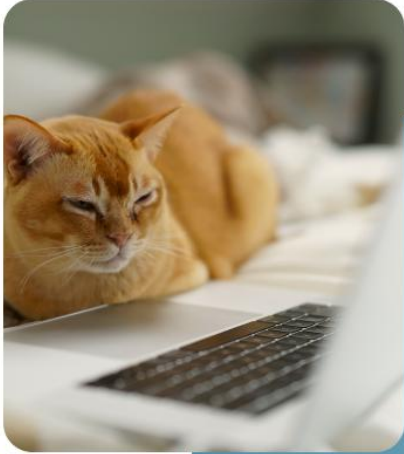


Ubiquitous, Pervasive & Context-aware
Computing - A.A 2021/2022



Ubicomp & animal care

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Giulia Torregrossa 873200



Let's start with some numbers

3,5 millions

People that during 2020 decided to **adopt or buy a pet**

15%

Increase in the **adoption** in 2020, also thanks to the pandemic

60+ millions

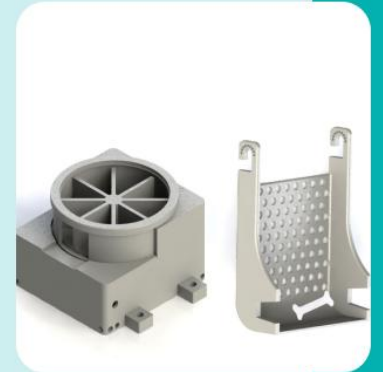
Number of **pets** in italian's houses



Index

- TECHNOLOGIES FOR CATS & DOGS
- TECHNOLOGIES FOR FISH & REPTILES
- TECHNOLOGIES FOR SMART FARM
- CONCLUSION

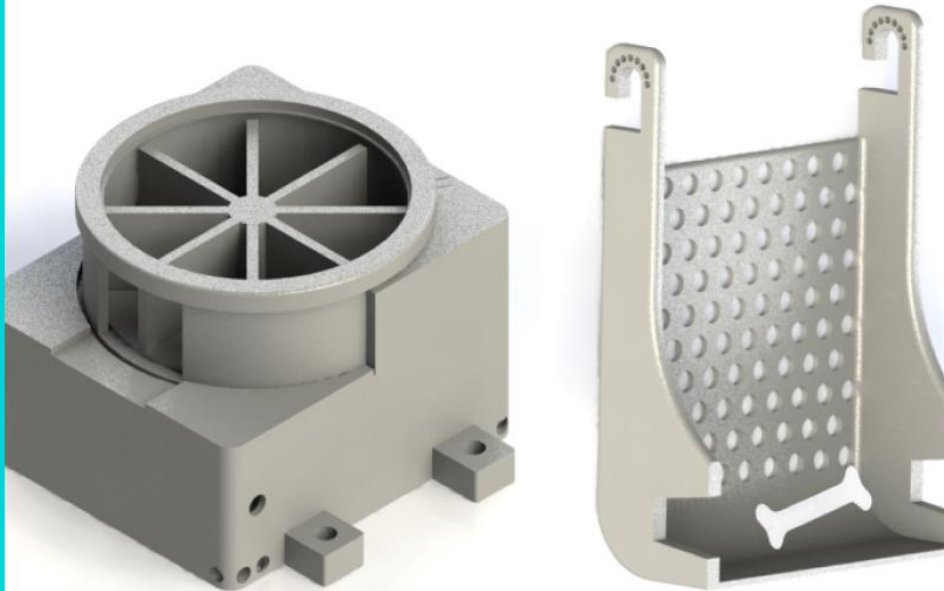
Technologies for cats & dogs



TRICKS AND TREATS

Designing tech to support mobility assistance dogs

- Assistance dogs are a key to support people with tetraplegia
- Technological intervention for supporting relationships between tetraplegic people and their assistance dogs





DESIGNING TECH TO SUPPORT MOBILITY ASSISTANCE DOGS

Treat-dispensing devices

Current off-the-shelf **treat dispensing devices** are **limited in their input modalities** for users

- They either can **only be activated by the button** remote that comes with the device
- Or can be **voice activated** due to their integration with Amazon Echo

None of these devices adapted to work with different switch devices that are highly variable in different individuals with tetraplegia

DESIGNING TECH TO SUPPORT MOBILITY ASSISTANCE DOGS

The **treat dispenser** consist in:

- **waterproof** outer **case** and **inner carousel**
- **micro-controller**
- **electrical components**

It can be **connected via USB** cable to a wheelchair's in-built USB port

Users of the device can **interact with the app** to activate the treat dispensing

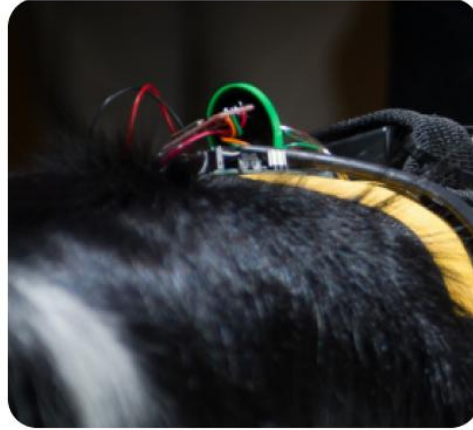


TECHNOLOGY FOR WORKING DOGS

Instrumented smart dog toys

- Working dogs help people in many ways, from helping people with motor disabilities to providing critical functions for police
- To facilitate communication the study uses smart devices to **reduce confusion or errors** in interpreting information





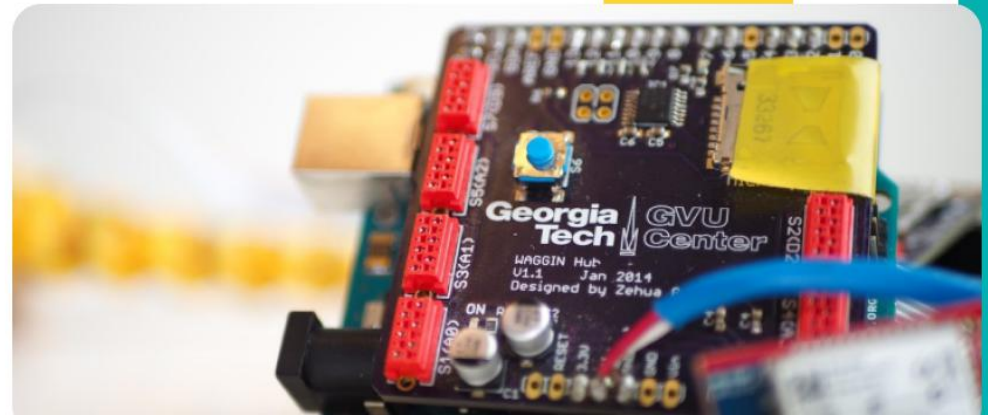
INSTRUMENTED SMART DOG TOYS

Discriminate best suitable *job* for dogs

- The requirements for a **dog that must be able to operate in any environment** cause a **failure rate of 50–60% or more**
- **Dogs** are typically found unsuitable because of **specific personality traits**, known as *temperament*
- Assessing a dog's temperament early in training allows to **provide the ideal working role for that dog**

INSTRUMENTED BALL TOY

- The ball toy **measure** “**fetch and chase**” **drive**
- The device **contains** inside a **pressure sensor, accelerometer, and gyroscope** to measure bite force, frequency, and head-shaking behaviors



INSTRUMENTED TUG TOY

- Made of a hollow **silicone rubber** bladder and contain a **pressure sensor**
- The bladder is attached to a rubber bungee cord with a **stretch sensor**. This allows to **measure pressure and pull force**
- **Testing dogs** with these devices early in the training process can **help to predict** with upwards of 87% which dogs would succeed or fail in which works



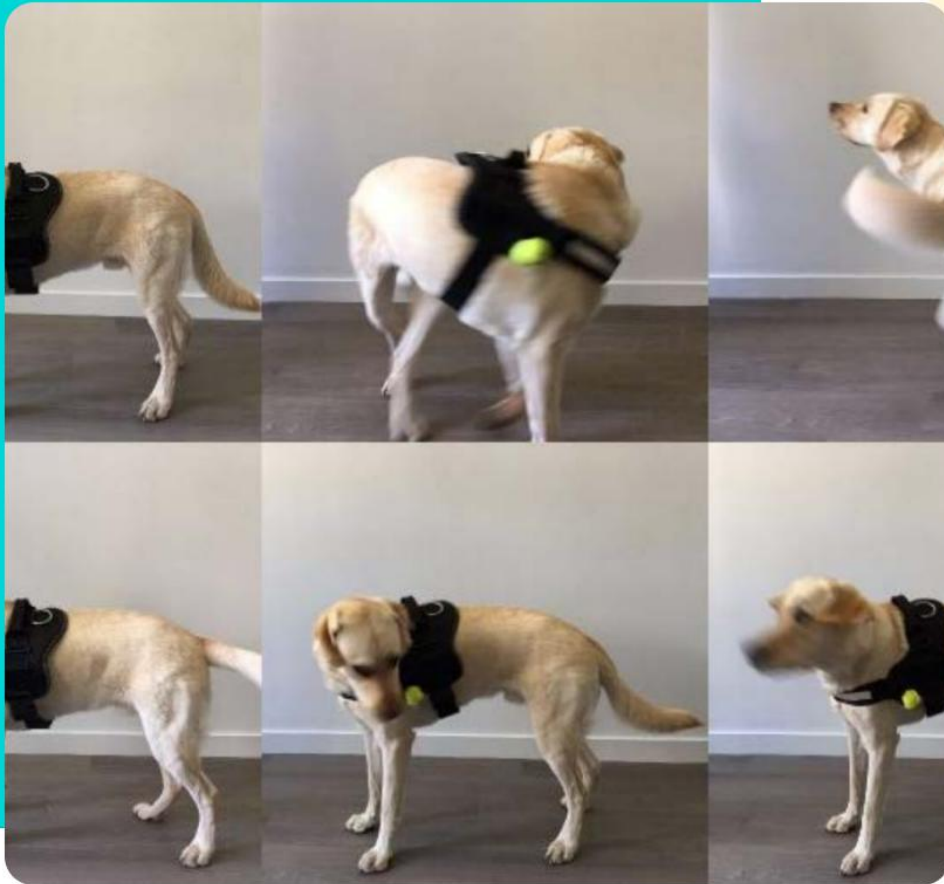
2
year study
at Canine Companions

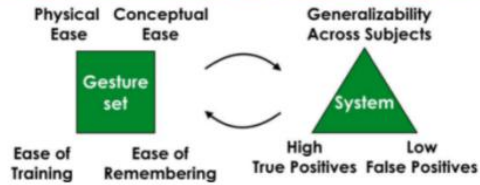
87%
of upwards
prediction of fail
or success

COLLAR SENSED MOTION GESTURES

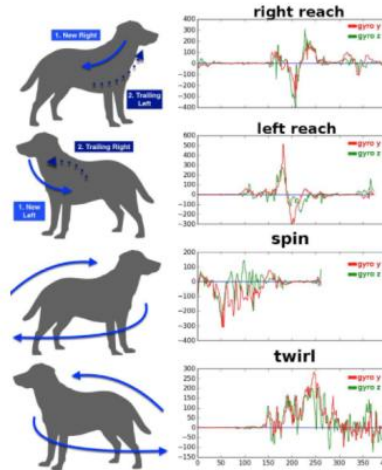
Gestures for Dog Human communication

- Working **dogs** have **specific skills** that enable them to perform tasks for humans
- **Motion gestures detected by devices** installed on a collar can be used to **communicate with humans**





Candidate Gestures	Description of gestures
Spin	Clockwise rotation of 360°
Twirl	Counterclockwise rotation of 360°
Right reach	Reaches to right ribcage and return
Left reach	Reaches to left ribcage and return



COLLAR SENSED MOTION GESTURES FOR Dog Human communication

The equipment used for the studies consist in:

- Inertial sensor collar which contains an 9-axis sensor, a 3-axis accelerometer, gyroscope and magnetometer
- Pocket vest on which to store a mobile phone to record data wirelessly

Chosen gestures was Spin, Twirl, Right and Left Reach

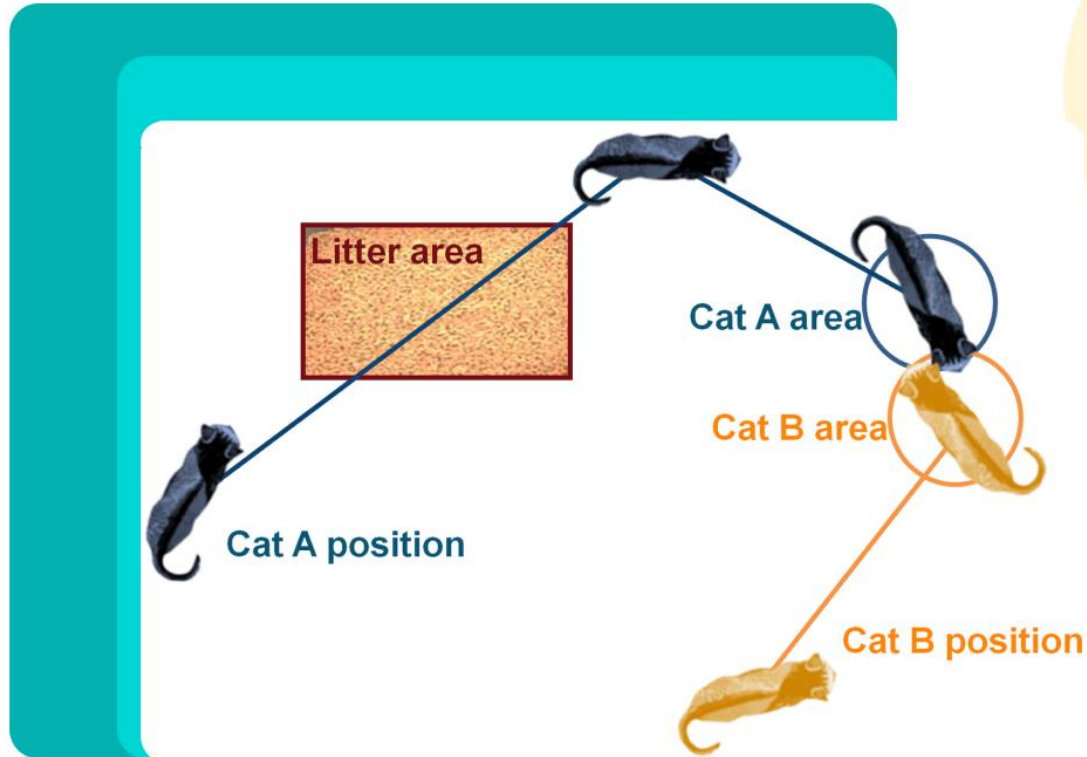
OVERVIEW

- Researcher isolated the gestures for **subsequently comparison** and **tested the dogs** with gestures in different sequences and times comparing it with the recognition result from the collar
- **Gestures** can be used to convey specific alerts to humans through a **mobile application**

75 – 100%
accuracy

of gesture
recognition

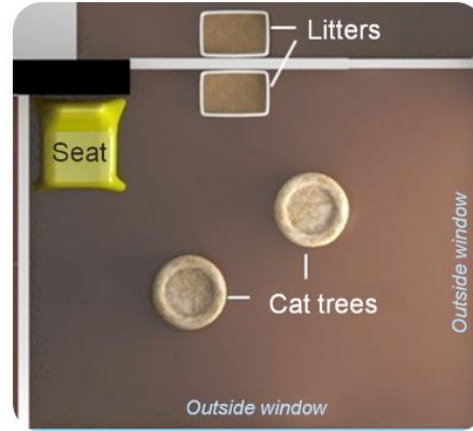
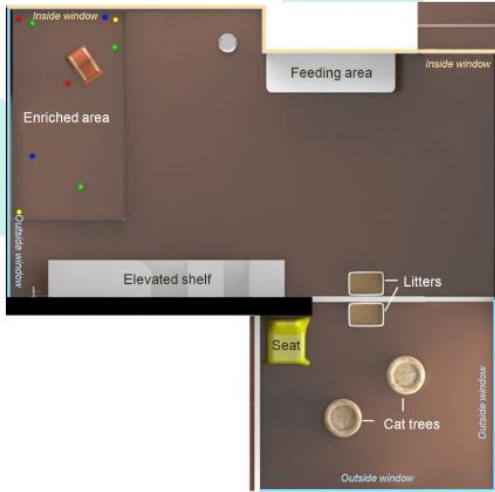




ULTRA WIDE BAND

Spatial monitoring for indoor cats

- **Ultra-wide band technology** is a new technique which allows **real time and highly precise indoor positioning**
- The technology can **improve the study of mammalian societies** using cats



ULTRA WIDE BAND

Spatial monitoring for indoor cats

Cats involved in the research wore **UWB tags** during the entire period, in the environment in which they normally live

10 – 30 cm
accuracy

at Canine Companions

Very low
latency

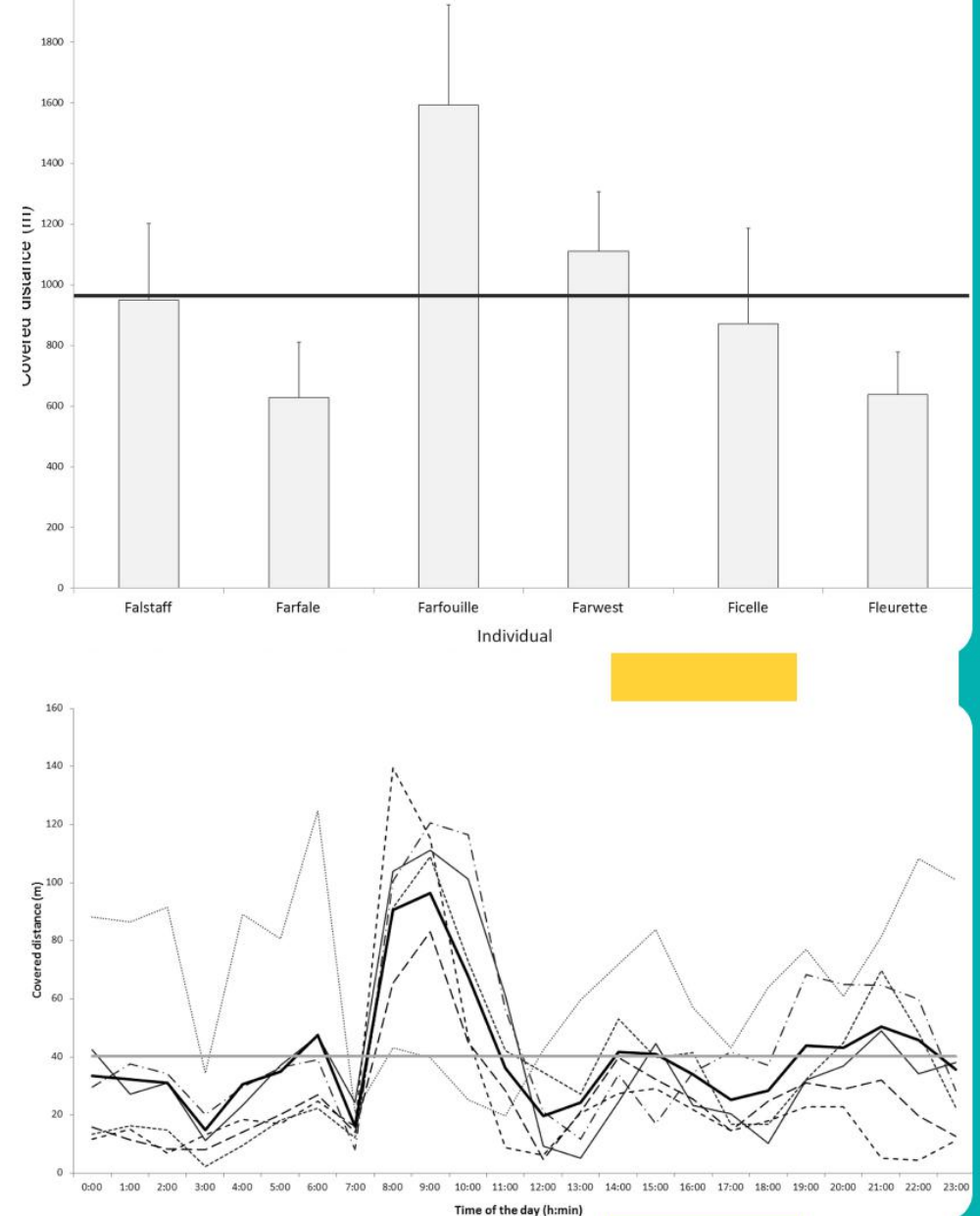
down to 100 times/sec

OVERVIEW

- **UWB setup** was made by **7 antennas** placed in corners of rooms
- **Data** were **recorded every 0.9s over 14 days**, using a computational unit
- **Real time monitoring** enables to examine **distribution** and **activity** with **accuracy of 15cm**
- This technology enables ethologists to **conduct long-term behavioural studies**

**7
antennas**

**UWB
tag**



Sure PetCare Cat Flap Technology

- This device uses **microchip-reading technology** that responds to the **microchip number or radio-frequency identification** collar tag of pets
- Owners can **control access and monitor behaviour** anywhere and at any time using the mobile application

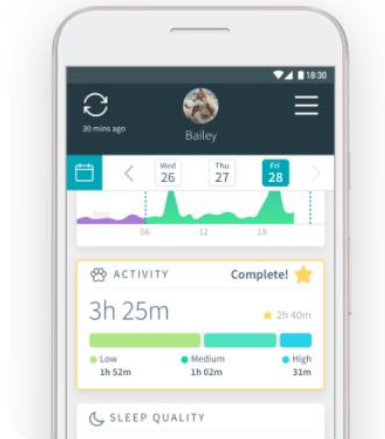




SURE PETCARE CAT FLAP TECHNOLOGY

Cat flap technology

- Owners of multiple cats can set **exit and entrance permissions for each pet** at specified times
- Owners can **track activity**, receiving **notifications** when pets leaves or enters the house



“Cats are harder to keep track of and technology enable us to see patterns in behaviour that could be an early warning of health problems such as arthritis”

Jon Bowen, Royal Veterinary College veterinary and animal behaviourist

MEASURE ACTIVITY, PROXIMITY AND
PHYSIOLOGICAL RESPONSES

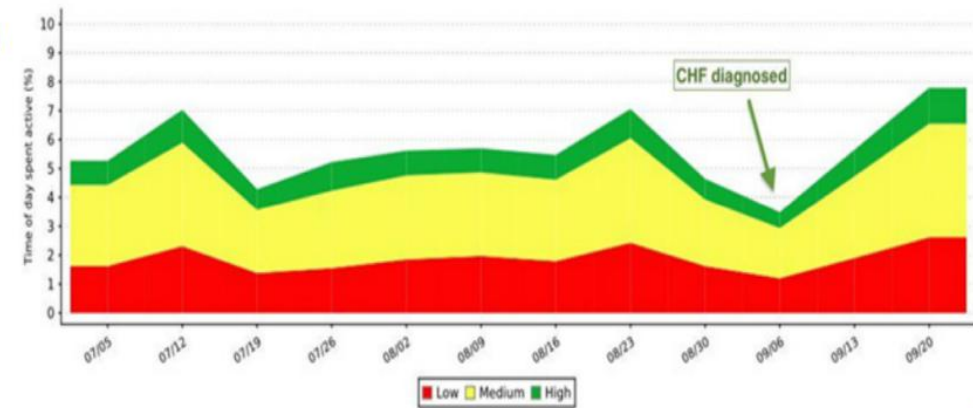
PetPace Collar



- The collar **monitors various parameters** and **analyzing the data can alert owners** via mobile notifications if some irregularity is detected
- This new type of pet wereable **provides data-driven insight into animal health**, and can help determine when vet visits are needed

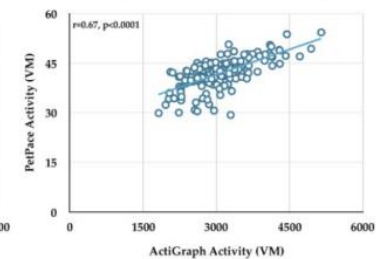
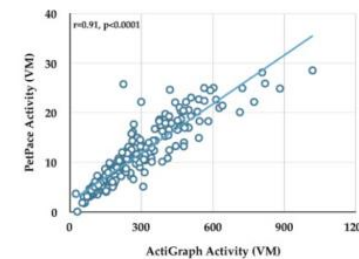
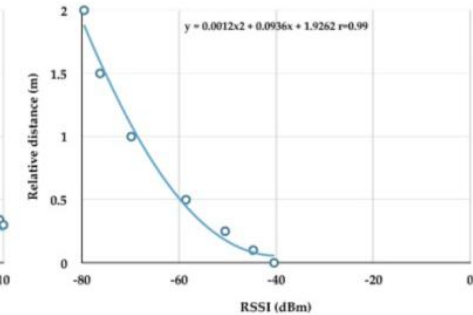
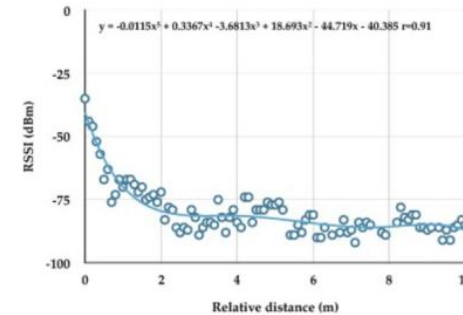
OVERVIEW

- The **real time monitoring** and the associated mobile application makes it a good tool for dog monitoring



Parameters Controlled

- Temperature
- Body posture
- Pulse
- Activity levels
- Respiration
- Calories burned
- Heart rate variability



Technologies for fish&reptiles



Felix Ai Smart Assistant

- The device allows to **control aquarium's key parameters**
- It provides a **real time analysis** of the aquarium state
- It automatically alert the owner and **apply corrective measure** if there's a problem
- The AI assistant through an app recommend to the person the best action to improve the aquarium life



OVERVIEW

- The 360° camera with an AI algorithm allows the owner to check the fish and their health
- The owner can check the various parameters at all time

Parameters Controlled:

Salinity

Ph

Ammonia

ORP

Temperature

Photosynthetic radiation

Total dissolved
solids (TDS)



Moai Robot



- The device helps maintain the aquarium in the **cleanest conditions possible**
- The tool is connected to an app and lets the person decide whenever and however it wants the aquarium to be cleaned

OVERVIEW

- The robot uses an **ultrasound technology** that maps the glass so it already knows where it has cleaned
- A mobile camera alllows to control the fish remotely and to **move around the sides of the aquarium**



Biopod



- Biopod is a smart terrarium for growing exotic animals and plants easily
- The device **automatically controls and regulate various parameters**
- Biopod is connected to an app that will **guide the person with suggestions** to help take an optimal care for their tropical pets.

OVERVIEW

- The person can select the pet that will live in the terrarium and **the device will automatically regulate parameters** to create the animal natural habitat
- Technology used to create the right environment:
 - Integrated misting that replicates natural rainfalls
 - UVB lights that replicate the sun's light
 - Heating to regulate the temperature

Parameters Controlled:

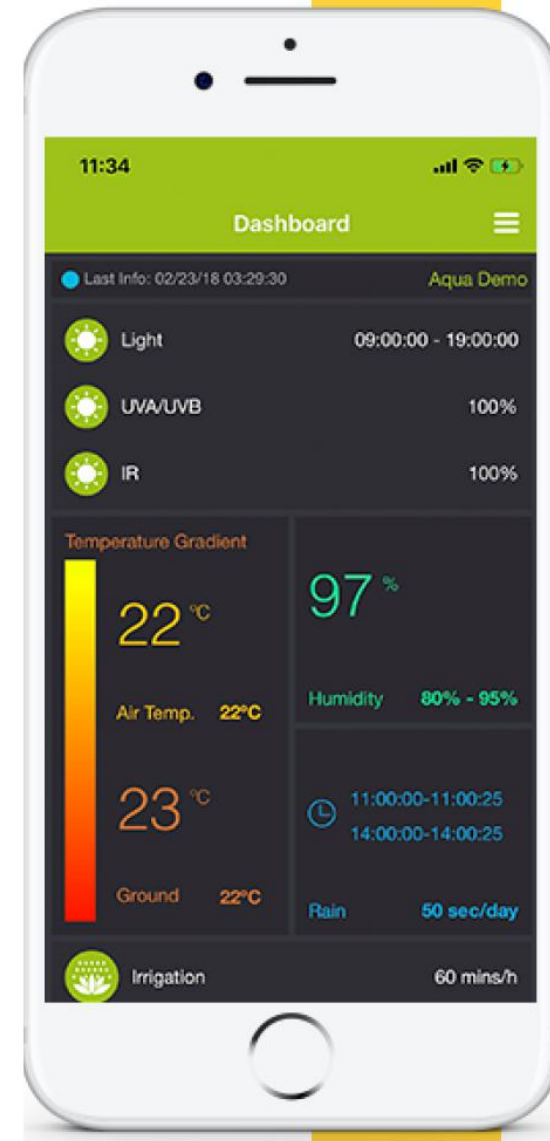
Humidity

Temperature

Light

Ventilation

Rainfall

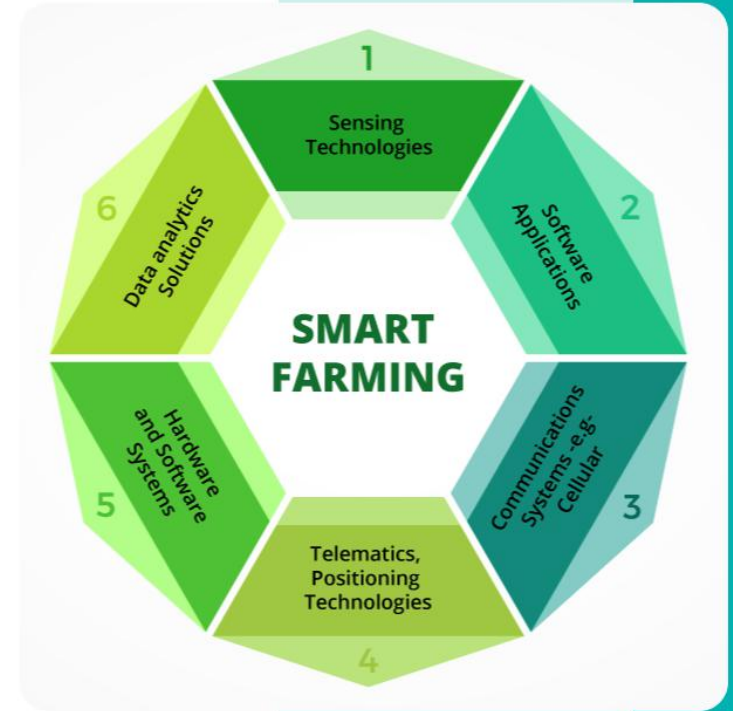


Technologies for smart farms



The technologies available for present-day farmers are:

- **Sensors:** soil, water, light, humidity, temperature management, animals parameter
- **Software:** specialized software solutions that target specific farm types or Applications agnostic IoT platforms
- **Connectivity:** cellular, etc.
- **Location:** GPS, Satellite, etc.
- **Robotics:** Autonomous tractors, processing facilities, etc.
- **Data analytics:** standalone analytics solutions, etc.





Cowlar- the cow fitbit

- Cowlar is a smart device that helps farmers to control their animals, especially cows, by checking various parameters

Why use Cowlar?

- Improve milk production up to 15%
- Early diseases detection
- Accurate heat detection

OVERVIEW

- The collars **gather the data from various sensors** on the device
- The data are fed back into an algorithm which determines general health informations
- With the help of **AI the system will then produce actionable recommendations** sent via smartphone, or found in a dashboard

Parameters Controlled:

Body temperature

Activity

Rumination

Step count

Posture

Eating behaviour

Body movement pattern



Alus



- The product uses **artificial intelligence** to automatically turns visual input obtained from smart cameras into real-time insights
- The insights are displayed daily on any device available on the farm – phone, tablet or PC

OVERVIEW

- ALUS control's cow activities such as lying, eating, drinking, standing and produce a 24-hours cow time budget with a **facial recognition technology**
- The device provides a complete analysis to control the animal's behavioural patterns
- Cow's lying time is crucial to maximise milk production and their welfare





Apisprotect

- The wireless in-hive sensor is created to monitor honey bees.
- The devices contain detectors for Temperature, Movement , Humidity, Sound
- The **bee keeper will receive smart alerts** with informations on the condition of the hives, possible colonies problem , and suggestion on a variety of actions to keep the colonies healthy and prevent loss.

OVERVIEW

- The information collected helps to develop machine learning and neural network models
- These models are capable of **predicting** the status, trend, strength and brood levels of the hives and used to make daily predictions based on real-time information
- The models are **refined by feedback** on the predictions that are made



Conclusion

There are undoubtedly hard technical and economic challenges to overcome, but these are minor in comparison to changing the existing mindset that makes difficult to develop technologies specifically for animals.

There are many smart technologies in use today, and a sea of promising innovations in the future, making it possible for smart computing and sensing technology to co-exist with the animals in a sustainable, humane and mutually beneficial manner.

thanks for your attention!

The sitography can be found here: [Sitography](#)