Principles and Design of IoT Systems (PDIoT) [INFR11150]

School of Informatics
University of Edinburgh
Coursework issued on 18 September, 2020 | Deadline – 16:00, 17th January, 2021

The PDIoT coursework (worth 70% of the marks) is conducted by students working in pairs to develop an Internet-of-Things application based on wireless Inertial Measurement Unit (IMU) sensors. Students will experience the different stages in the design and implementation of a complex system, from its specification to the demonstration of a working prototype and evaluation of its performance. You will be exposed to aspects of embedded systems programming, sensor data analytics using machine learning techniques, mobile application development, user interface design, and system integration and testing.

Each student pair is given a set of Mbed development board (NRF52-DK), Inertial Measurement Unit (MPU-9250) with 3-axis accelerometer and gyroscope sensors, and an on-line software development environment – the ARM Mbed compiler. Your task is to design and implement a Step Tracker for walking on level ground, running and climbing stairs using the wearable sensor which interfaces to an Android App and demonstrate a working prototype on Wednesday, 4th December, 2019. Your final written report is due by 16:00, Friday, 17th January, 2020.

Organisation: Weekly tutorials are held on Wednesdays between 10am and 1pm. Student pairs should sign up for one of the three 1-hour slots and **are required to attend** the weekly tutorials. Lockers are provided in the room for storing their boards and accessories.

Week 1 Timetable: Students wishing to take this course should attend the first lecture at 10am on Tuesday, 17th September 2019 in Room 2.3 Lister Learning and Teaching Centre, and the first tutorial at 10am on Wednesday, 18th September, 2019 in AT3.09 (After the first week students can sign up for one of the three 1-hour tutorial slots at 10am, 11am or 12 noon on Wednesdays).

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Schedule:

Discover -

Week 1: First meeting of the PDIoT students; Explanation of the assignment; Demonstration of an end-to-end IoT system as an exemplar; Pairs will be formed, and students will collect walking data with the sensor which will be deposited in a shared repository.

Define -

Week 2: Capture the requirements and use cases for the application; Description of sensor data collected in Week 1 and possible approaches to data analysis and step tracking algorithm development.

Develop -

Week 3: Introduction to Android development. By following week: Implementation of app to perform step tracking on level ground in real time. Display step count in Android app.

Week 4: Demonstrate working step tracking algorithm on level ground for walking and running with step count displayed in Android app.

Week 5: Demonstrate working step tracking algorithm climbing up and climbing down stairs, with step count displayed in Android app. Receive feedback and integrate over the following week. [**Formative feedback to students**]

Week 6: Introduction to mbed platform and development environment, NRF52 development board. By following week: transfer data from board (connected to accelerometer and/or gyroscope) to Android app using BLE.

Weeks 7 – 9: Algorithm Migration: Implementation of step tracking algorithm on the NRF52 development board.

Week 10: Second demonstration of step tracking algorithm, ideally implemented on board. Receive feedback and integrate over the following week. **[Formative feedback to students].**

Week 11: Performance analysis of step tracking/power consumption/classification. Preparation of presentation and final demonstration.

Week 12 (4th December, 2019): 10-minute presentation and demonstration by each pair to the Course Lecturer followed by a 5-minute Q&A session. **[Feedback to students]**

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Submission: The .pdf version of the final individual report should be submitted (using the DICE electronic practical submission system "submit" command[1]) no later than **16:00, 17th January, 2020.** You should include all your code within a "code" subdirectory with further subdirectories for each platform, e.g., Python, Mbed, Android. You should be clear in your report which parts of the project you had implemented.

Report: The report (in 11pt font) should not exceed 15,000 words (excluding Bibliography and Appendices) and should be organised along the following chapters:
Title page: PDIoT coursework (2019-20); Project title; Name; Matriculation Number; Abstract.
Introduction: The project aims; brief description of the method adopted; summary of the results.
Literature survey: A review of the state-of-the-art for step counting algorithms.
Methodology: A description of the system and its implementation: hardware and firmware, wireless communication, algorithm for step counting, mobile application, software organisation, and testing.
Results: Critical analysis of the implementation using quantitative methods; benchmarks used.
Conclusions: Reflection on the project, and how you might wish to extend the project and improve on the implementation.
You should use diagrams, drawings, photographs, and graphs where possible to supplement the text.

Assessment:

Students will be awarded individual marks (out of 100) based on the oral presentation in Week 11 and the final report, and the breakdown of marks and criteria for assessment are as follows:

[**Technical evaluation – 60%]**: Completion of the project; degree of difficulty; quality and amount of work undertaken; justification of design decisions; software design for reusability.

[**Presentation – 20%]**: Quality of the oral presentation (50% - 10 marks) and the written report, including the literature review (50% - 10 marks).

[**Analysis – 20%]**: Critical analysis using quantitative methods; performance analysis.

Final marks and feedback will be delivered by 31st January, 2020.

[1] http://computing.help.inf.ed.ac.uk/practical-submission