Autonomous Greenhouse Challenge – Final result

AgriFoodTech 12&13 December 2018, Den Bosch, The Netherlands

Silke Hemming, WUR

WAGENINGEN UNIVERSITY & RESEARCH

Tencent 腾讯

Artificial intelligence & cucumber production

Worldwide first international challenge
Benchmark experiment
Grow cucumbers remotely with AI

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Organisor
Data collection & analysis

WAGENINGEN UNIVERSITY & RESEARCH (WUR)

Sponsors

Tencent

DAVID WALLERSTEIN

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Tech-partner LetsGrow.com YOU'RE IN CONTROL

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The challenge

www.autonomousgreenhouses.com

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Teams

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iGrow


ADOLE-
SCENTS
PAKKETJE
SONOMA
Sonoma


the cr p erators

The Growing Experiment

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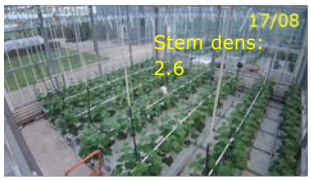
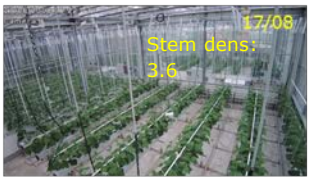
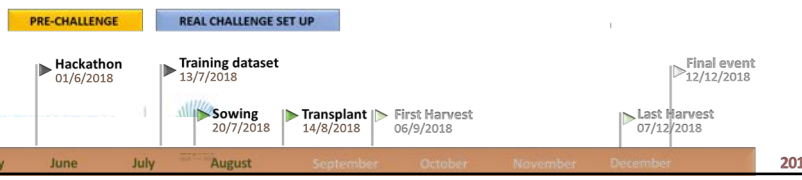
Preparing the autonomous greenhouses..





Different decision since the beginning..



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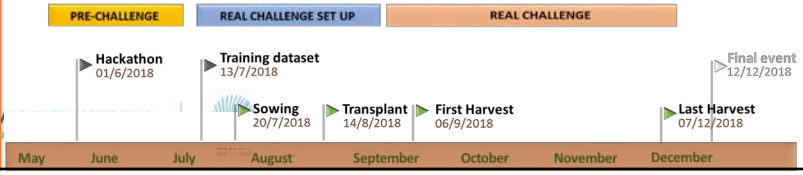
Additional sensors..

- RGB camera
- Thermal camera (own design)
- wireless sensor networks (own design
- Root zone sensors
- Net radiation sensor
- crop and substrate weighing sensors
- Crop sap flow meters, stem diameter
- no sensors



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All the plants alive after 1 month..






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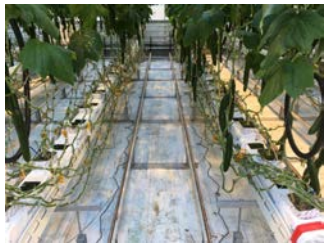
..and until the end..





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..and productive

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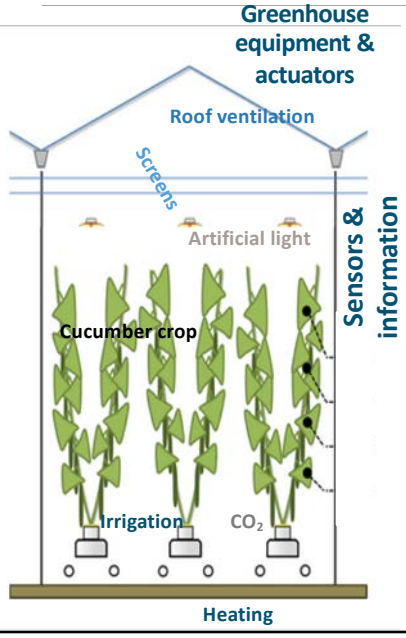
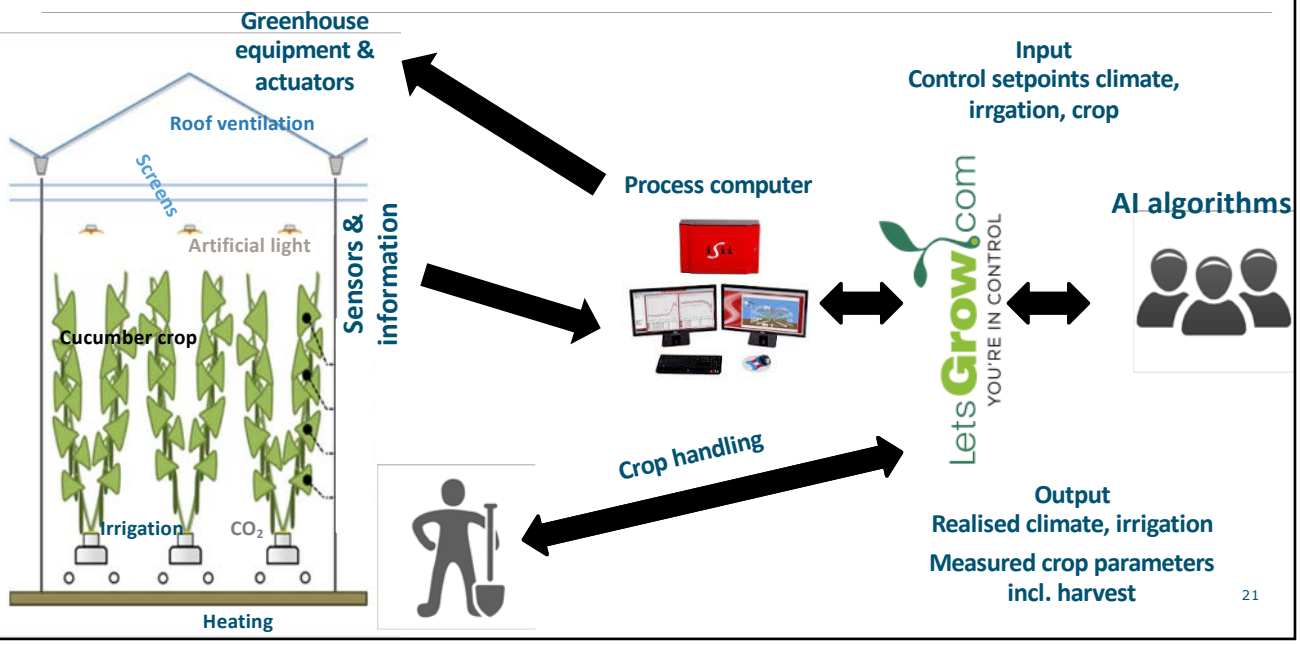
Greenhouse actuators-sensors



Greenhouse actuators-sensors-setpoints-AI

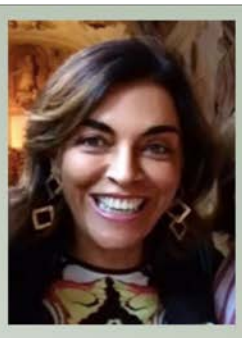


Judgement

Our jury

Jaco den Bakker- Cucumber grower from Brielle, Netherlands. Studied Horticulture and Plant Sciences at the Wageningen University

Marco Bressan- Chief Data Scientist in Satellogic where he is bringing together a team of AI experts to build a planet-scale real-time analytics platform



Stefania De Pascale- full professor at the Department of Agricultural Sciences (DAS) in the University of Naples Federico II

Eldert J. van Henten - full professor and head of the Farm Technology Group at Wageningen University since 2005

Leo Marcelis- full professor Horticulture and Product Physiology at Wageningen University

Judgement criteria

Teams get points for:

1. Net profit (**50%**)
2. Sustainability factor (**20%**)
3. AI strategy (**30%**)

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Sustainability

- Counts for 20%, thus factor x2
- Aspects to consider are:
  - Energy use efficiency (MJ/kg cucumber)
  - CO_2 dosage (kg/ha)
  - Water use efficiency (m^3/kg cucumber)
  - Pesticide usage as registered

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AI strategy

- Counts for 30%, thus factor x3
- Aspects to consider are:
  - Novelty with respect to overall scientific community, novelty with respect to application on horticultural domain (**novelty**)
  - Capacity to operate autonomously on a distance without manual interventions (**functionality**)
  - Capacity to operate without too many additional sensors or information (**robustness**)
  - Easiness of implementation on large scale (**scalability**)
  - Any other aspect the jury might find relevant

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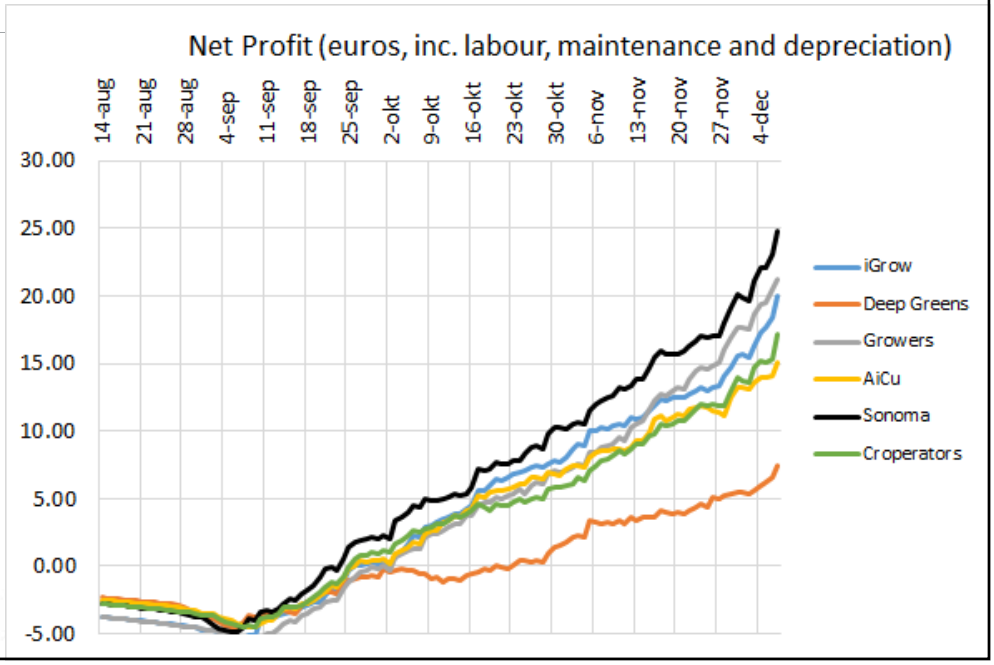
Results

Net profit



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	Net profit	
	Score (1-5, 5=best), Ranking	Weighing factor (x5)
AiCU	2	10
deep_greens	1	5
iGrow	4	20
Sonoma	5	25
The Croperators	3	15

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Sustainability factors

	iGrow	deep_ greens	Growers	AiCU	Sonoma	The Croperators
Kg CO_2/ Kg cucumber	0.20	0.47	0.20	0.26	0.20	0.29
kWh electricity/ Kg cucumber	3.12	4.39	3.02	3.17	3.59	3.82
kWh heat use/ Kg cucumber	2.94	13.61	3.20	3.13	2.49	4.87
L water use/ Kg cucumber	5.89	5.87	5.52	7.62	4.91	5.98
mL pesticide/ Kg cucumber	0.39	0.49	0.34	0.48	0.35	0.35

Weighing factor by jury:
0.25 for electricity, heat, water
0.125 for CO_2, pesticides

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	Sustainability factor	
	Score (1-5, 5=best), Ranking	Weighing factor (x2)
AiCU	3	6
deep_greens	1	2
iGrow	4	8
Sonoma	5	10
The Croperators	2	4

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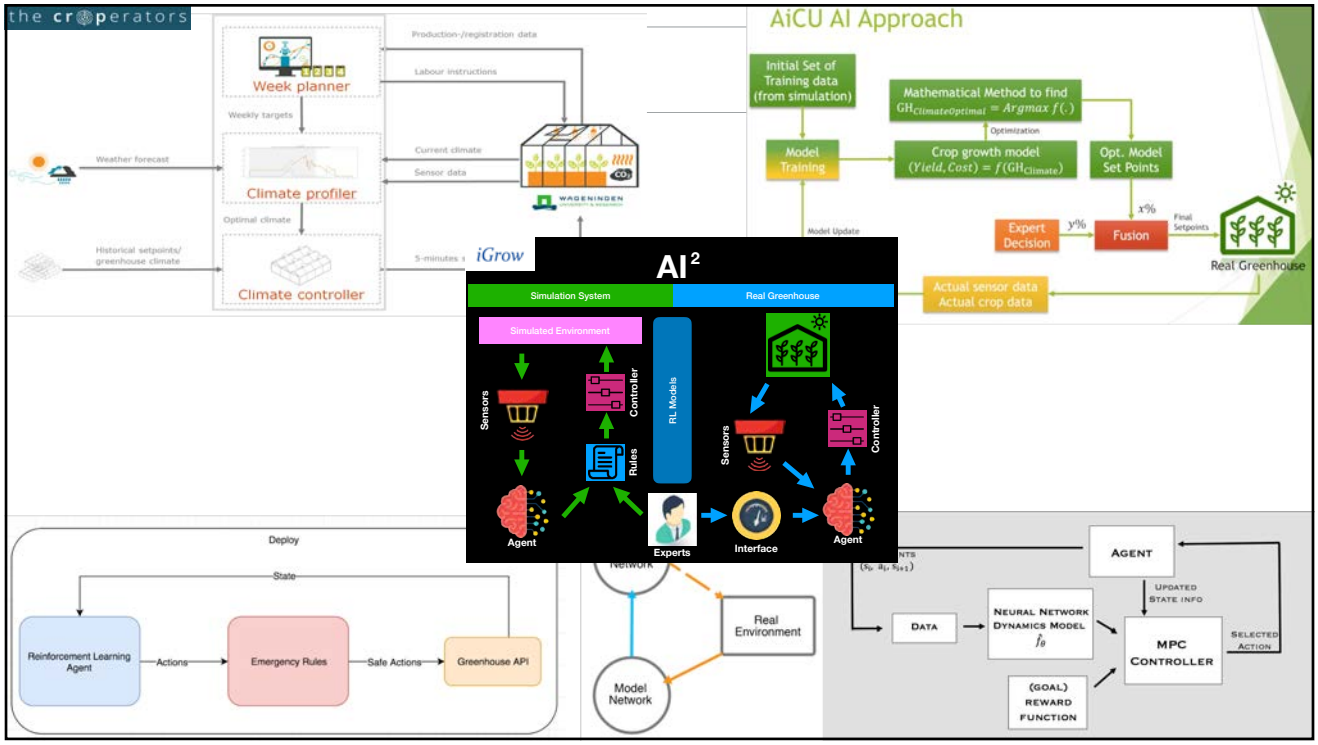

	AI strategy	
	Score (1-5, 5=best), Ranking	Weighing factor (x3)
AiCU	2	6
deep_greens	1	3
iGrow	5	15
Sonoma	3	9
The Croperators	4	12

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Final ranking

	Total (max. 50)
AiCU	22
deep_greens	10
iGrow	43
Sonoma	44
The Croperators	31

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Lessons learned

- AI can beat the grower
- Sensors needed for automated measurements
- *NOTE: no extended AI testing yet, no upscaling yet, no other crops, no pest and diseases, no automated crop handling*

Visit our booth!

Thanks to all colleagues:
Feije de Zwart, Anne Elings, Isabella Righini, Anna Petropoulou, Sjaak Bakker, Kees Scheffers, Fred van Leeuwen, Johan van der Eijk, Hanjo Lekkerkerk, Gert Vletter, Denise Huyskes, Rob Pret Ben Kaashoek, Piet Koornneef, Wim van Wensveen, Peet Grootscholte, Bram van Haaster, Aat van Winkel, Chantal Pont, José Frederiks