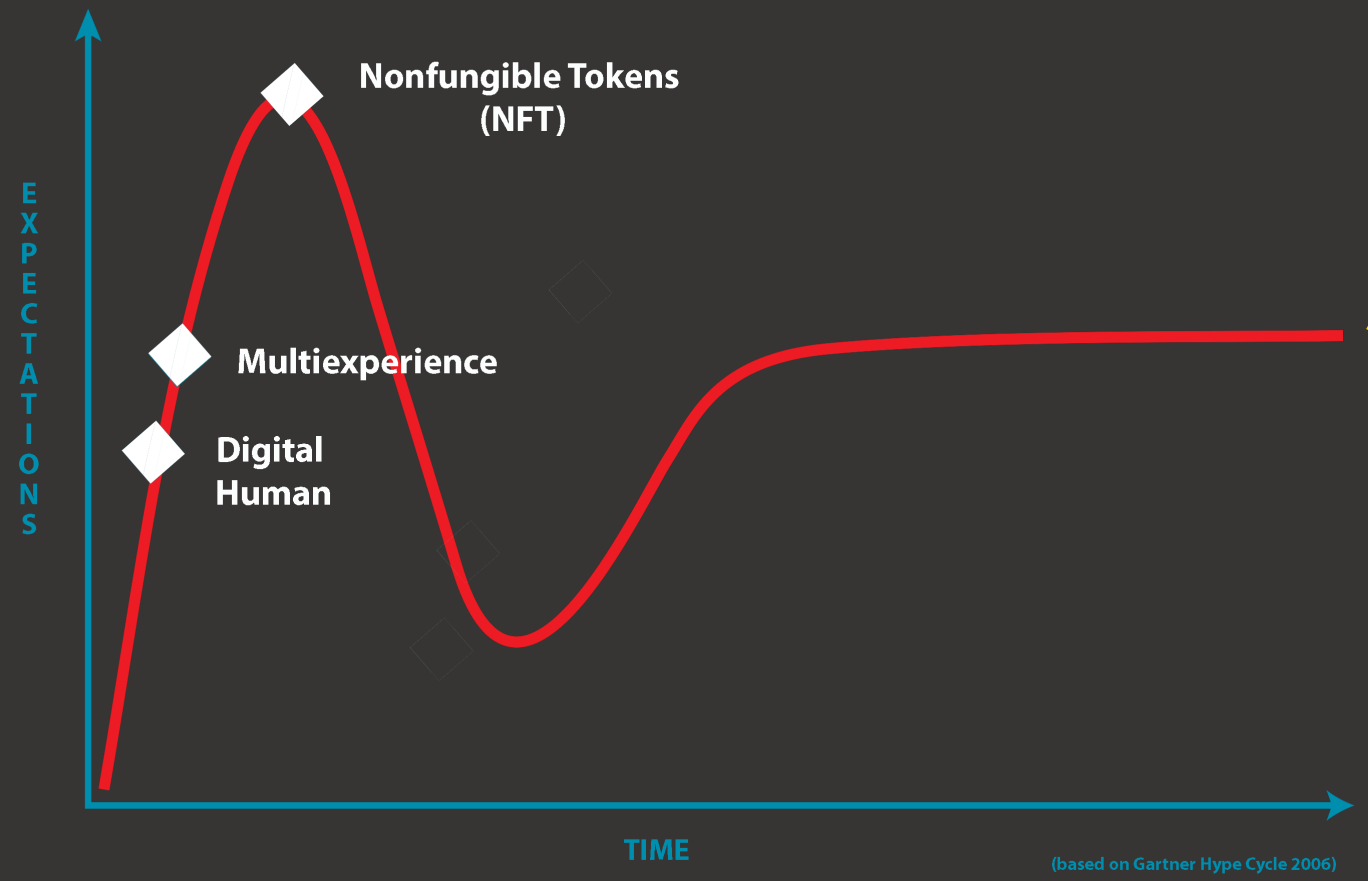

3rd and 4th Stages

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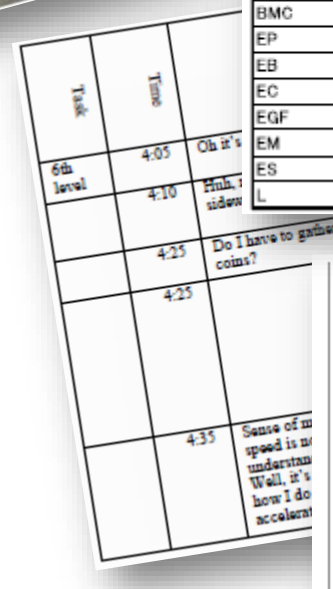
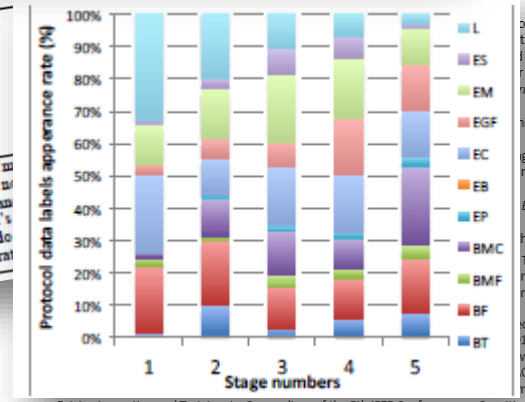
(Serious) Games in Finland?

	Points of view		
Labels	*Positive – Negative*	*Understandable*	*Hard – Easy to play*
BT	Negative	Mean	Mean
BF	Positive	Good	Mean
BMF	Positive	Good	Easy
BMC	Negative	Bad	Hard
EP	Negative	Mean	Mean
EB	Negative	Bad	Too Easy or Too Hard
EC	Negative	Bad	Hard
EGF	Negative	Bad	Hard
EM	Positive	Good	Good game balance
ES	Positive	Good	Good game balance
L	Mean	Mean	Hard





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Before adjunct professoship

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Flagship Status


GAMES FOR HEALTH JOURNAL: Research, Development, and Clinical Applications
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DOI: 10.1089/g4h.2017.0072

Exergames Designed for Older Adults:
A Pilot
ation on Psychosocial Well-Being

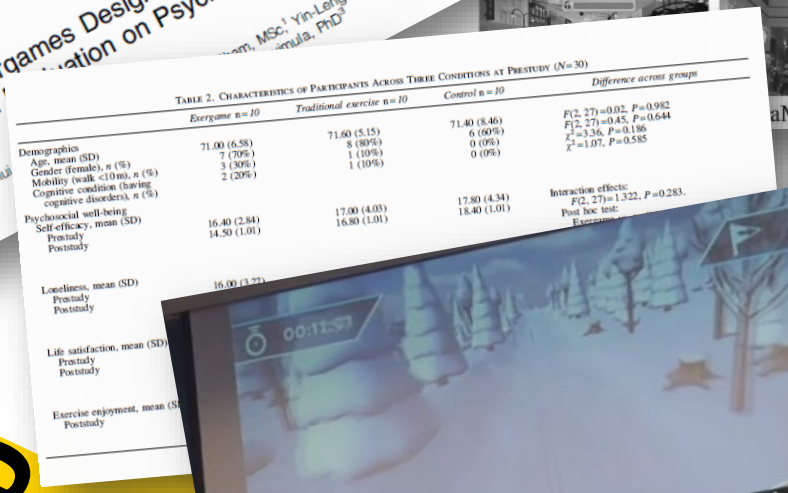
Table 2. Characteristics of Participants Across Three Conditions at Prestudy ($N=30$)

	Exergame n = 10	Traditional exercise n = 10	Control n = 10	Difference across groups
Demographics				
Age, mean (SD)	71.00 (6.58)	71.60 (5.15)	71.40 (8.46)	$F(2, 27)=0.02$, $P=0.982$
Gender (female), n (%)	7 (70%)	8 (80%)	6 (60%)	$F(2, 27)=0.45$, $P=0.644$
Mobility (walk <10 m), n (%)	3 (30%)	1 (10%)	0 (0%)	$\chi^2=3.36$, $P=0.186$
Cognitive condition (having cognitive disorders), n (%)	2 (20%)	1 (10%)	0 (0%)	$\chi^2=1.07$, $P=0.585$
Psychosocial well-being				
Self-efficacy, mean (SD)				Interaction effects:
Prestudy	16.40 (2.84)	17.00 (4.03)	17.80 (4.34)	$F(2, 27)=1.322$, $P=0.283$.
Poststudy	14.50 (1.01)	16.80 (1.01)	18.40 (1.01)	Post hoc test:
Loneliness, mean (SD)				
Prestudy				
Poststudy				
Life satisfaction, mean (SD)				
Prestudy				
Poststudy				
Exercise enjoyment, mean (SD)				
Poststudy				

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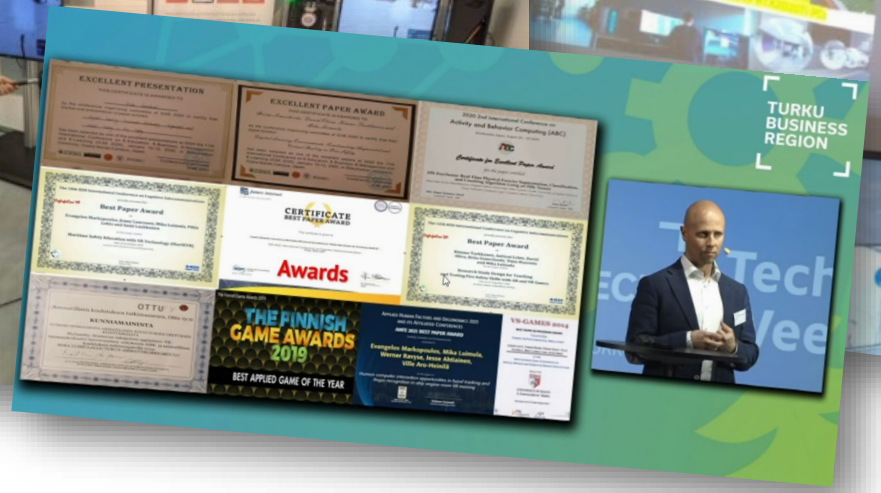
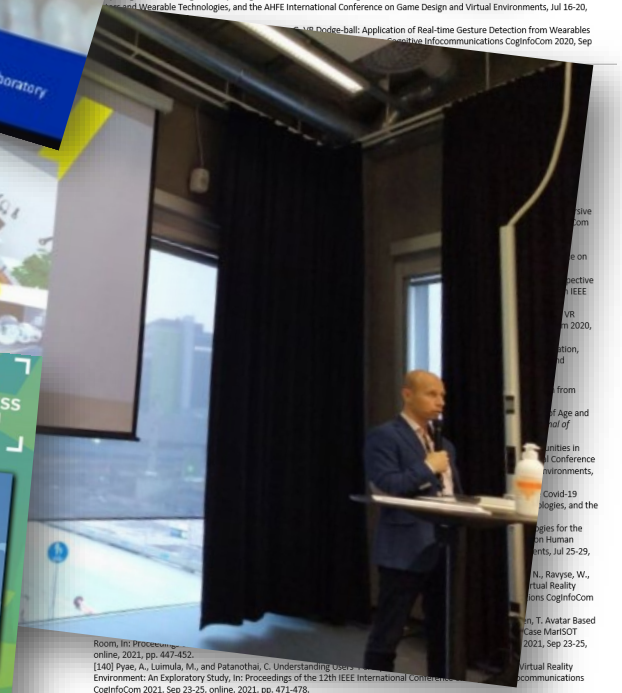
Future of Learning:





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Three Principles

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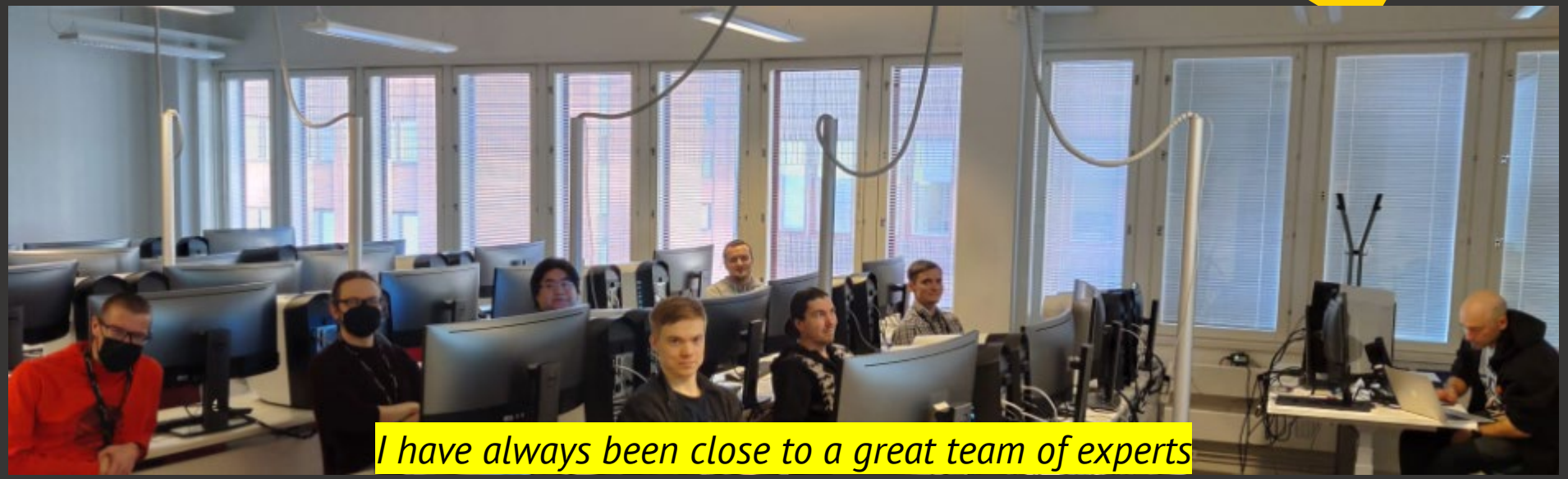
#1 - Excellent Colleagues



I have always been close to a great team of experts

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#2 – Money Talks

Without funding not able to develop education, to do research, to travel, to invest etc.

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#3 – Thinking Big

When there is a chance to say, to show, or to do something (that is to say to shine) not a single stone will be left unturned.

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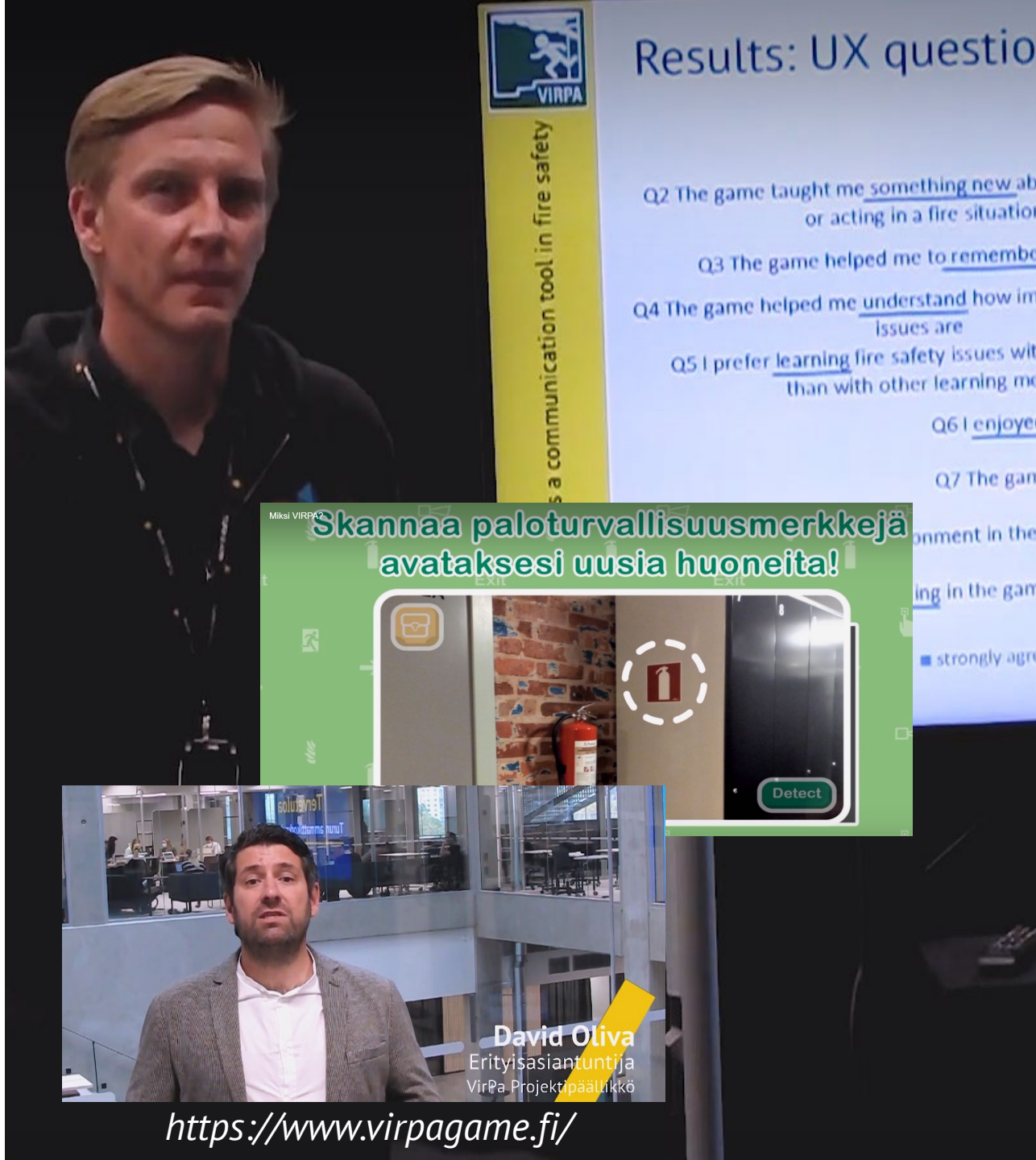
Latest Results and Future Directions

Example of The Award-Winning Project

- *Utilized virtual reality – possible to operate in hazardous scenarios*
- *Finding alarming results (Oliva et al., 2019)*
- *Utilized augmented reality – forcing physical visits in task locations*
- *Developed own AR technology (utilizing machine learning)*
- *Excellent example of RDI integrated education*
- *End users in the center*



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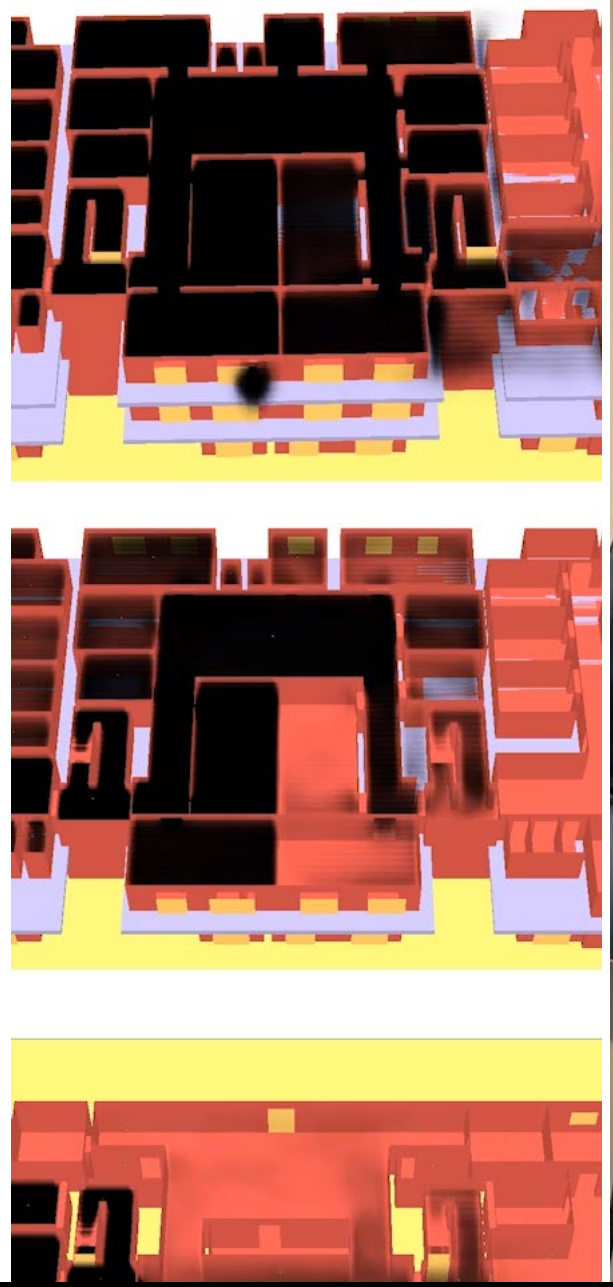
he main door. Situation awareness (N1), and time spent to leave the initial room (N2 nd N3), show a clear relationship with those who died or survived. Also looking at xit signs and floor plans (N9 and N10) and avoiding smoke (N13) seem to have a elationship with survival chances.

Table 1. Results from the four groups; all, survivors and dead as average percentages.

		children	young adult	adult	firemen	ALL	survivors	dead
Participants (N)		51	34	17	67	169	108	61
N1 Player reacts immediately to the alarm	(%)	47.1	41.2	52.9	59.7	51.5	70.4	18.0
N3 Player doesn't leave the room within 20 sec	(%)	86.3	79.4	70.6	65.7	75.1	67.6	88.5
N4 Player doesn't leave the room within 40 sec	(%)	56.9	58.8	41.2	43.3	50.3	30.6	85.2
N5 Player interacts with NPC after the alarm	(%)	82.4	94.1	82.4	92.5	88.8	88.9	88.5
N6 Player calls 112 to inform about fire alarm	(%)	2.0	5.9	0.0	6.0	4.1	1.9	8.2
N7 Player takes along personal belongings	(%)	7.0	3.9	3.9	1.3	3.0	3.7	1.6
N8 Player takes extinguisher from the wall	(%)	13.7	11.8	5.9	10.4	11.2	11.1	11.5
N9 Player makes eye contact with escape signs	(%)	3.9	20.6	23.5	16.4	14.2	16.7	9.8
N10 Player looks building floor plan in the wall	(%)	27.5	38.2	47.1	59.7	44.4	50.9	32.8
N11 Player takes elevator despite the fire alarm	(%)	2.0	0.0	0.0	0.0	0.6	0.9	0.0
N12 Player changes the wing of the building	(%)	27.5	8.8	23.5	22.4	21.3	27.8	9.8
N13 Player was in the smoke at least temporarily	(%)	86.3	85.3	94.1	88.1	87.6	80.6	100.0
N14 Player founds the blocked escape exit	(%)	17.6	38.2	23.5	41.8	32.0	29.6	36.1
N15 Player exits the building by any door	(%)	62.7	44.1	70.6	62.7	59.8	93.5	0.0
N16 Player exits the building by the main entrance	(%)	27.5	17.6	29.4	11.9	19.5	30.6	0.0
N17 Player exits the building by an escape door	(%)	35.3	26.5	41.2	50.7	40.2	63.0	0.0
N18 Player dies	(%)	33.3	52.9	23.5	32.8	36.1	0.0	100.0
N19 Player tapes the door with tape (shelter)	(%)	3.9	2.9	5.9	4.5	4.1	6.5	0.0

he averaged results of the UX questionnaire, questions Q2–Q9 based on all partici-ants, are presented in Figure 5. Overall, over 70 and 80% agreed that the game was ffective to remember and to understand fire safety issues (Q3, Q4) and over 60% de-lared that VR could be more interesting than traditional methods to learn fire safety Q5). Regarding enjoyment, playability, truthfulness and immersion (Q6, Q7, Q8, Q9 espectively), over 60% in all groups rated them positively. Less than a half of the re-pondents felt they learned something new (Q2).

Fig. 5. Subjective measures of player experiences in UX questionnaire.



Serious fire escape challenges

Oliva et al. (2019)

Hazardous Training Scenarios

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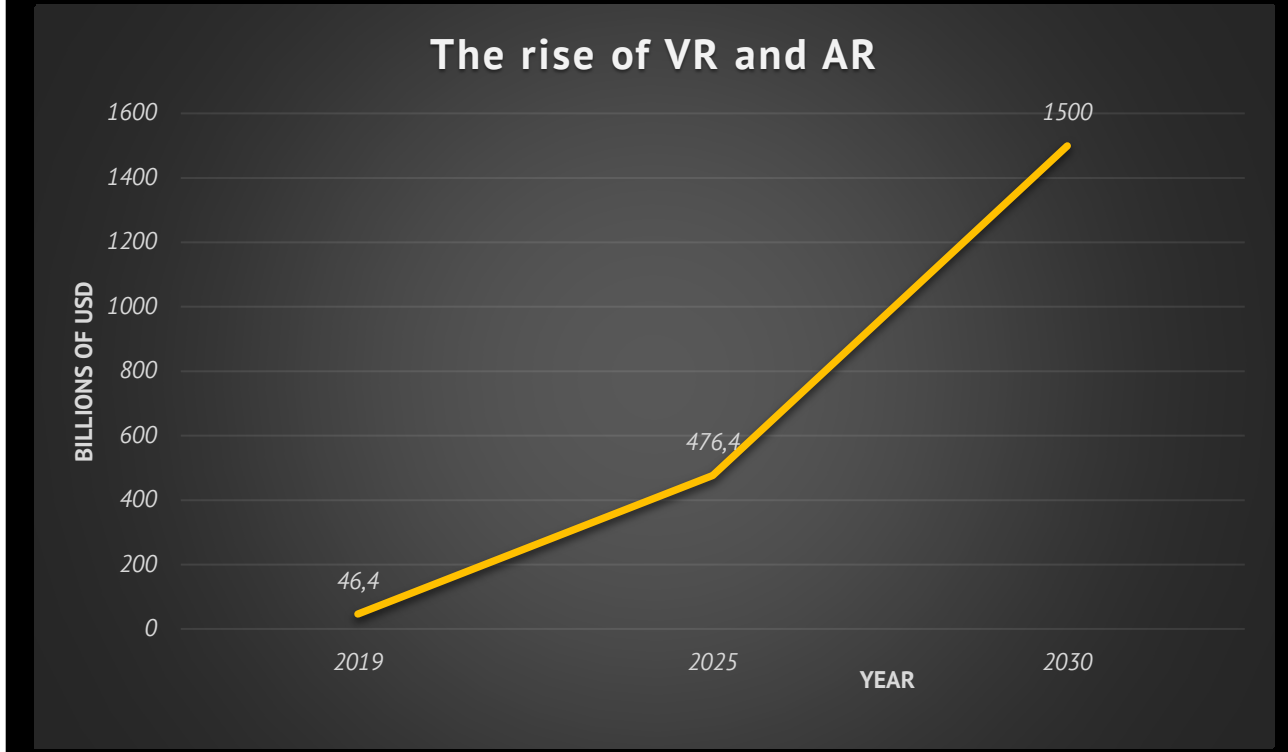
Metaverse Is Coming - Why Do We Need It in Turku?

This timeline illustrates what's happening in the consumer business

20 May 2020 – “Flight simulators are amongst the most vulnerable verticals hit by COVID-19 pandemic” (AviationPros.com)?



Before COVID-19: VR and AR have the potential to boost GDP globally by 2030 by up to $1.5 trillion (PwC Seeing is believing report, 2019)

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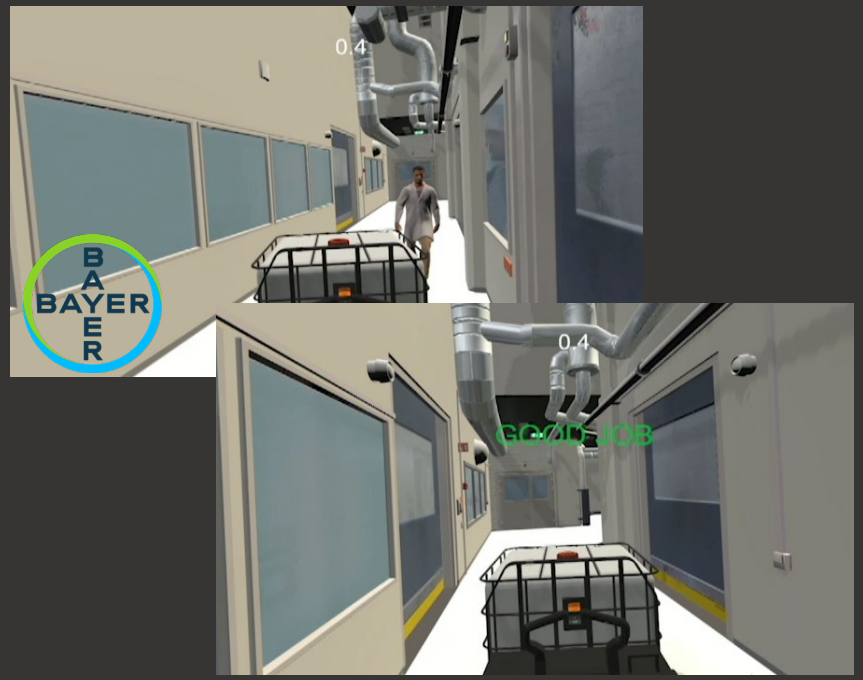
Metaverse in Turku?



Markopoulos et al. (2020) Virtual Reality (VR) Safety Education for Ship Engine Training on Maintenance and Safety (ShipSEVR)

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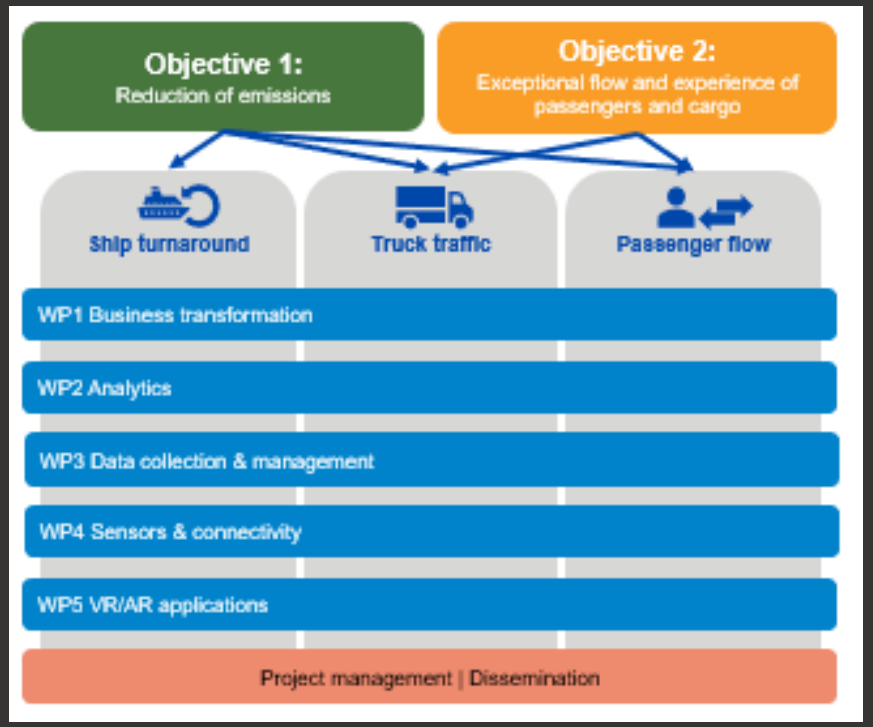
Example Metaverse in Marine Industry?



Yes, we are already studying how to utilize metaverse in marine industry

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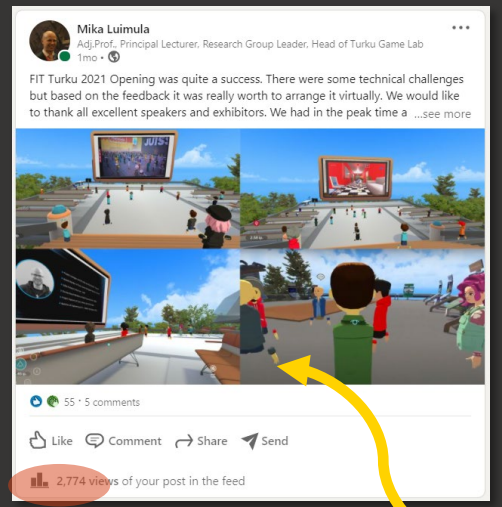
Metaverse – Our Approach



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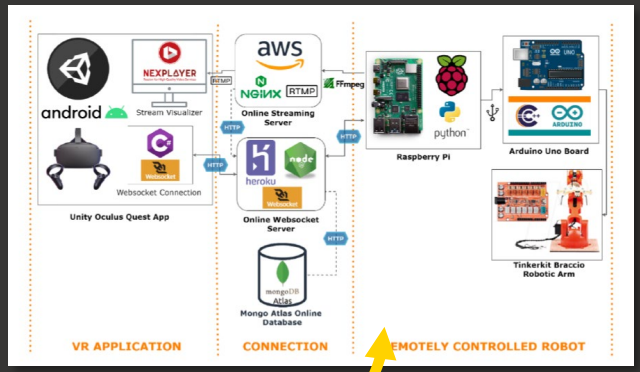

Victor Blanco Bataller (2021) Using Virtual Reality to Control a Robot Remotely

Metaverse = social communication + hands-on-training + real-life integration (Luimula et al, 2022)

This timeline illustrates what's happening in the consumer business

... how much time do we need before we have metaverse in shipbuilding?

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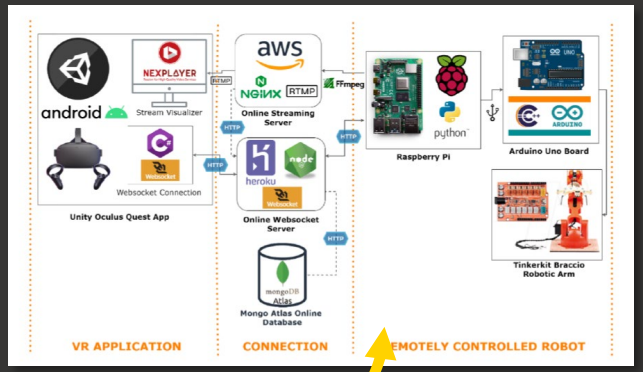
Example Metaverse in Marine Industry?

Luimula et al. (2020) Unlimited Safety Productivity - A Finnish Perspective Using Virtual Learning Methods to Improve Quality and Productivity in the Construction Industry



Victor Blanco Bataller (2021) Using Virtual Reality to Control a Robot Remotely

Metaverse = social communication + hands-on-training + real-life integration (Luimula et al, 2022)

- *Yes, we need better ways to be present remotely, can we even sell while using Teams or Zoom?*
- *Yes, we are struggling in competence management, how to renew competence cards during lockdowns?*
- *Yes, we generate challenges once sending the best expert for weeks abroad, how about sustainability?*

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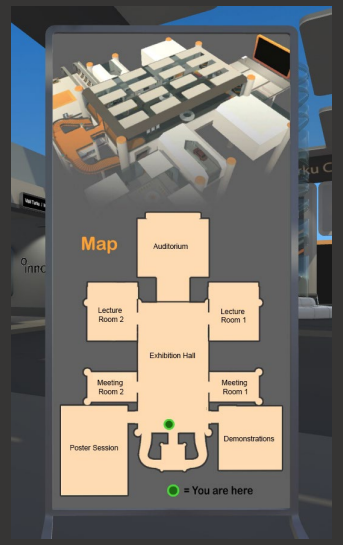
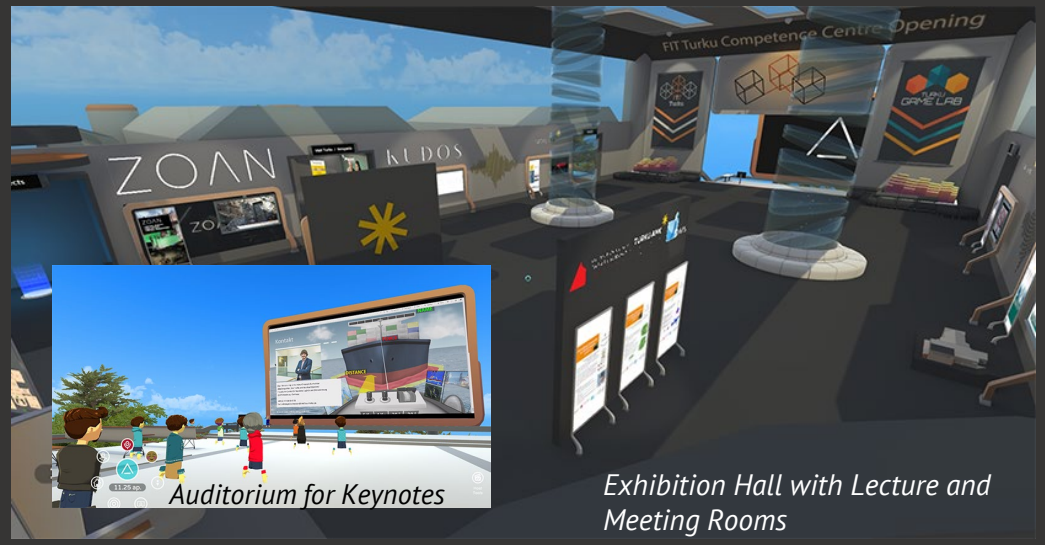
Our Approach

First Testing Existing Technologies





?

This story started in TechTurkuWeek 2021…

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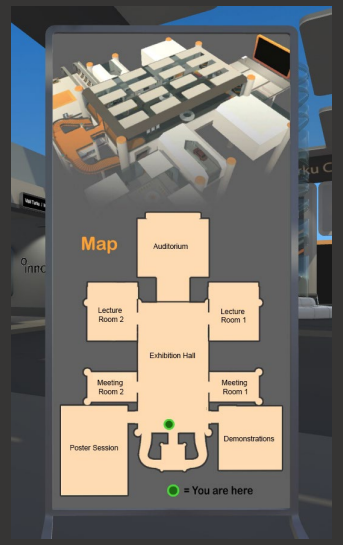
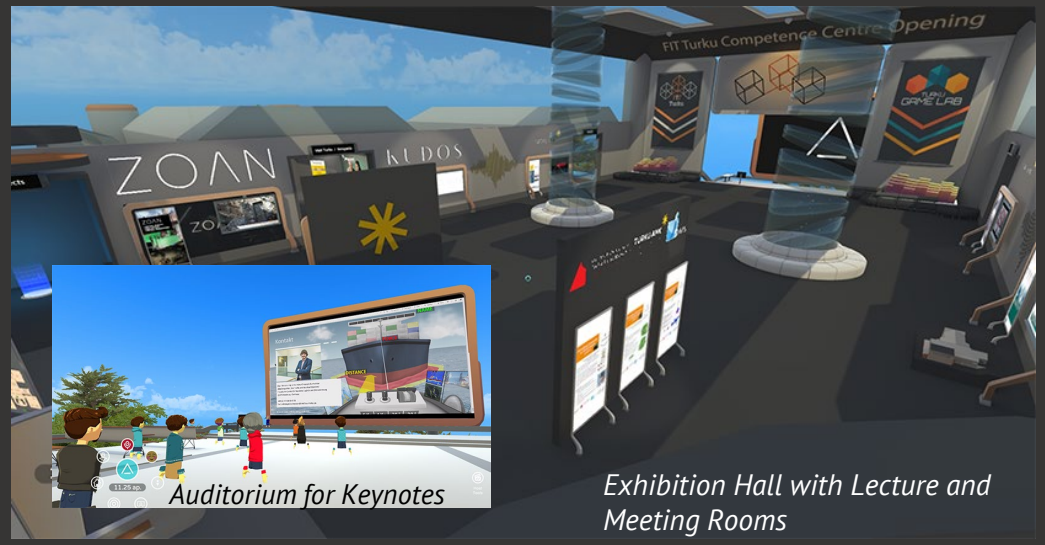
Our Approach

First Testing Existing Technologies





Not suitable for marine industry

- *Limited number of users*
- *Complicated registration*
- *No hands-on-experiences*
- *And much more challenges identified*

Markopoulos et al. (2021) Understanding How Users Engage in an Immersive Virtual Reality-Based Live Event

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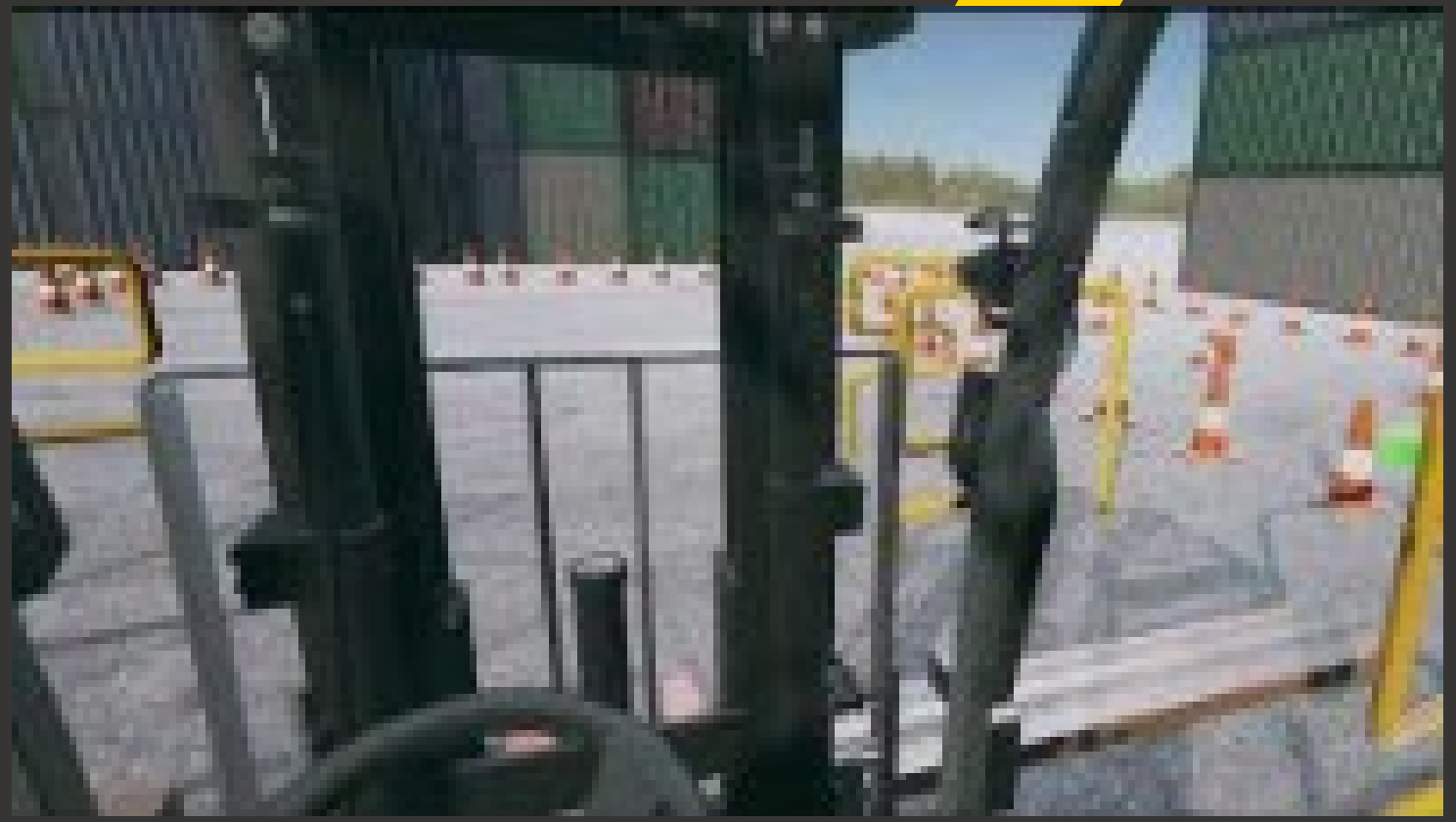
Virtual Training – Business Already Running in Single User Mode

Ade together with Kiwa have developed various competence cards where virtual reality is applied in hands-on-training



https://www.facebook.com/ADEturku/videos/suorita-trukkikortti-k%C3%A4tev%C3%A4sti-verkkokoulutuksenaaden-ja-kiwa-suomi-toteuttamass/937987703503815

Our Approach

Creating First Own Prototypes

Towards Metaverse – Virtual Training and Social Interaction

- *Students or employees are able to work together in teams and solve challenges in multi player scenarios*

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Our Approach

Creating First Own Prototypes (Luimula, et al. 2022)

Massive number of users with voice communication and hands-on-experiencing

Advanced virtual object manipulation

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Our Approach

Integrating Metaverse Technology to Existing Training Scenarios

Virtual Classroom in metaverse – enabling lectures but also collaborative training scenarios
Technology tested between Turku and Karlsruhe in Feb 2022

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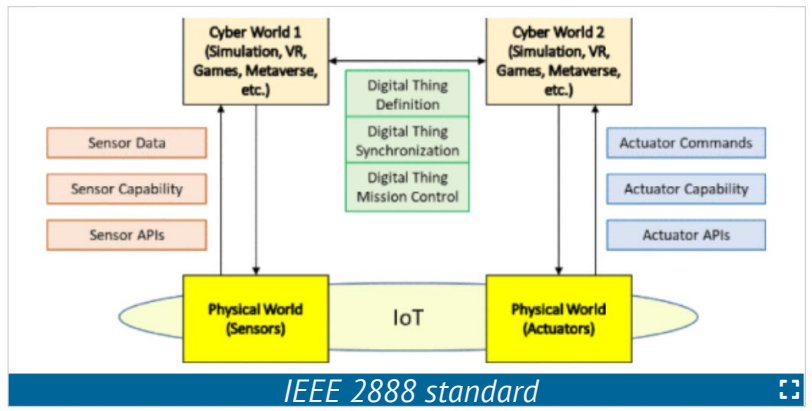
Our Approach

IoT Integration for Remote Control

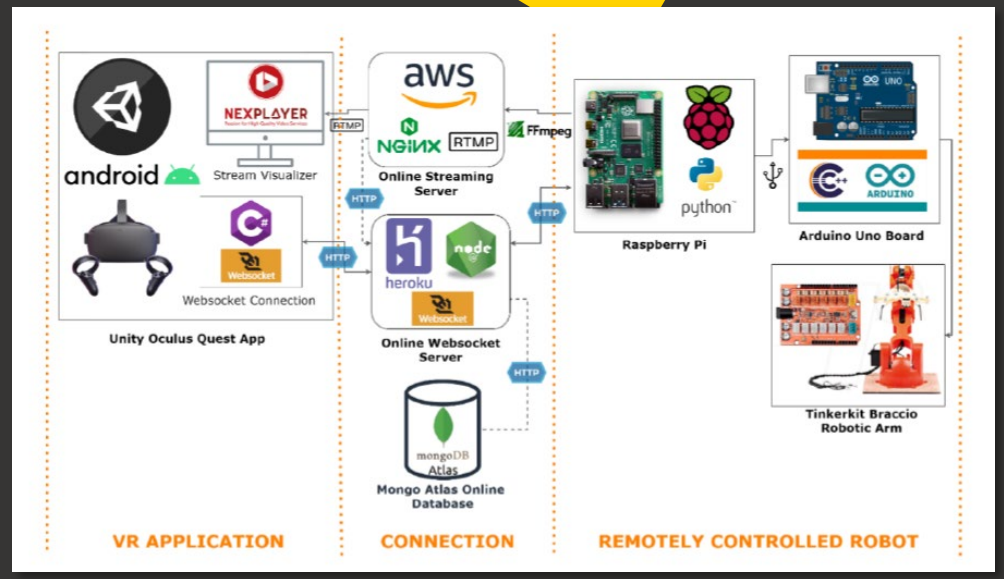


Head-mounted Display Market worth $36.5 billion by 2026, at a CAGR of 46.0%

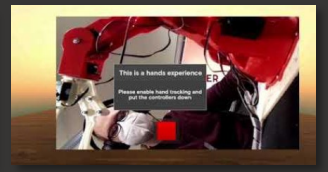
Industry 4.0 Market worth $165.5 billion by 2026 with COVID-19 Impact Analysis

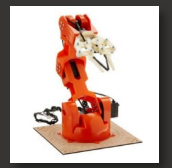
Digital Twin Market worth $48.2 billion by 2026, at a CAGR of 58%

MarketsandMarkets (2021)



Victor Blanco Bataller (2021) Using Virtual Reality to Control a Robot Remotely



Our Approach

IoT Integration for Remote Control

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