Advanced Sensors and Services for Precision Dairy Farming

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Silent Herdsman Ltd
Outline

- Background/Innovate UK Project ALERTS
- Partners
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- Sensor Platforms
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  - Ph bolus
  - Tail mounted calving sensor
  - Methane collar
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**Precision Livestock Farming (PLF)**

- core to satisfying the increasing world-wide demand for good quality animal products whilst heavily reducing environmental load and resource use
- farms are becoming larger to remain profitable and the cost of skilled labour is increasing
  - technology is used in many different ways within animal production focusing the valuable time of animal husbandry staff onto those animals that most require attention
- animal wellbeing is at the start of a chain linking to farmer profitability, product quality, consumer satisfaction and environmental sustainability
- Silent Herdsman® is the basis for a highly scalable and functional decision support platform provisioning cloud based services that assist in securing a sustainable food supply internationally
- ~1 Billion cattle worldwide
Background; ALERTS

- development of a health and condition monitoring platform
  - neck mounted collars
  - boluses
- a foundation to creating decision support services
  - to catalyse improvements in production efficiency
  - reduce waste and losses in the ruminant protein supply chain
- primary traits in beef and dairy cattle were
  - oestrus
  - calving detection
  - Sub-Acute Ruminal Acidosis (SARA)
- reliable and continuous monitoring of individual animals in farmed livestock in commercial farming environments
- *KTN provided meaningful support/input during the submission of the proposal; our thanks to David Telford*
Development Methodology

Agricultural College
Vet School

Innovate UK Support
Features

- neck mounted collar, the *data gathering engine*
  - 3-axis accelerometer mounted on the side of animal's head measuring position and hence activity profiles continuously

- wireless network transmitting data from collars to backend system
  - an intelligent Medium Access Control (MAC) that enables data transmission to take place only when a cow enters into a base station coverage area

- artificial intelligence software embedded onto collar which interprets sensor data and indicates animal conditions
  - amount of data transmitted minimized giving a scalable solution

- Over-the-air-Programming (OTAP)
Smart Collar

- Battery
- Ultra low power Processor
- Ultra low power Processor
- Flash Memory
- Sensor X, Y, Z Axis

Location for Collar Sensor

Weight
Collar Feature; Rumination

‘halter’ and accelerometer outputs for Rumination
Multiple Outputs
One Collar, Multiple Information
mySilent Herdsman

Cow ID: 790

Oestrus detected
2 days ago at 16:03

History

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<th>Event</th>
<th>Detail</th>
<th>Date</th>
<th>Days ago</th>
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Bolus
Bolus Outputs

- pH variable when the cow is placed on the transition diet
- drops <5.5 for extended periods of time – several weeks
- periods of not eating but they are not predicted by pH value change
Onset of Calving

paper by Michie *et al* provides more detail; presented on Tuesday 14\textsuperscript{th} April at 16.30
Calving Detection; Tail Mounted Sensor

![Graph showing calving detection using tail mounted sensor with acceleration data over time.](image-url)
Calving Detection; Tail Mounted Sensor

![Graph showing cumulative tail raise over hourly interval with distinct markers for D17, H27, H34, H35, and calving point.](www.silentherdsman.com)
Methane Collar

- Aspirating holes
- Flexible tubing
- Air intake
- Plastic enclosure
- Gas sensor TDS 0068
- Micro-controller
- Micro pump
- Batteries
- Vented gas
- Antenna
- Remote data logger
- Base station
- Sensor
- Micro-pump
Evolution

- on-farm wireless data acquisition platform able to integrate all data streams e.g. parlour into a single data base
- extend the on-farm decision support functionality to provide early indication of multiple cow conditions associated with animal welfare e.g. eating, rumination
  - utilising the same hardware platform
  - novel, self learning animal specific models that will identify time spent eating/ruminating
- a customised information presentation/interface assisting a range of stakeholders across the supply chain to make informed decision on business needs and capable of being linked to existing applications
Summary

- truly global market
- a sector exemplifying the challenges of IoT and SaaS
- data analytics a necessary goal for the sustainability of the farming sector
  - economics and human factors key in the evolution
- solutions are a mix of advanced, elegant engineering in collaboration with animal scientists and industries operating in the supply chain
  - multiple behavioural states of individual animals can be derived from the raw data captured by a neck mounted 3-axis accelerometer
    - heat detection
    - eating times
    - rumination times etc etc
- a mix of services......
  - fertility
  - breeding
  - illness etc etc
Contributors

- Mike Gilroy
- Willie Thomson, Callum Harvey
- Andy Warne
- Andrew Loftus, David Evans
- Malcolm Bateman
- Carol Anne Duthie, Shane Troy, Jimmy Hyslop, Malcolm Mitchell, Dave Ross
- Jakub Konka

Rob Merrall – Project Monitoring Officer