The University Of Sheffield.

Electronic & Electrical Engineering

# APPLICATION FOR A DEREK GRIESS SUMMER PROJECT 2014

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| Project title: | Sleeping helper (special thermostat) |

## 1. Applicant Details

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| Name: | Tai Li |
| Contact Telephone No: | 07453-327579 |
| Email: | tli6@sheffield.ac.uk |

## 2. Potential Industrial Partner Details (if any and not essential)

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| Organisation Name: | |
| Address: | |
| Contact Name: | |
| Telephone (include full STD code): | |
| Email: | |

## 3. Project Details

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| Proposed Start Date: | 16th-June(I will not be working for this project from 4th-Aug to 29th-Aug) |
| Proposed End Date: | 19th-Sep |

**Project Summary (Maximum 300 Words)**

*Please provide an overview of project, including background to the project, an overview of the work to be undertaken, and the next stages anticipated if the project is successful.*

*International students and fresher usually trend to live in student accommodations where they pay fixed bills, such as electricity bills. However, they often have sleeping issues in the winter since the timer of the radiator typically found in such student accommodation work for a maximum period of two hours. Therefore, if they wake up because they feel cold, they either have to get up to turn on the radiator again by pressing a button on the timer, or stay in the bed and hope they can fall asleep again. Of course, buying a mobile radiator is not a bad solution since it can be on for the whole night without being automatically shut down. Plus it does not violate the accommodation regulations since the bill is fixed. But a mobile radiator may be costly, and it takes up extra room. To address this issue, the essential aim of this project is to develop a simple, cheap, reliable thermostat attaching to the radiator timer so that the thermostat is able to press the button on the existing room timer automatically to make sure the radiator is as necessary on throughout the night. The product also has additional product requirements, such as reasonable energy saving, smart controls to keep a constant temperature. This project will involve product requirements definition, project management, documentation writing, system design, simulation, verification, and hardware prototyping with mechanics, hardware, and software. If this project is successful, in the marketing perspective, hardware prototype will be given as a gift to who want to use it in the winter and the users need to give feedback in return. In the engineering perspective, the future roadmap for this product could be either an upgraded version of this product with new features, such as generic mechanical system, less power consumptions, or building up a smart home system with wireless communications and smart controls, and this thermostat is just one of the primary elements in this system.*

**Outline Project Plan**

*Please include details of objectives, deliverables and timescales and any stage gates. Include details of any specific deliverables.*

1. Product requirements definition phase (1 week). A general investigation on different radiators in student accommodations will be carried out in the first place, such as measurements in size of the timer, spring constant of the bounced button. And a survey will be carried out to potential users, e.g. my friends, to look for the possible and desirable product requirements. Furthermore, general investigation on the components I am probably going to use in the product development, such as, battery lifetime, working temperature. Based on the results, by using S.W.O.T analysis, the product requirements will be defined and documented.
2. Engineering Design and implementation phase with subsystem verification (5 week).
   i) System architecture design (3 days). Based on the product requirements, the system design will be divided to five parts, mechanical subsystem design, software subsystem design, hardware subsystem design, product physical design (e.g. size of the product, user interface), and interface between subsystems (e.g. setting requirements of current in hardware system, to ensure the maximum current microprocessor drive exceeds the hardware system maximum needed for driving the switch).
   ii) Mechanical subsystem design (2 week), two or more mechanical subsystem prototype will be built up based on system requirements, e.g. size of mechanical system, the minimum force it need to support. The first candidate would be made up of mechanic clamp, DC motor, and button, using a clamp kit to try which gear and camp fit best. The second candidate would be an electromagnet kit with some clips. The third, if possible, would be a screw-like stick with one head connected to the motor, another head connected to outside. If there is no solution managing to work, a replacement will be using a commercial electromagnet to implement the mechanical subsystem.
   iii) Hardware subsystem design (1 weeks and 2 days), there will be a proper design of switching circuit to the mechanical system. The system consists of power supply circuit, choosing proper microprocessor, microprocessor surrounding circuits, reliable switching circuit, reliable peripheral circuits (e.g. GPIO to the user interface, thermal sensor, ADC). The hardware design is critical since it is in between software and mechanic subsystem. When the design goes great in the simulator, building up a hardware prototype and tests it.
   iv) Software subsystem design (3 days), the software would be relatively simple. According to the

radiator characterises, a constant sampling on the temperature resulting in turning on/off radiator by pressing bottom. The low level software on controlling switching circuits and reading ADC will be implemented when hardware prototype has been done and it passed the test suite. (i.e. a series of tests against specification)

v) Interface verification and product physical design (2 days). Interface between hardware and mechanical subsystem, software and hardware subsystem, need to be varied in the first place. The physical interface of the product needs to be strictly designed according to the product requirements.

N.B. Every design, verification, tests will be documented with revision control.

3. System verification and product validation with bug fixing (3 weeks).
   There will be smoke test suite on mechanical subsystem, (e.g. using current sources/wave generators to simulate the signal generated by microprocessor) hardware subsystem, (There are lots of tests needed to run, e.g. reading GPIO, writing GPIO) software subsystem (e.g. writing assertions with 100% coverage on the code, and running tests to simulate what user will do to ensure code can handle any possible errors). When the subsystems pass each test suite, system test suite will be run, majorly on critical operations and scenario-based tests. Once the system passed, a validating process on the system will be carried out against the product requirements specification. There might be some trade-off in this phase if a major defeat exists in the system.

4. Reporting (1 week)
   A report will be written in terms of the whole of project. Any features, instructions, further improvements to be done and error errata will be declared. Furthermore, in its appendix, the final released specifications of product requirements, system requirements, design, verification, tests, and test results will be attached.

**Resources Required**

*Please provide details of the resources required for the project including:*

*i) Access to equipment*
*ii) Consumables, travel, expenses*

i) EEE department mechanical workshop (e.g. building up mechanical subsystem)
ii) EEE lab workbench (e.g. soldering, testing using wave generator)
iii) Lab desktop (Circuit simulation software, e.g. Proteus, LTspice PCB layout software, e.g. Proteus )
iv) Free revision control software with documentations and code (they also can be downloaded online)
v) Hardware implementation:
PCB manufacturing –£0,
Mechanical clamp toolkit - £15,
Other components
(e.g. battery - £1, ARM M0 cheap microcontroller - £1, motor, electromagnet ) - £15

Total expense: #40

**Potential IP Position (if any and not essential)**

*Please provide full details of any background IP required for the project and the status of this (e.g. submitted COD, filed patent, granted patent)*

N.A.

**Name of Proposed Academic Supervisor**:

**Peter Judd**

## 4. Signature

| I confirm that I wish to apply for funding for the Derek Griess Summer Project. | |
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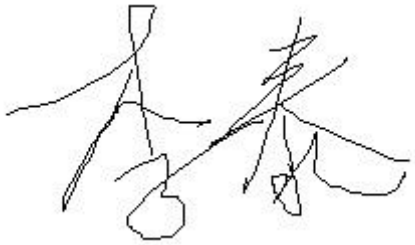
| Signature of Student: |  |
| Date: | 24th/Apr/2014 |

## 5. Return

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| One signed electronic copy to: Hilary J Levesley<br><br>Or send a hard copy to: | h.j.levesley@sheffield.ac.uk<br><br>Hilary J Levesley<br>Postgraduate Research Administrator<br>University of Sheffield<br>Department of EEE<br>Sir Frederick Mappin Building<br>Mappin Street<br>Sheffield<br>S1 3JD |

## Derek Griess Innovation Summer Award

Thanks to a generous bequest by Dr Eugene Derek Griess, an alumni and Mappin Medal winner from this Department (1934,1938), the Department is able to fund a number of vacation bursary students. Students (2nd & 3rd Year) will be paid a bursary of £2,000 for a 10 week period over the summer, and will have full access to the facilities with the Griess Laboratory in Portobello. There will also be some limited funding for small consumable items.

The project should ideally involve some aspect of student innovation and enterprise, through prototype production and test. Collaborations with industry are encouraged. It would be helpful if students could identify a potential academic supervisor for this duration. For further information about this scheme, please speak to your Personal Tutor. To apply for support to develop an idea, **please fill in the attached form and submit to Mrs Hilary Levesley in E133 before Friday 25 April 2014.**

Hilary J Levesley