

CS35710 Ubiquitous Computing exam notes

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1 Scenario

1.1 Outline

The Government and the farming industry are planning to start a pilot study to allow the tracking of sheep during their lifetime. All sheep farms currently maintain a holding register and information about sheep moving onto and off of the farm. The government want to use the tracking system to monitor sheep movements, so that in the event of a disease outbreak they can determine which sheep have mixed together over a period of time. The system will also keep track of which animals have been treated with medicines and which ones have been treated against parasites.

The pilot study will start with two adjacent farms located in Ceredigion.

1.2 Requirements

- Sheep need to be tracked arriving and leaving the farm
Being bought/sold or being born/death.
- Request status of all sheep
The Government wants to be able to request all details of all sheep and must be available no later than 2 hours after the request has been made.
Sheep that left the farm must also remain on the system for records.
- Location of each sheep in the field
- Which field a sheep is in
- identify holes in the fence
note: each field is a different size
- Farmers visit the fields twice a day on average to take food and water.
- Display movements of sheep over the past week on a map.

1.3 Alerts

- If a sheep has not been detected for a specified number of hours
- A sheep has entered an area known to be used to lambing and has stayed there for a period of time. This might help indicate when sheep are due to give birth.
- A sheep from the neighbouring farm has been detected on the farm. The two farms keep different breeds and the farmers don't want any cross breeding. They want early detection so that they can remove sheep.

- A sheep is no visiting the feeding/watering area regularly. This may be a sign of illness.

The farms have wireless networks that cover the main farm buildings on each farm, but the networks do not cover all fo the farm land. There is a mobile phone coverage across the area, but it is patchy and intermittent in places.

2 Solution

2.1 Server

- Located in main farm building.
- Runs a database.
- Connected directly to router/internet
- Centralised processing
- Web interface for farmer interaction (requires another device with a web browser to access interface)
- Wires extension to an xbee relay by the fields
- 1TB hard drive for storage. Excessive amount due to storage being cheap

2.2 Sheep device

- zigbee radio
- Litium Polymer battery (XMah)
- Possibly an arduino pro micro

2.3 Fence Device

- zigbee radio
- Lithium polymer battery (smaller than sheep ones)
- Mains supply as it is a fixed device
- Used as a known point of reference for localising the sheep

2.4 Data

- Sheep ID (possibly the same as its rfid tag)
- Peers in range
- Peer signal strength
- Data sent through mesh network to router node
- Data sent from router node to central server for processing
- Stored on central server database

2.5 Notes

- Angle of arrival
- Time difference
- Signal strength
 - 3 Methods of localisation
- RSSI - recieved signal strength indication is the best method due to no extra hardware being required and have a much lower power requirement
This is done by knowing the original signal strength (standard for all devices used) and how the signal degrades (power propagation loss model).
The disadvantage to this method is that objects in the environment can disrupt the signals causing inaccurate readings, such as the other sheep.

2.6 Specs

2.6.1 Jennic JN5139 Zigbee module

Jennic JN5139 ZigBee Microcontroller

- 2.4GHz IEEE802.15.4compliant transceiver
- Wireless ZigBee stack with AES Security
- Deep sleep current ;0.4uA
- 32-bit RISC low power processor
- Sleep current 2.6 microA
- TX current 37mA
- RC current 37mA
- 18x30mm size
- 1km range with external antenna
- typical 400ft

2.6.2 Battery

2000mAh Lithium Polymer battery

- 2000milli amp hour capacity
- 3.7 volt output
- weighs 36 grams (1.27 ounces)
- -25 -; +60degrees operating temperature
- 5.8 x 54 x 54mm size

2.7 Costs

- JN5139 zigbee/microcontroller unit 25 Euro for single unit but bulk discount to 20 Euro per 100 units at mouser.com
The Jennic JN5139 ZigBee Module with ceramic antenna JN5139-Z01-M00R1T is also available at industrialinterface.co.uk for 21.47 per unit.
- Polymer Lithium Ion Battery - 2000mAh
10.88 from sparkfun electronics
6Ah version for 25
- ASROCK ION3D152D/B Nettop PC
Could be used as the server, small at 195x70x186mm
2GB RAM, Intel Atom processor for low power, dual core 1.8Ghz, plenty for the processing needed
274 from scan.co.uk
comes with 320GB HDD
- 1TB 2.5" HDD
60 from novatech.co.uk
Samsung M8 1TB 8MB Cache 5400RPM SATAII

2.8 Alternatives

GPS

High power consumption and expensiveness of devices makes it impractical for monitoring sheep in a field.