CSSE4011 Project Topics 2017

Raja

1. Use the sensor tags to develop a peer-to-peer data muling app in a relevant mobile application. The application should support:
    - sensing of an indicator of interest
    - storing data until you encounter another node
    - implementation of a protocol that decides when and which node to forward data to (this may be repeated across multiple hops)
    - eventual data delivery to the base station when one of the mobile nodes encounters the base station

2. Use a few sensor tags with gas or sound sensors (microphone) as a wearable device. Use wearers as 'mobile environmental sensors' to capture the state of the environment and generate heat maps of sound or gas concentration. For instance, if CO2 is selected, you can use maps to identify potentially crowded areas.

3. Develop an application that implements machine learning on the sensor tags and/or the android phone to adapt the sampling frequency of the sensors on either tags or phone to changing context. Examples of such an application are:
    - Changing your location sampling frequency depending on your activity
    - Adjusting music volume/filtering on smartphone based on observed noise

Phil

1. UQ Bridge Monitoring:
    - interface SensorTag to http://www.ti.com/product/PGA900
    - sample at 100-1kHz and attempt to send data back (possibly using lossless compression of data)
    - perform some signal processing or anomaly classification on the SensorTag
    - Focus on achieving low power operation utilising energy harvesting (probably solar) for perpetual (though likely duty cycled) operation

2. Implement (or port) BLE stack with GATT services layer to modify sensor sampling schedules and download historic data from the SensorTag
    - implement a variety of periodic and event (motion, light change etc) triggered sampling schedules for a variety of sensors
    - implement GATT layer (https://learn.adafruit.com/introduction-to-bluetooth-low-energy/gatt and https://developer.bluetooth.org/TechnologyOverview/Pages/GATT.aspx)
    - use GATT layer to configure various sampling schedules

Navinda/Matt

Acoustic fingerprinting: Localisation using tablets

Given the ubiquitous nature of mobile phones capable of significant processing power with a suite of sensors makes it possible to use these devices to derive rich contextual information from its surroundings. Indoor localisation is a challenging problem and is an active research area. Location identification and activity detection using acoustics with mobile phones have been studied in the literature with varying degrees of success [1,2]. The published work attempts to identify which room a device is located using the ambient acoustic signature of that particular room. In this project, you will attempt to increase the accuracy of the localisation compared to work by Tarzia et al [1], as well as increase the resolution of the system to try an identify which area of the room the phone is located in. An additional extension would be to add activity detection capability to the system as described by Lu et al [2].

References

[1] S. P. Tarzia, P. A. Dinda, R. P. Dick and G. Memik (2011), Indoor Localization Without Infrastructure Using the Acoustic Background Spectrum, In proceedings of MobiSys 2011

[2] M. Azizyan, I. Constandache, and R. R. Choudhury (2009),SurroundSense: mobile phone localization via ambience fingerprinting. In Proceedings of the 15th annual international conference on Mobile computing and networking (MobiCom '09)

[3] H. Lu, W. Pan, N. D. Lane, T. Choudhury and A. T. Campbell (2009), SoundSense: Scalable Sound Sensing for People-Centric Applications on Mobile Phones, In proceedings of MobiSys 2009

UQ Lake Water Quality Sensing

Wireless Sensor Networks are commonly used for monitoring environmental factors such as humidity, temperature and water quality. This project will involve developing three wireless sensor nodes: Wireless Solar Radiation, weather climate monitoring and water quality logger to be used on the UQ Lake.

- The solar radiation logger using the LI-200R Pyranometer Light Sensor should provide regular solar radiation readings, which will be used to model the solar radiation absorbed by the lake, in-conjunction with other parameters.

- The weather climate monitoring node using the Vaisala climate sensor should provide regular readings.

- The water quality logger using the exosonde water quality probe, should provide regular readings, which will be used to model water quality of the lake, in-conjunction with other parameters.

The system should be based around a sensor tag or a neomote platform. There should also be a smartphone app that can access each logger individually and the online database. A heat map of the SRS showing the sensor readings should be produced. Advanced challenge to display the sensor history in a peruvasive manner.

Indoor Localisation using Magnetic Field Sensing

Indoor environments can exhibit fluctuating magnetic fields due to the presence of metal infrastructure and electrical equipment. This indoor localization project will attempt to use magnetic field sensing fingerprints to determine a user's indoor position. This project will involve using a mobile phone's magnetometer or sensor nodes to map the magnetic fields in various indoor environments. The Encog neural networking API will be used to determine a user's position.

http://www.heatonresearch.com/encog
https://www.youtube.com/watch?v=iHVoI1n89TY

Sensortags Improvements

The sensortags are a new platform with many features but with exhibits problems with programming, powering and usability.

- Improve the sensortag usability by modifying the sensortag to use the serial bootloader.
- Add wireless recharging.
- Add a wireless/Bluetooth bootloader programming (similar to TI example)

Thermopulse Improvement

The thermopulse was a project from 2015/2017 that attempted to measure a person's heart rate using the Flir infrared imager. Improve the thermopulse project to measure a multiple heart rates from different people, within view of the Flir infrared imager.

Thermopulse for Tracking Project A

The iRat robot is a rat-sized robot with the abilities of a PC-on-wheels. It is used for a range of neuroscience studies interacting with real rats, and cognitive science studies evolving robot languages and interacting with people. This project involves development of a tracking software for rats and iRats in an arena using an overhead thermal sensor (Lepton).
Pre-requisites : openCV, Linux OS and python

Thermopulse for Tracking Project B

The iRat robot is a rat-sized robot with the abilities of a PC-on-wheels. It is used for a range of neuroscience studies interacting with real rats, and cognitive science studies evolving robot languages and interacting with people. This project involves development of rat's body temperature monitor used to differentiate mood states using an on-board thermal sensor (Lepton).
Pre-requisites : openCV, Linux OS and python

LIDAR Person Localisation Tracker

A LIDAR is a laser Radar that can be used to measure the range of objects, within view. Use a LIDAR (laser Radar) to track multiple people in a room. Create a rig for moving the LIDAR in a scanning pattern. Display the positions with a tablet.

~~iBeacons Person Localisation Tracker (already assigned)~~

~~ibeacons use Bluetooth Low Energy to determine a person's room or area location within a building. Use ibeacons estimotes to track multiple people in a room and to improve the location accuracy. Display the positions with a tablet and with an augmented reality interface (Google cardboard on tablet).~~

Augmented Reality (AR) using Sensortags

Overlay the position of a mobile tracking device (tag) on top of your camera feed from your phone. Use your phone's sensor for self-localization and self-orientation (GPS + digital compass + accelerometer). Calculate the position of another device (tag) and display it on your screen (you can build upon existing AR libraries for this step). Use information from barometric pressure sensors on the phone and on the tag to compensate for errors in the GPS altitude.