

How AI and MATLAB Are Helping Winegrowers Analyse Bushfire Smoke Contamination

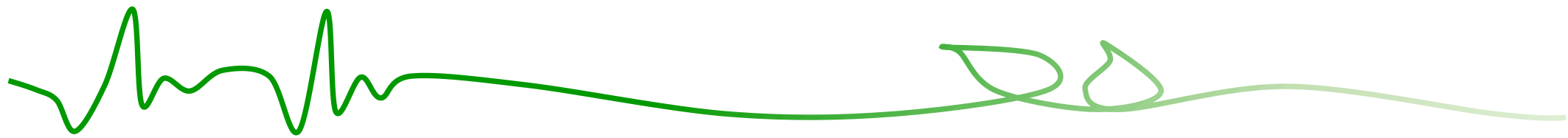
Sigfredo Fuentes

sfuentes@unimelb.edu.au

Associate Professor in Digital Agriculture,
Food and Wine Sciences

[https://www.researchgate.net/profile/Sigfredo Fuentes](https://www.researchgate.net/profile/Sigfredo_Fuentes)

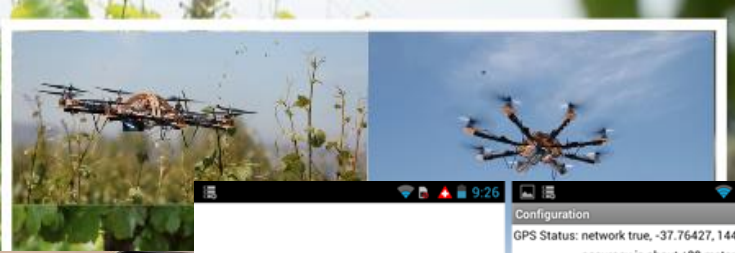
School of Agriculture and Food



The vineyard of the future initiative

www.vineyardofthefuture.com

Future



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Digit



Inspector Paw
100,000 times better than human

Configuration
GPS Status: network true, -37.76427, 144.95911
accuracy is about ±39 meters
TimeNow: 13/07/2017 09:28:01 PM

Inspecting
Dog Sit Angle \gg Y: 52.85296 Degrees
Trigger Timer: 2 Second(s)

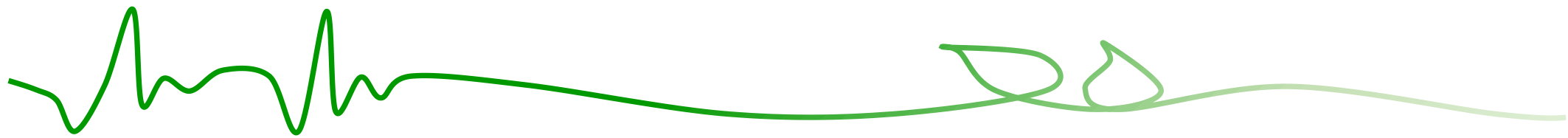
Inspecting
Dog Sit Angle: 12.99554 degrees
Dog Sit Duration: 0 seconds
Latitude: -37.76432 Longitude: 144.95921

Inspecting
Dog Sit Angle: 27.64739 degrees
Dog Sit Duration: 1 seconds
Latitude: -37.76432 Longitude: 144.95921

Inspecting
Event Logged
Dog Sit Angle: 14.0225 degrees
Dog Sit Duration: 0 seconds
Latitude: -37.76432 Longitude: 144.95921

Dog in the picture: Luther, trained by Sonja
Photo: Sonja Needs


Photo: James Morgan



The vineyard of the future initiative

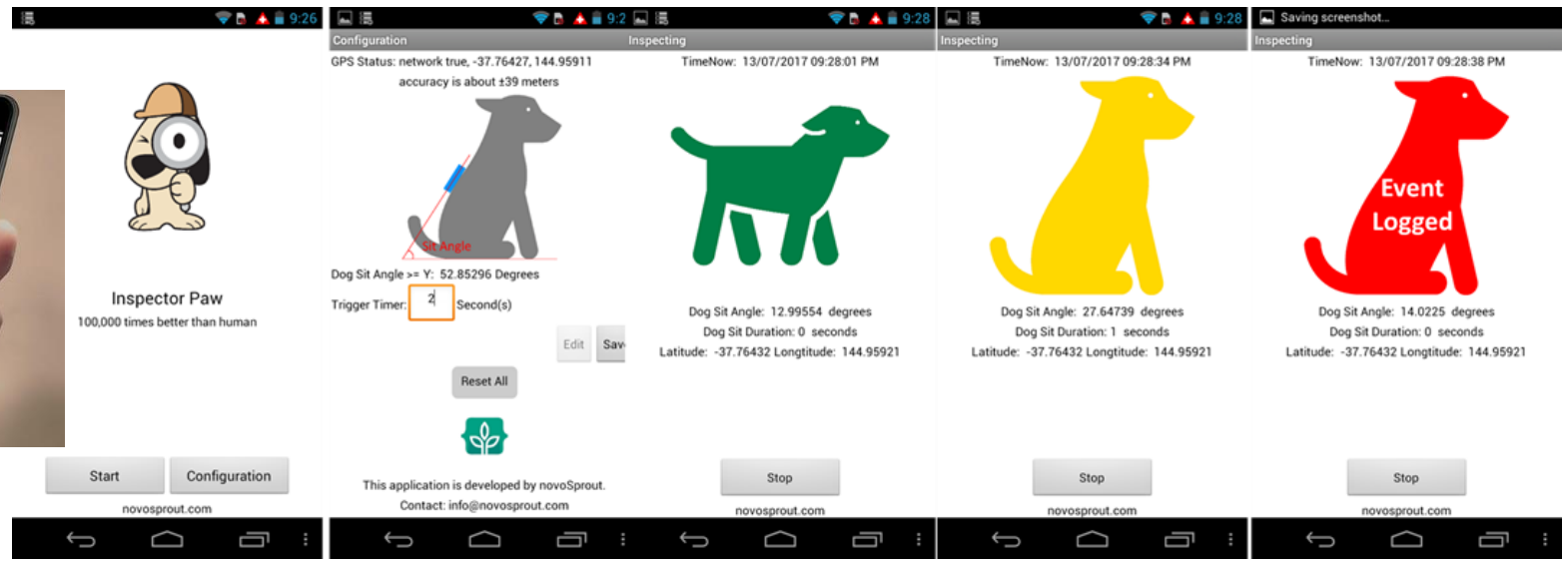
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Inspector Paw
100,000 times better than human

Configuration
GPS Status: network true, -37.76427, 144.95911
accuracy is about ±39 meters
TimeNow: 13/07/2017 09:28:01 PM

Inspecting
Dog Sit Angle \geq Y: 52.85296 Degrees
Trigger Timer: 2 Second(s)
Edit Save
Reset All
This application is developed by novoSprout.
Contact: info@novosprout.com

Inspecting
Dog Sit Angle: 12.99554 degrees
Dog Sit Duration: 0 seconds
Latitude: -37.76432 Longitude: 144.95921

Inspecting
Dog Sit Angle: 27.64739 degrees
Dog Sit Duration: 1 seconds
Latitude: -37.76432 Longitude: 144.95921

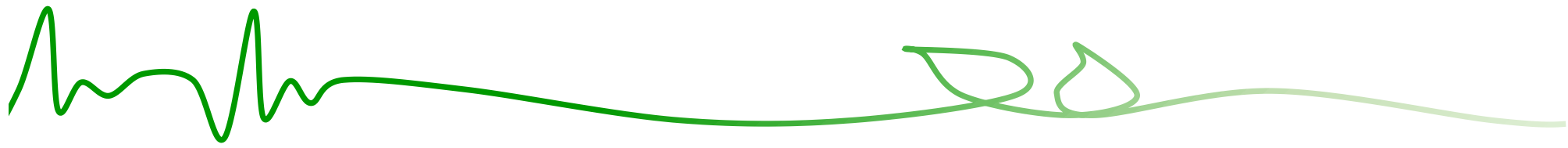
Inspecting
Event Logged
Dog Sit Angle: 14.0225 degrees
Dog Sit Duration: 0 seconds
Latitude: -37.76432 Longitude: 144.95921

Inspector Paw App



Automated Recognition of Cattle Features for Data Extraction

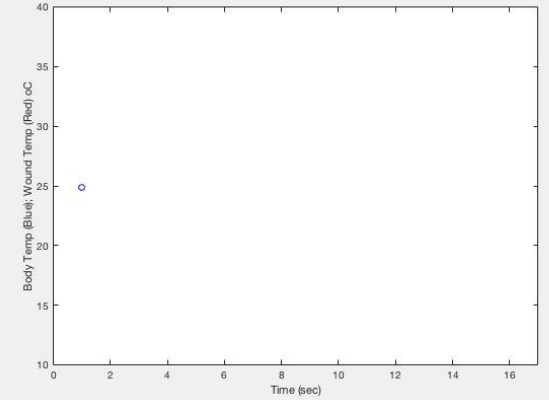
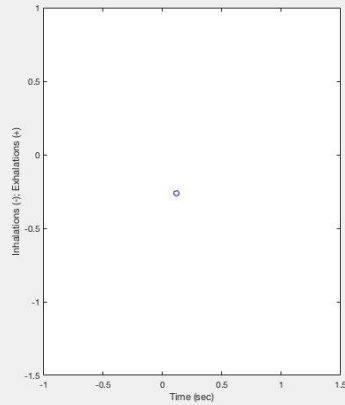
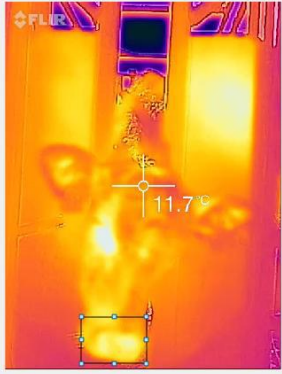




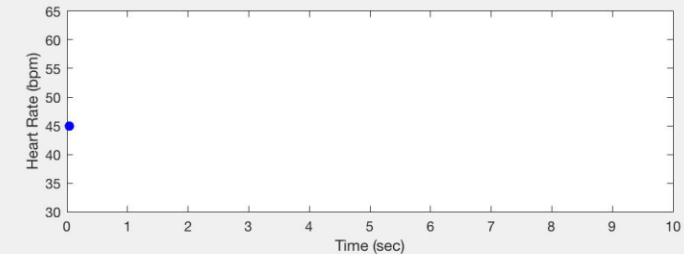
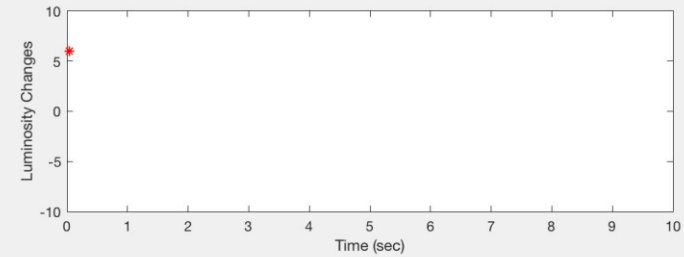
Monitoring Cattle Biometrics

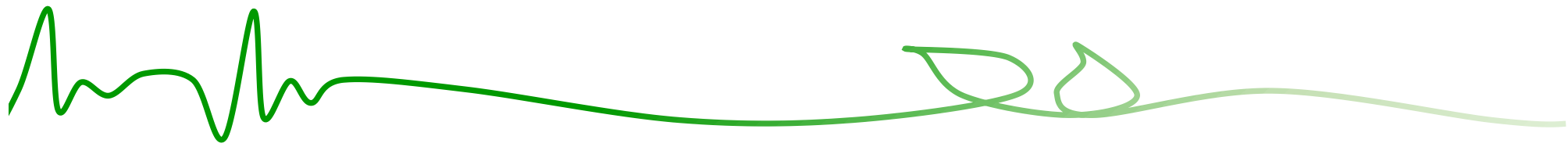
Respiration Rate: IR-Non radiometric

Body Temperature: InfraRed Thermography Radiometric

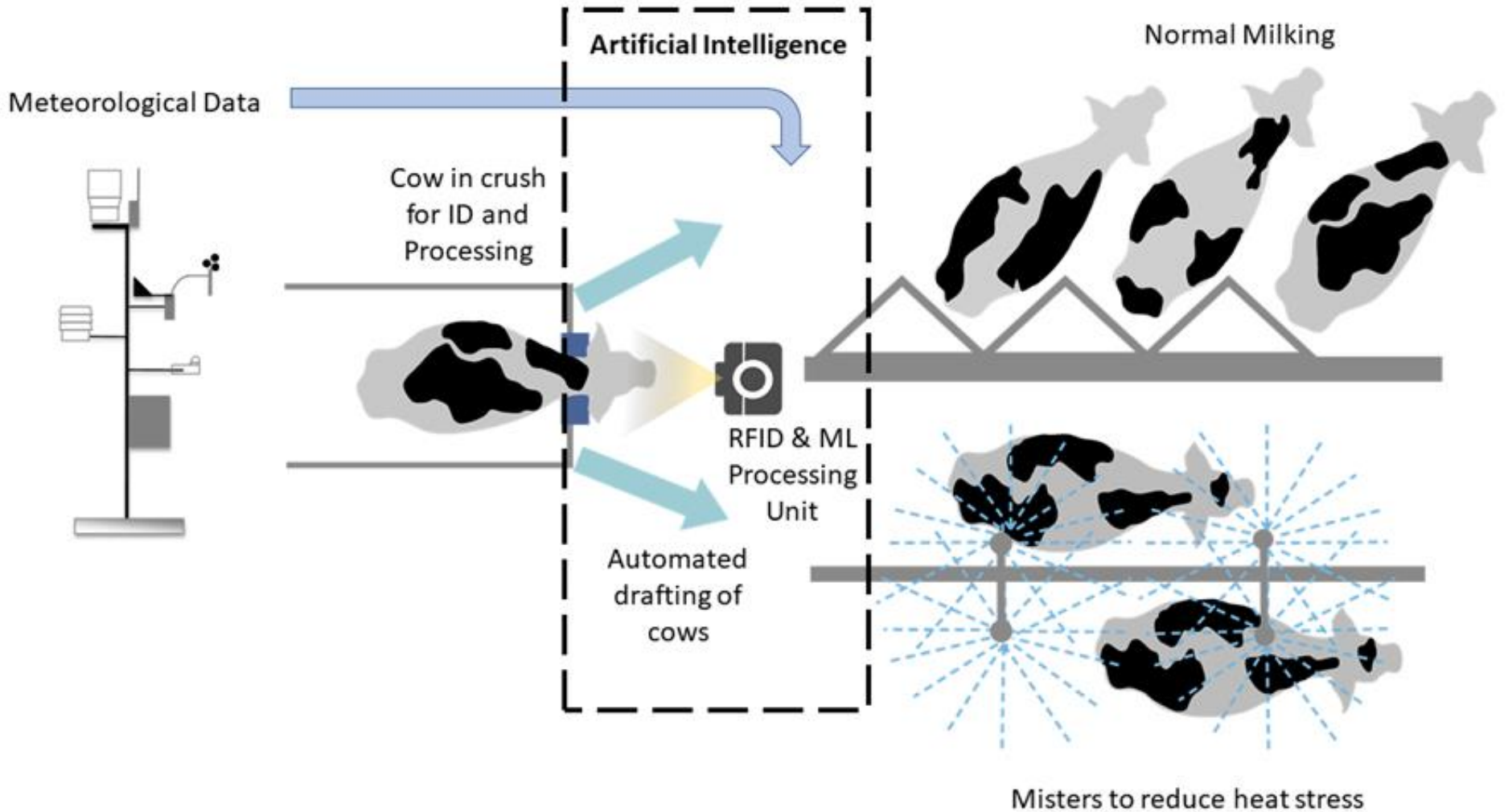


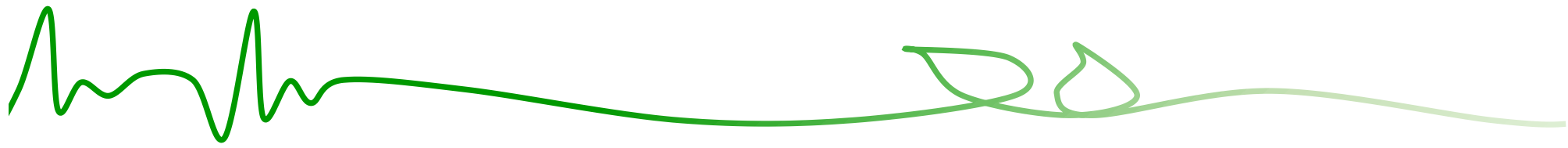
Heart Rate: Video Magnification Analysis



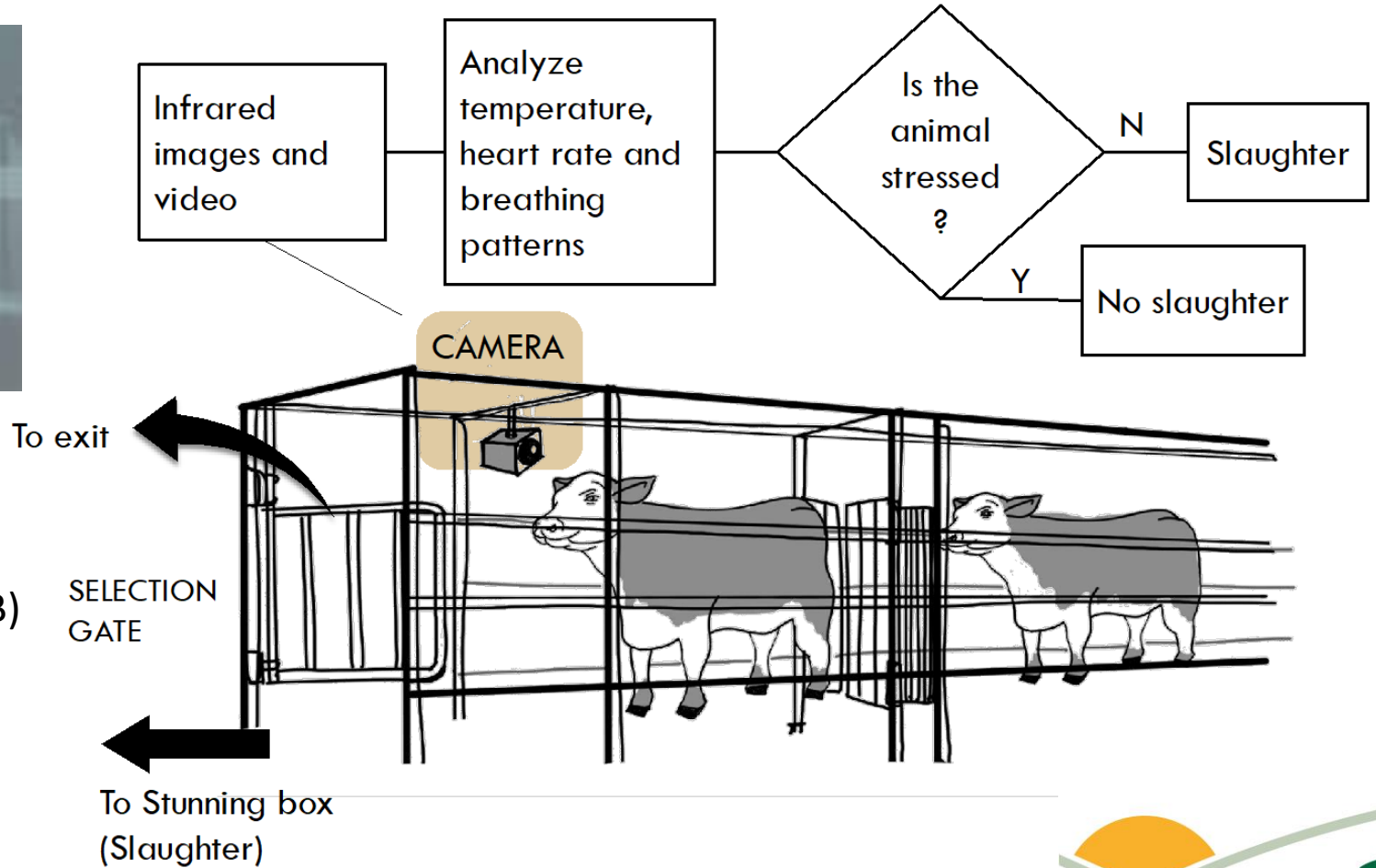


**Big Data and
Machine Learning to
achieve Artificial
Intelligence to
maximize
productivity and
quality of milk in a
robotic dairy farm**



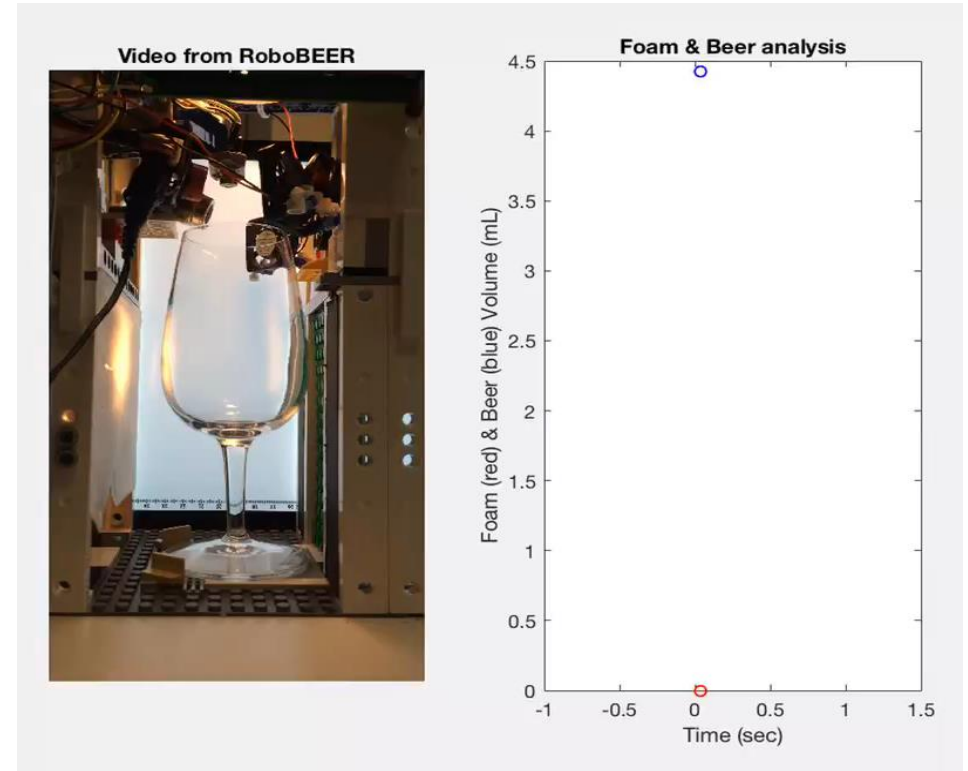
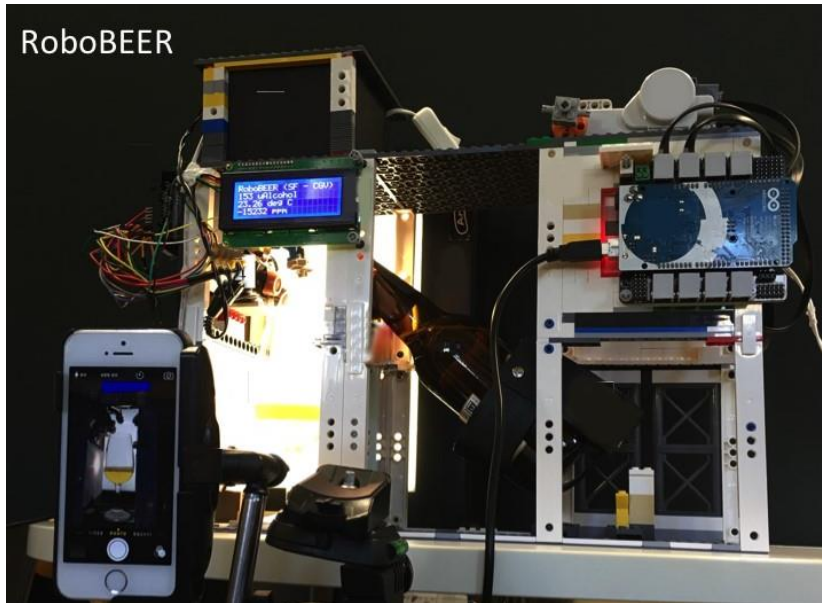


Artificial Intelligence Application to Minimise Dark Cutting Beef (DCB)

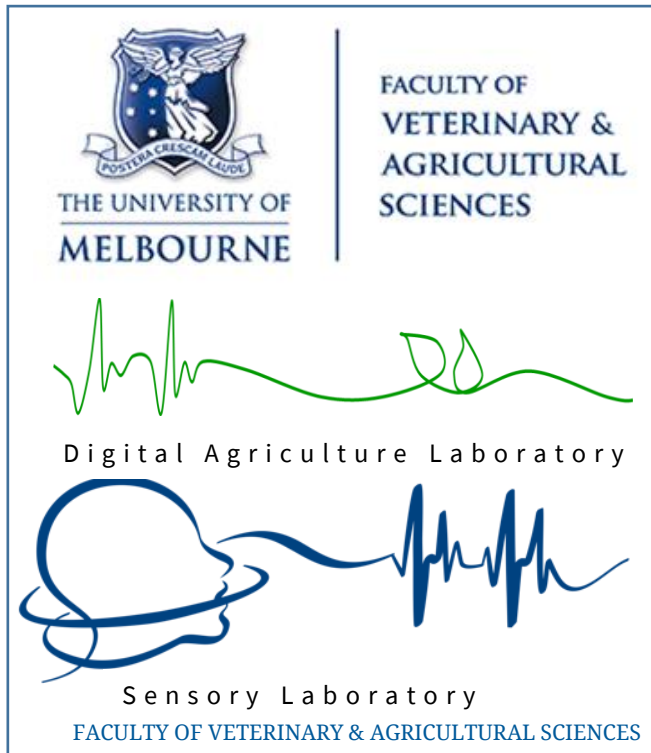


Inputs: Non-contact Animal Biometrics
Target: Minimise Dark Cutting Beef (DCB)

Automatic Robotic Pourer to assess foamability (RoboBEER)



- 14 Peer Reviewed Papers since 2014
- Featured in **Science** and **Forbes** Magazines



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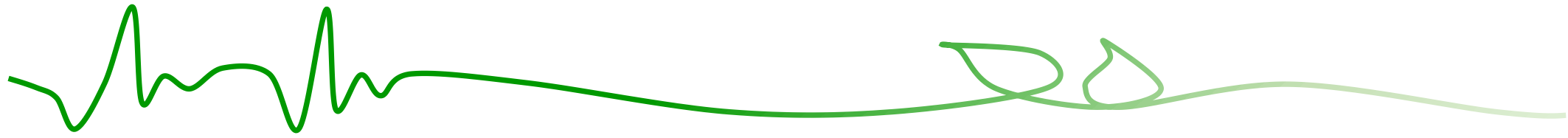
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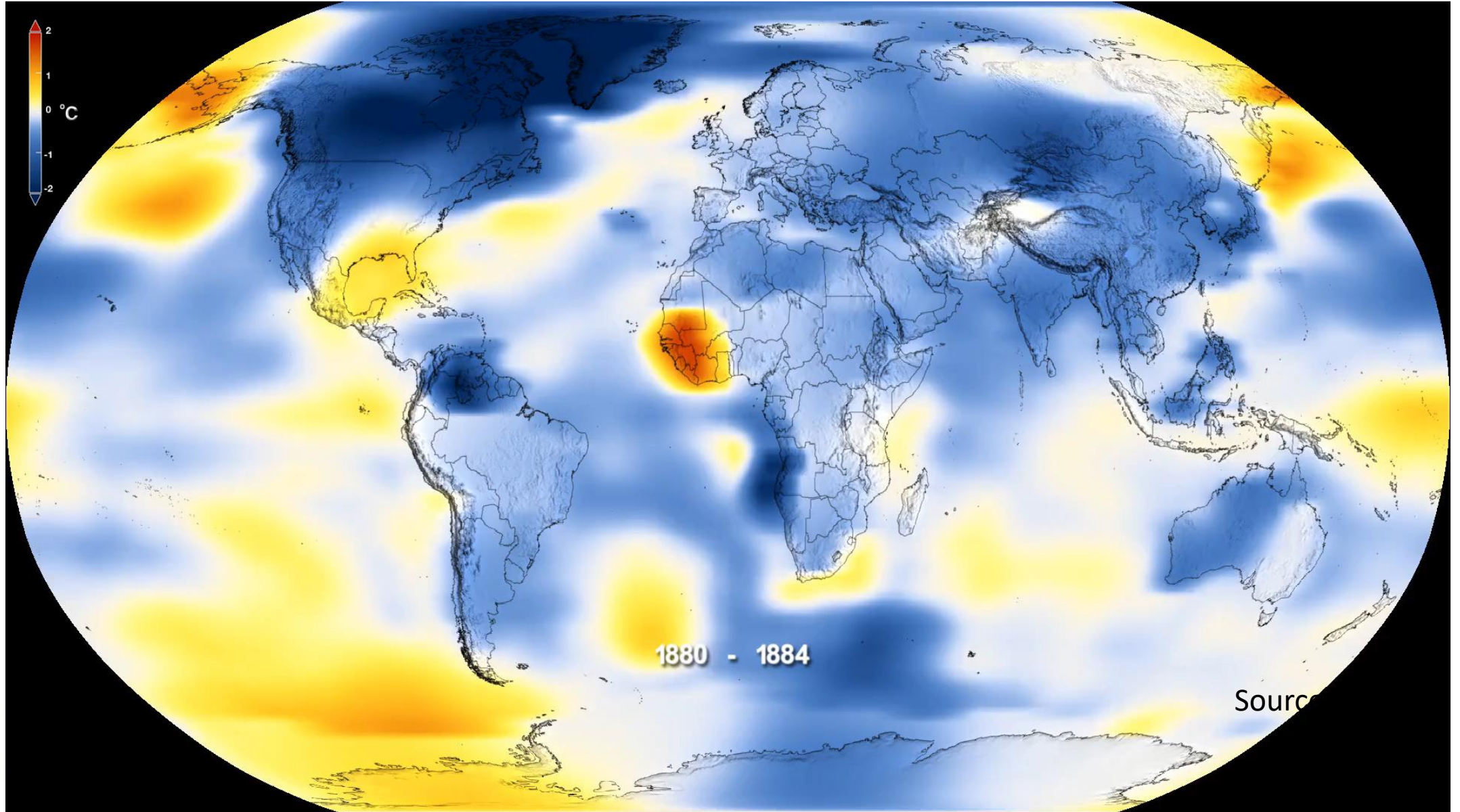
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School of Agriculture and Food



Global Warming

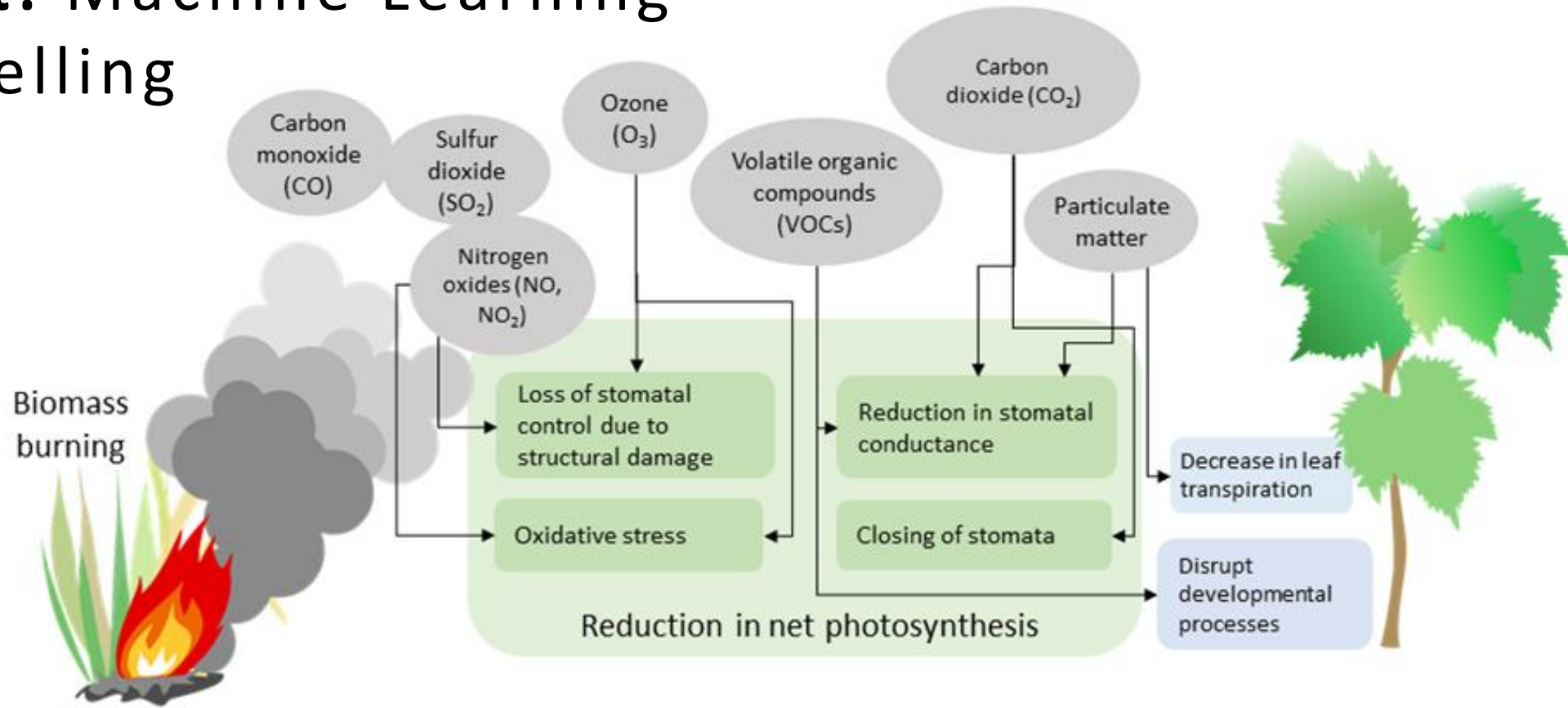


Global Warming Bushfire Events

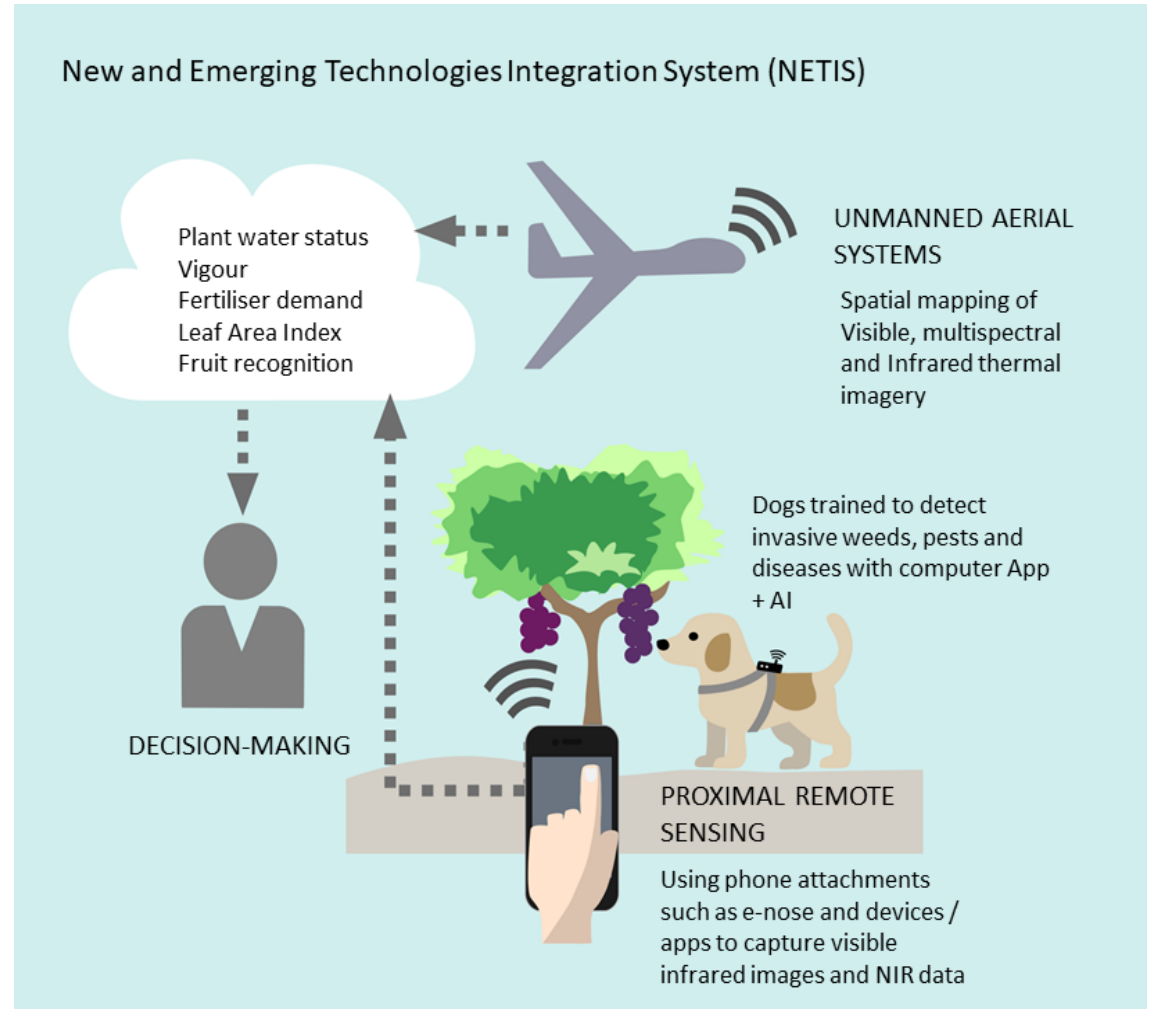
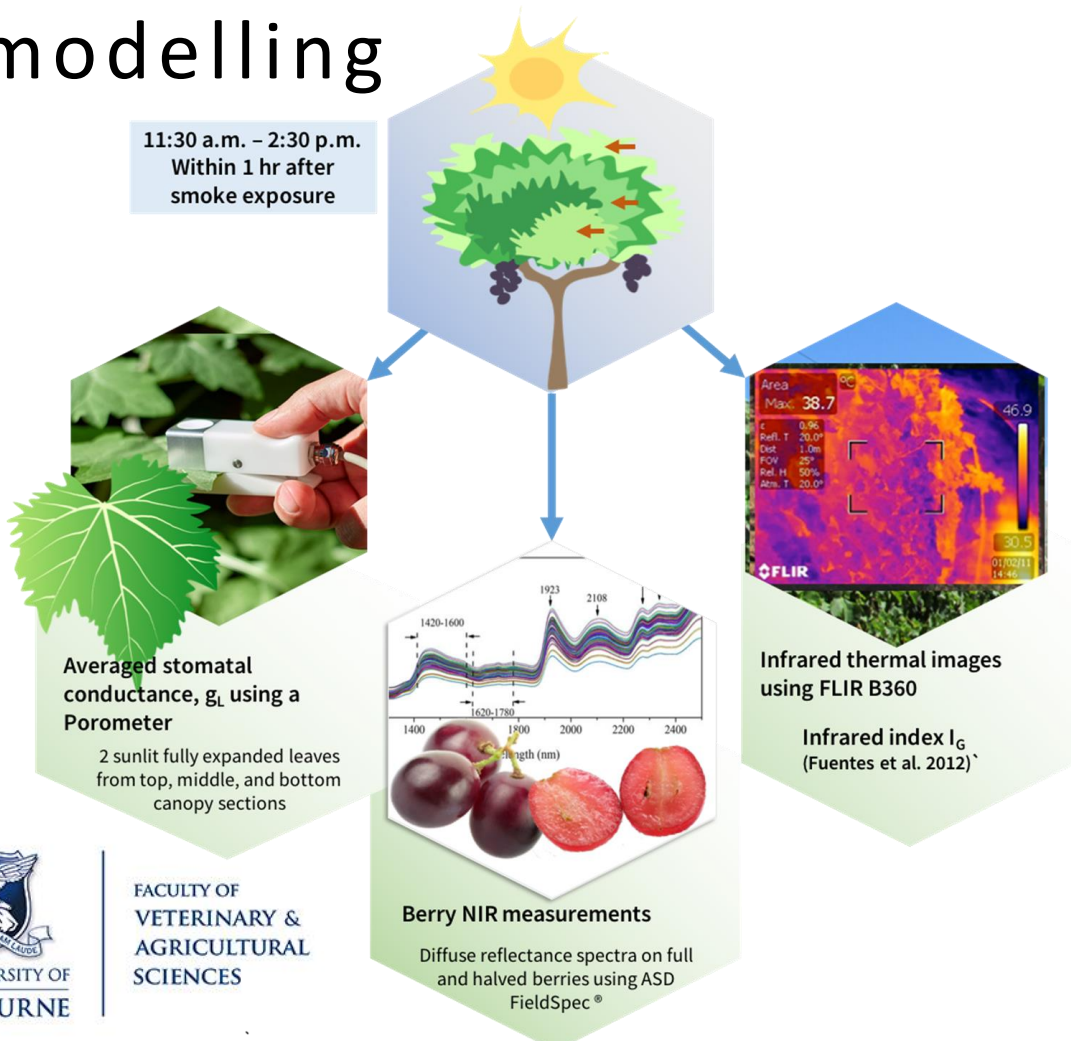


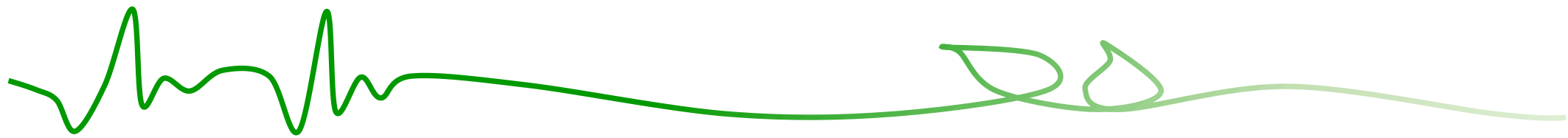
Source:Hormick, 2019

Smoke Contamination / Taint: Machine Learning modelling



Smoke Contamination / Taint: Machine Learning modelling



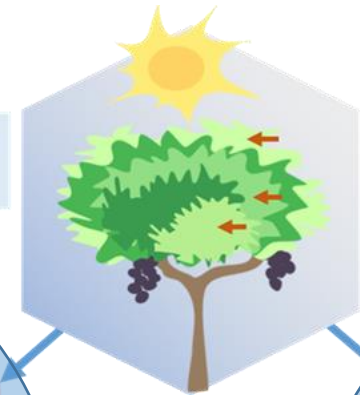


Smoke Contamination / Taint: Machine Learning modelling



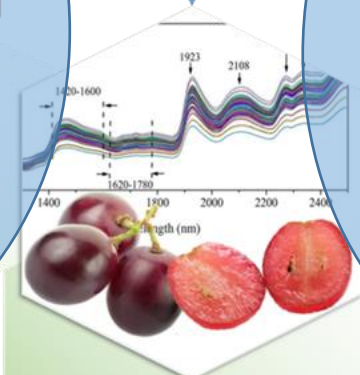
2019

11:30 a.m. – 2:30 p.m.
Within 1 hr after
smoke exposure



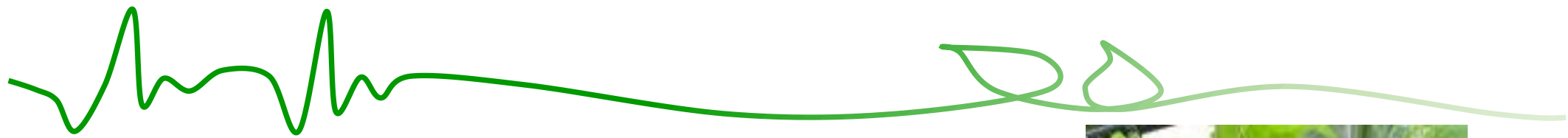
Averaged stomatal conductance, g_L using a Porometer

2 sunlit fully expanded leaves from top, middle, and bottom canopy sections



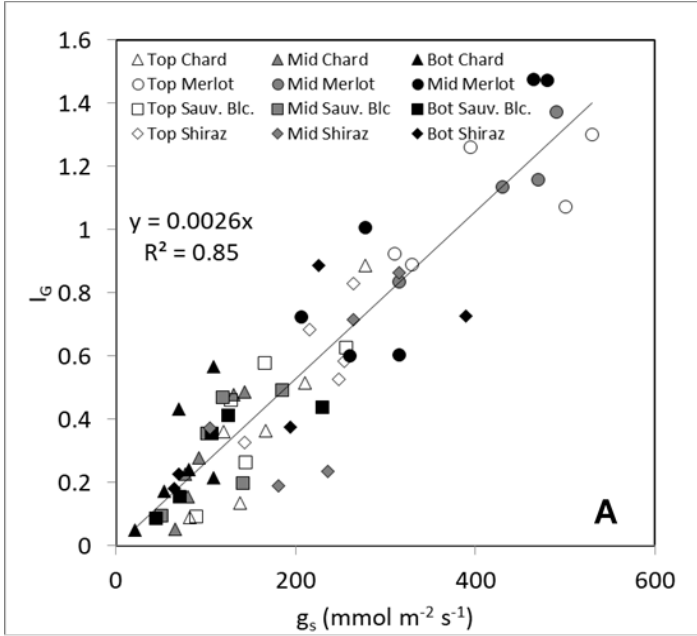
Infrared thermal images using FLIR B360

Infrared index I_G (Fuentes et al. 2012)



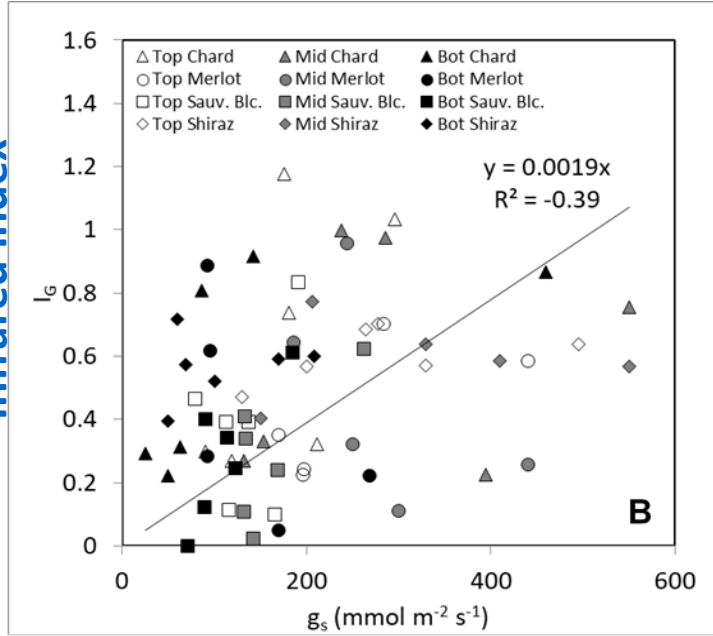
Smoke detection in Canopies

Infrared Index

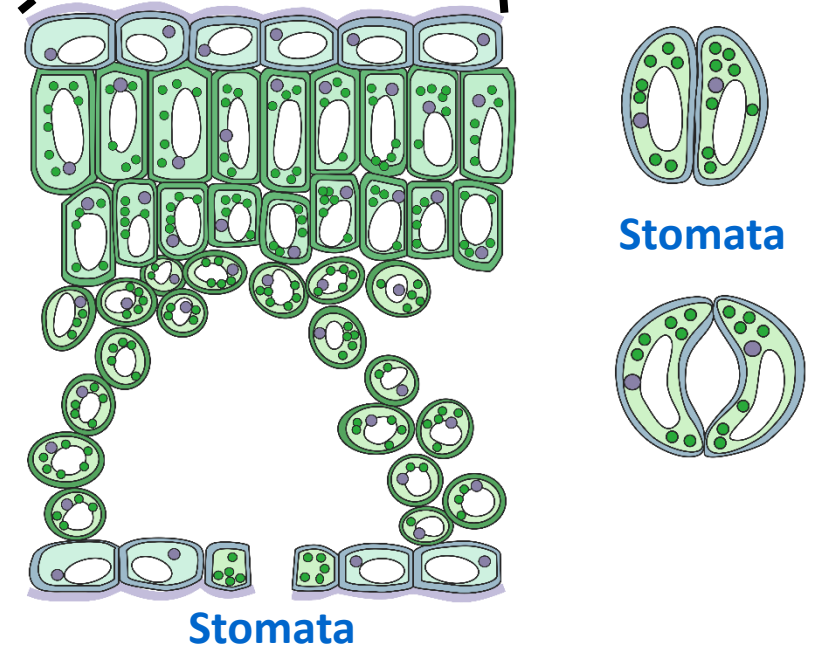


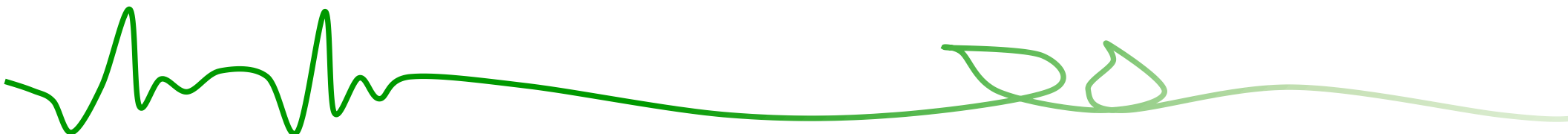
Canopy Conductance

Infrared Index

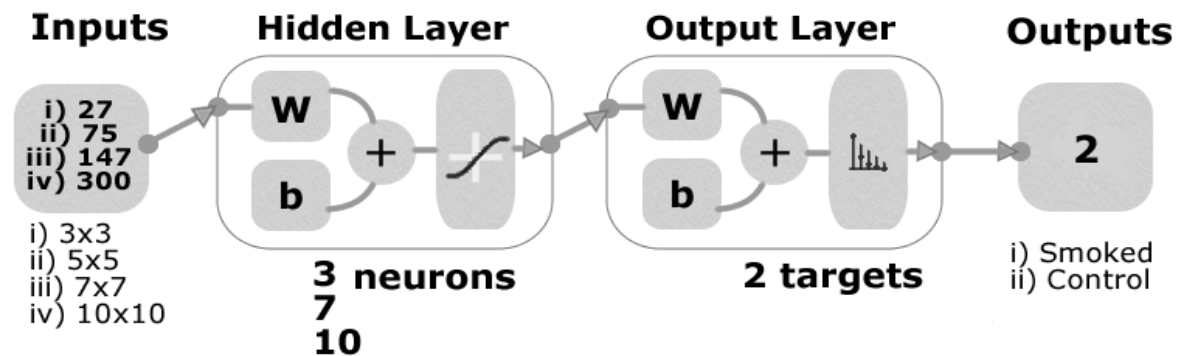
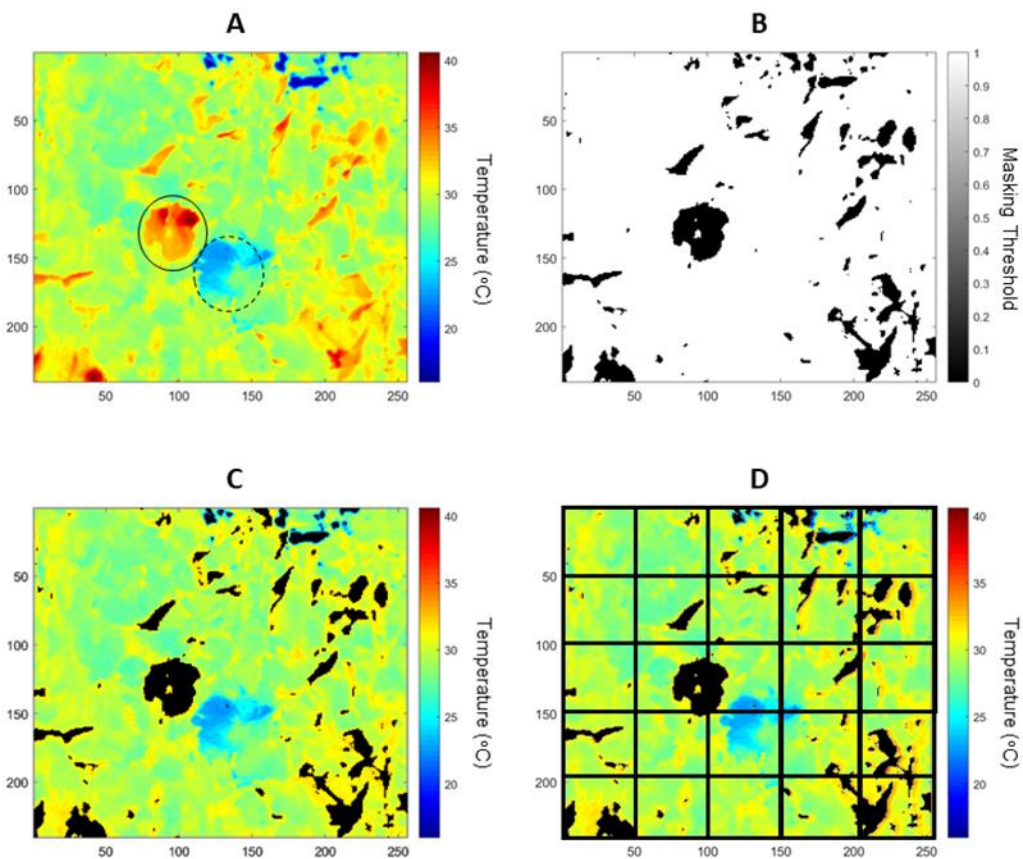


Canopy Conductance

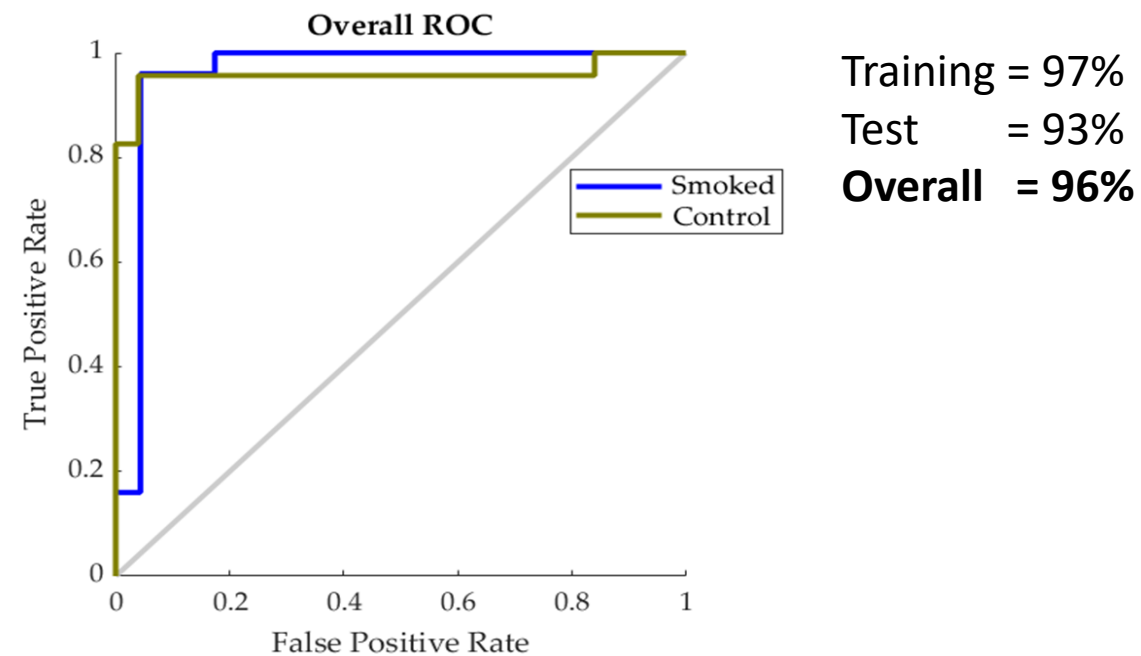


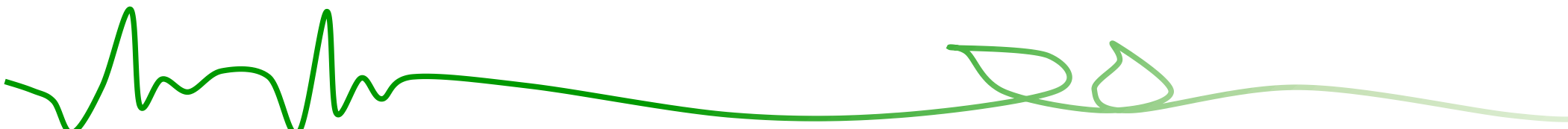


Smoke detection in Canopies

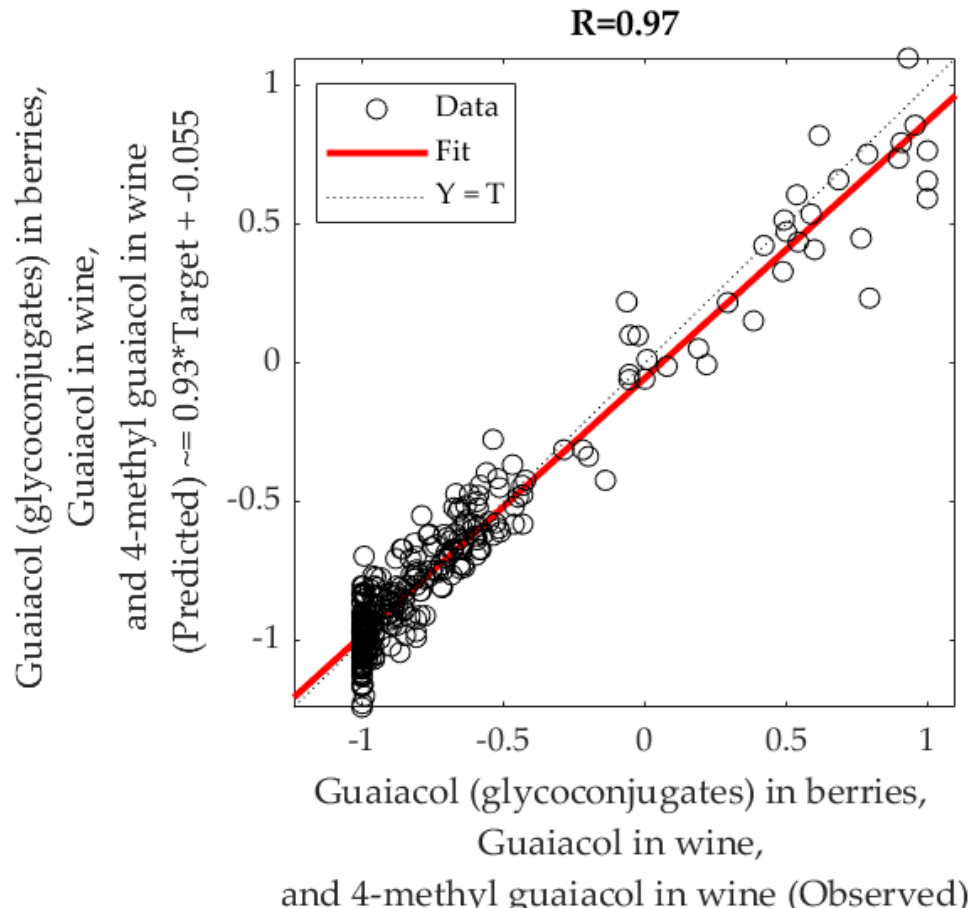
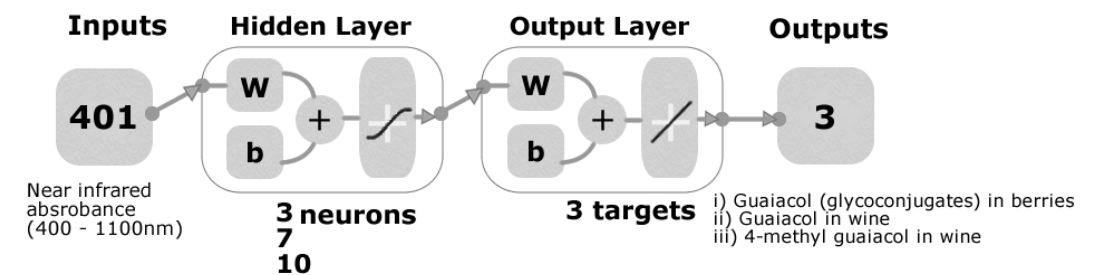
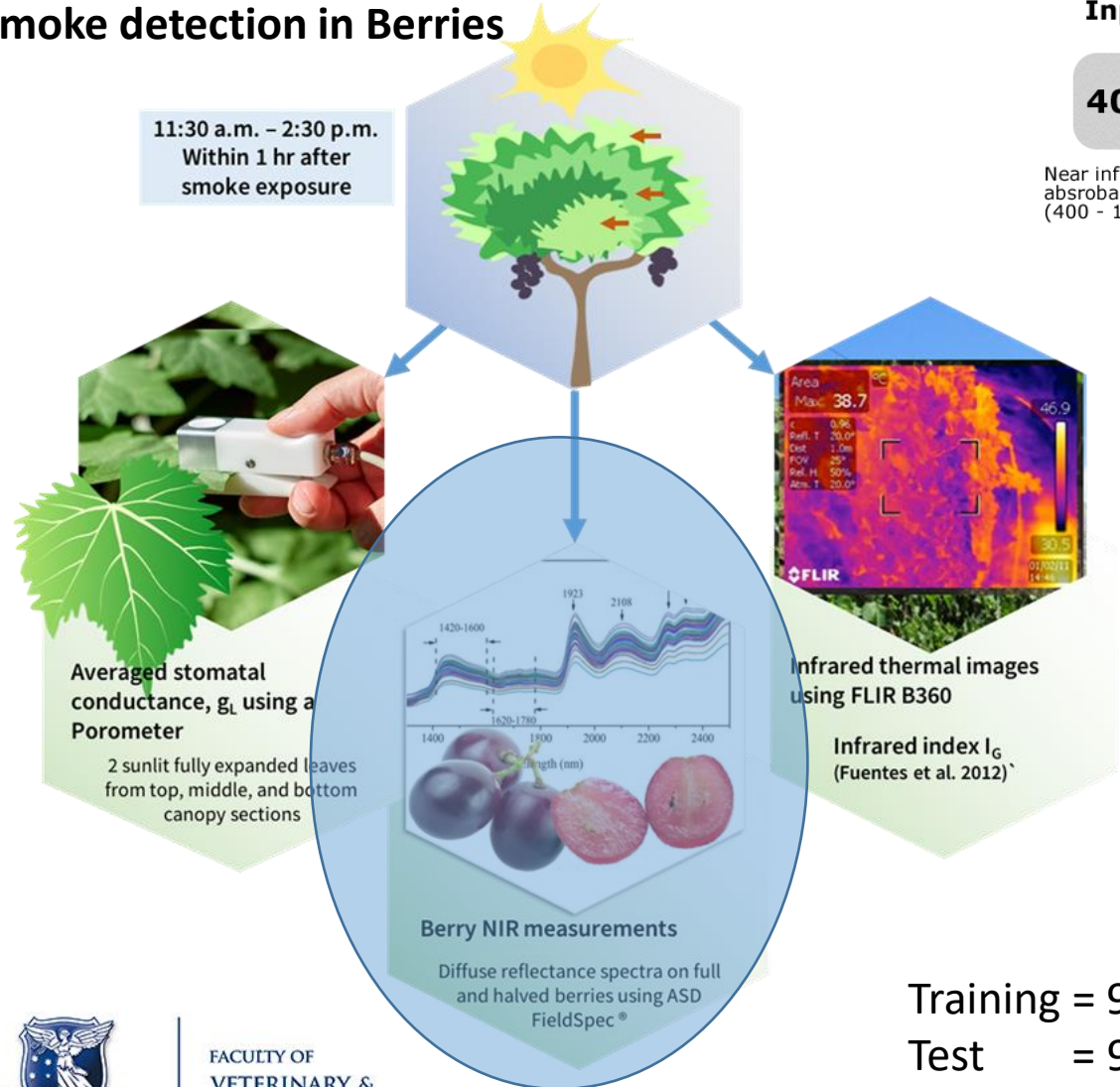


Sequential order weight and bias





Smoke detection in Berries



Training = 91%
 Test = 91%
 Overall = 93%

Sequential order weight and bias



Smoke detection in Canopies and Berries



sensors



Article

Non-invasive tools to detect smoke contamination in grapevine canopies, berries and wine: A remote sensing and machine learning modeling approach

Sigfredo Fuentes^{1*}, Eden Jane Tongson¹, Roberta De Bei², Claudia Gonzalez Viejo¹, Renata Ristic², Stephen Tyerman², Kerry Wilkinson²

¹ School of Agriculture and Food, Faculty of Veterinary and Agricultural Sciences, The University of Melbourne, Parkville 3010, Victoria

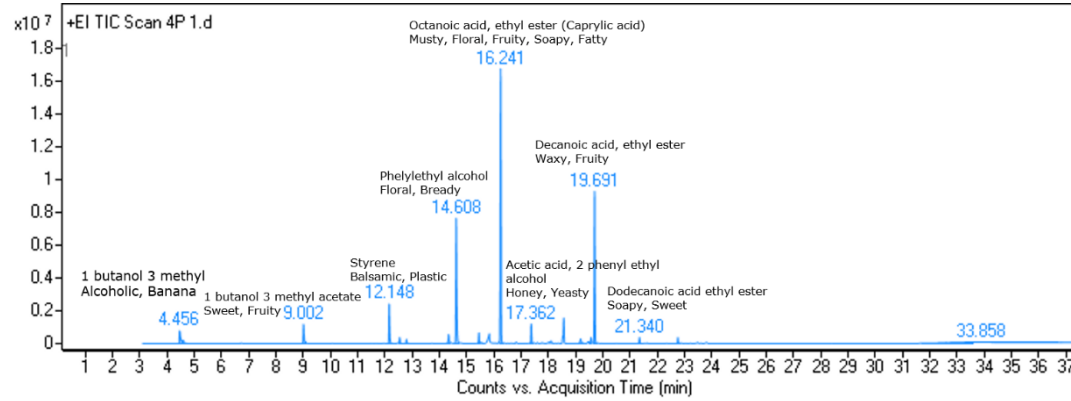
² School of Agriculture, Food and Wine, The University of Adelaide, PMB 1, Glen Osmond, SA 5064, Australia

Development of an e – Nose coupled with Machine Learning

Gas Sensors (x9)



Gas Chromatography outputs

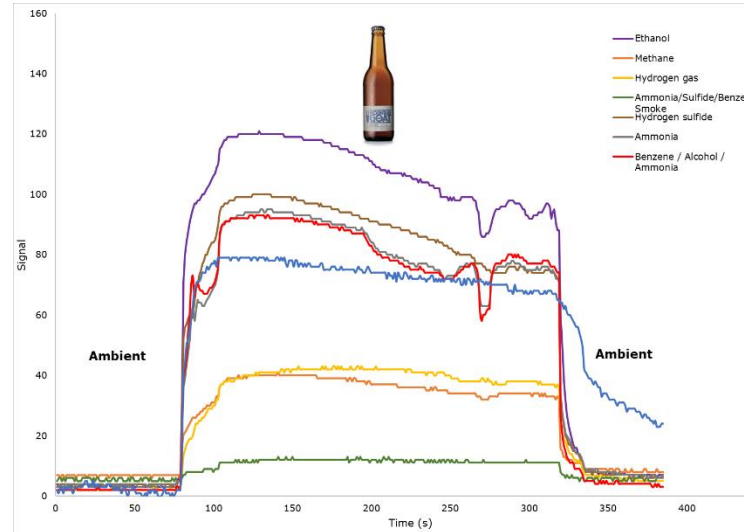


Example of outputs

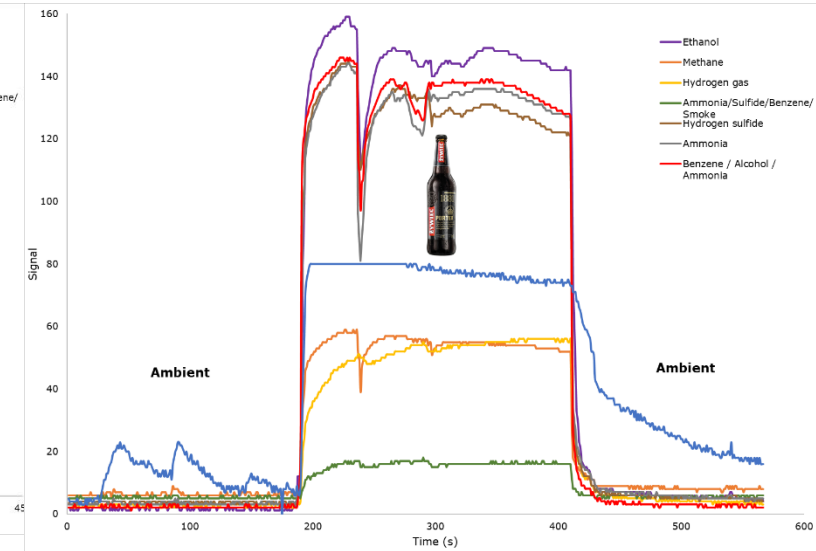
Electronic board + Sensors



Steam Ale



Porter



Development of an e – Nose coupled with Machine Learning

Gas Sensors (x9)



Electronic board + Sensor





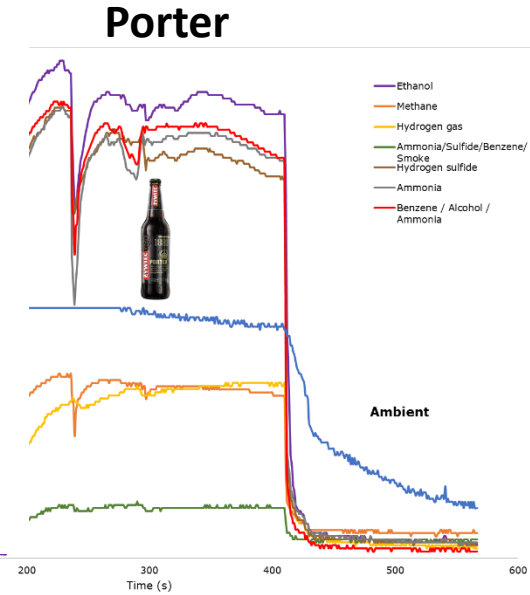
Gas Chromatography outputs



Example of outputs

Development of a low-cost e-nose to assess aroma profiles: An artificial intelligence application to assess beer quality

Claudia Gonzalez Viejo ^a, Sigfredo Fuentes ^a  , Amruta Godbole ^a, Bryce Widdicombe ^b, Ranjith R Unnithan ^b



Development of an e – Nose coupled with Machine Learning

Gas Sensors (x9)



Electronic board + Sens



Gas Chromatography outputs



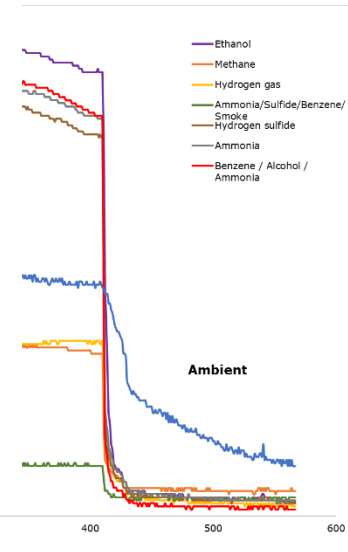
- 1 Article
- 2 **Assessment of smoke contamination in grapevine berries and taint in wines due to bushfires using a**
- 3 **low-cost e-nose and artificial intelligence**
- 4

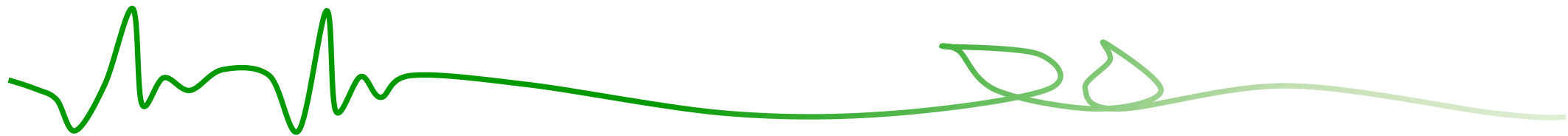
5 Sigfredo Fuentes^{1*}, Vasiliki Summerson¹, Claudia Gonzalez Viejo¹, Eden Tongson¹, Nir
6 Lipovetzky², Kerry Wilkinson³, Colleen Szeto³, and Ranjith R. Unnithan⁴

- 7 ¹ School of Agriculture and Food, Faculty of Veterinary and Agricultural Sciences, The University of
8 Melbourne, Parkville, VIC 3010, Australia
- 9 ² School of Computing and Information Systems, Melbourne School of Engineering, The University of
10 Melbourne, Parkville, VIC 3010, Australia
- 11 ³ School of Agriculture, Food and Wine, The University of Adelaide, Waite Campus, PMB 1, Glen Osmond,
12 SA 5064, Australia
- 13 ⁴ School of Engineering, Department of Electrical and Electronic Engineering, The University of Melbourne,
14 Parkville, VIC 3010, Australia

outputs

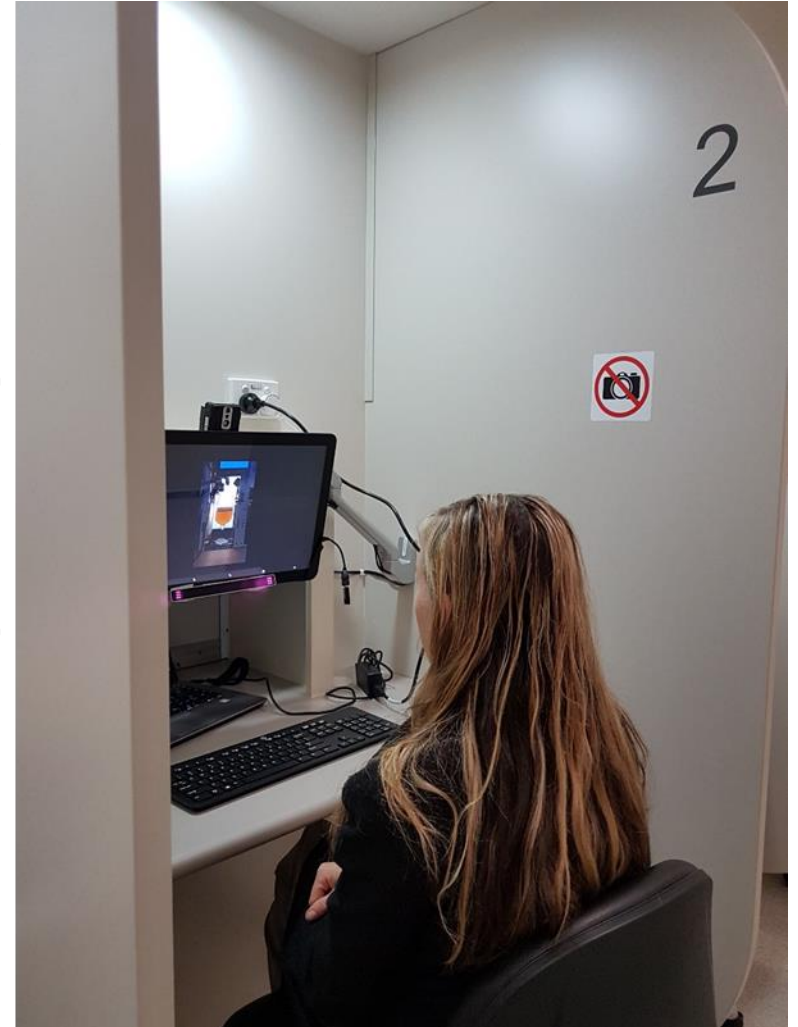
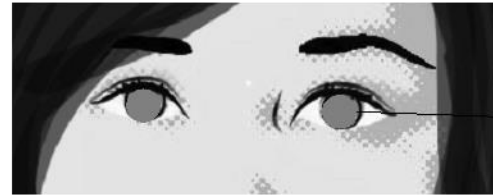
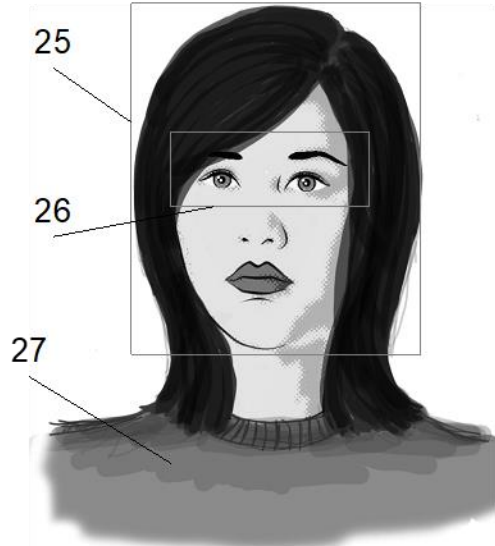
or







Software Development

- BioSensory Computer App



Article

Development of a Biosensory Computer Application to Assess Physiological and Emotional Responses from Sensory Panelists

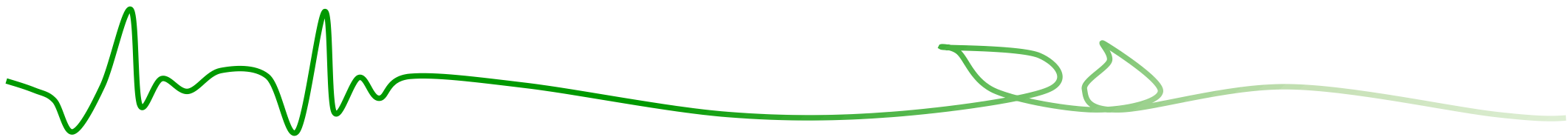
Sigfredo Fuentes ^{*} , Claudia Gonzalez Viejo, Damir D. Torrico and Frank R. Dunshea 

Faculty of Veterinary and Agricultural Sciences, University of Melbourne, Parkville, VIC 3010, Australia; cgonzalez2@unimelb.edu.au (C.G.V.); damir.torrico@unimelb.edu.au (D.D.T.); fdunshea@unimelb.edu.au (F.R.D.)

* Correspondence: sfuentes@unimelb.edu.au; Tel.: +61-3-9035-9670



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Software Development

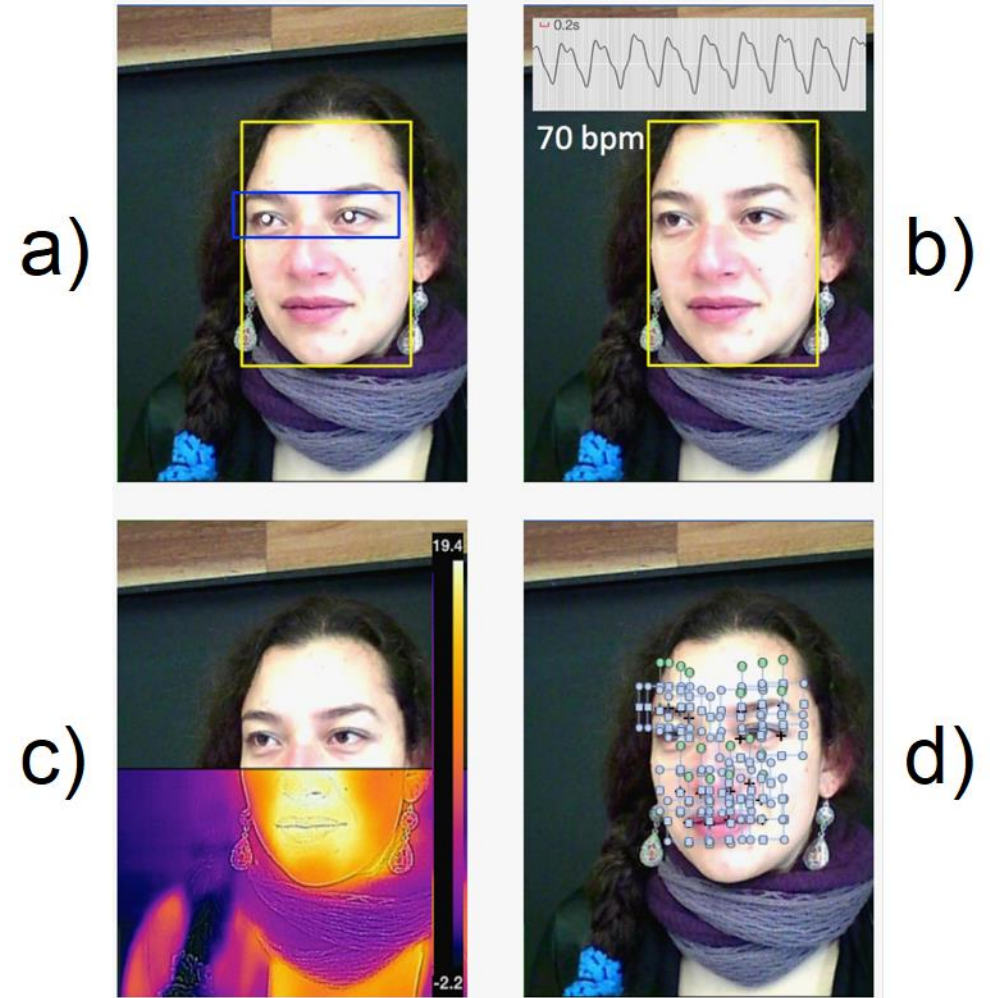
• BioSensory Computer App

Biometrics:

- a) • Eye Tracking:
 - Pupil dilation, Fixations
- b) • Heart Rate:
 - Rate, Amplitude, Frequency
- c) • Body Temperature
- d) • Face expressions:
 - Sad, Disgusted, Contempt, Neutral, Angry, Happy, Surprised
- Posture Tracking
- Brain Waves:
 - Alpha, Beta, Gamma, Attention, Meditation, Blinking, Zone.

Machine Learning Modelling to obtain:

- Liking
- Emotional Response

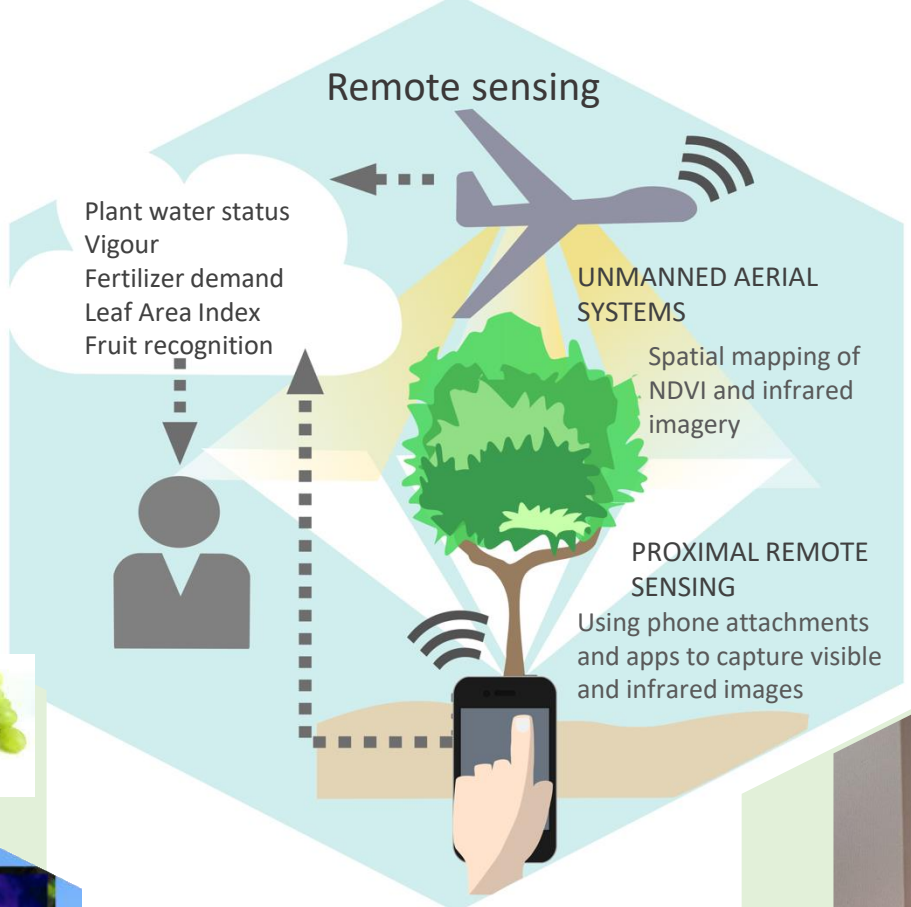


Integration of technologies: From Tree to the Palate



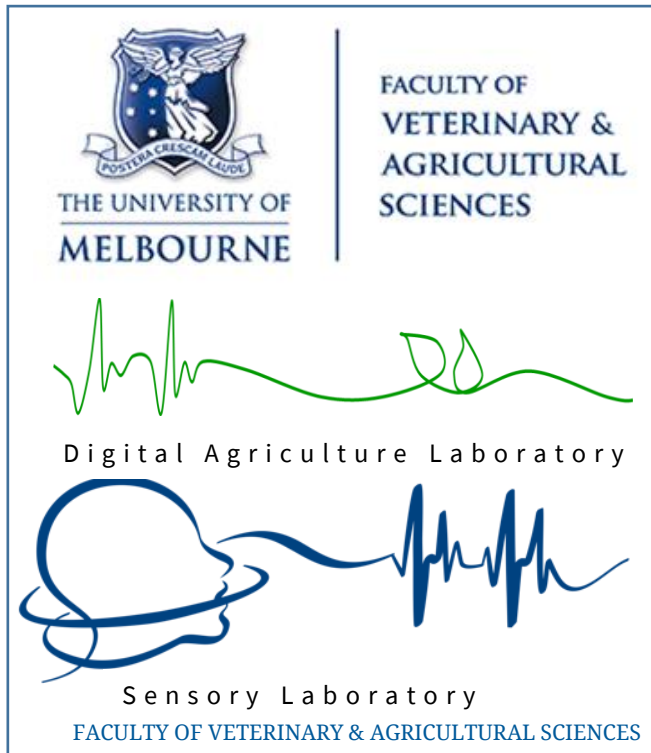
Ground-truth for remotely sensed information

Non-destructive/ GCMS assessment



Harvest for sensory analysis

Liking and sensory profile to be related with field data



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Thank You

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[https://www.researchgate.net/profile/Sigfredo Fuentes](https://www.researchgate.net/profile/Sigfredo_Fuentes)

School of Agriculture and Food