

**SCHOOL OF ELECTRICAL, COMPUTER AND TELECOMMUNICATIONS ENGINEERING**

# ECTE451 PROJECT PROPOSAL FORM

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| **1. Candidate Details** | |
| **Name: Kane Stoboi** | **Student No: 3897370** |
| **Supervisor: Zheng Li** | |
| **Title of Project:**  Stepper Motor Feedback Control System | |
| **Brief Overview:**    **Write a paragraph on why this is important.**  **To solve the issue with current control methods etc…., a** stepper motor control board based around the TMC2100 will be designed to operate a bipolar stepper motor silently and accurately. A feedback system will be used to monitor the incoming step signals from an external controller as well as the actual movement of the stepper motor shaft to ensure no steps are lost during operation. The control board and feedback system will be able to attach easily to the stepper motor requiring little to no modification to a motor. | |

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| **2. Project Description:** (Expand to one page maximum) |
| *Describe your project. Questions that you should answer are:*   * 1. *What problem is being addressed?*   2. *Why is this project important?*   3. *What are the objectives and planned outcomes of the project?*   Stepper motors have become a common component used in positioning systems in many applications such as robotics, printers as well as medical and industrial applications. The decision to use stepper motors over traditional DC/AC motors are largely due to their accurate position, speed and motion control [1]. Stepper motors, being brushless motors, require a H-bridge circuit to achieve motion with digital signals controlling the switching of the MOSFETs to energise the stator coils. Although this current chopping is generally the most efficient way of driving stepper motors it induces audio-frequency noise due to the constant energisation and de-energisation of the stator coils. This project will evaluate the option to reduce this audio noise.  Traditional stepper motor controllers use a current controlled chopper design, a voltage controlled chopper design can significantly reduce the vibrations and mechanical noise. Although this technique is able to reduce the audio noise emitted from the induction coils of a motor, it does this by reducing the torque applied, in turn, causing motors to skip step movements Find 1 or 2 references for this. The objective of this project is for a stepper motor driver board that will operate a stepper motor silently while not compromising on the speed or accuracy of positioning and utilise hardware that will remain within the $350 budget.  This project will take 451 and 458 to complete, so the planned outcomes for 451 have been developed with the objectives for 458 to be re-visited upon analysis of the preliminary results.  For 451, the initial literature will be analysed and preliminary simulations/experiments will be run. This will include component research and selection, circuit topology investigations and comparison of results against existing control methods. |

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| **3. Project Plan:** (Two pages maximum) |
| Detail your project plan. This should be a resilient engineering plan accommodating realistic alternatives and contingency measures to meet the objectives and assuming a total duration of two sessions (including ECTE458). Budget constraints should also be considered. Questions that you should answer are:   1. What do you intend doing? Briefly describe the methods that you will use to achieve the objectives stated above as well as the software and/or hardware that will be developed. 2. Why is this strategy being adopted? Indicate with reference to the literature you have read so far. 3. How do you intend to validate your solution/experimental results/simulations/procedures? 4. What is the timeframe for achieving the project objectives? Indicate all milestones and deliverables, clearly showing specific outcomes to be achieved by the end of ECTE451 (no Gantt chart required).   The project will require the design and manufacture of a custom circuit board which will entail the procurement of various electrical components. The stepper motor controller will be based around the TMC2100 which will be controlled using an MCU. Additionally, an encoder will be used for the shaft position sensing and provide feedback to the control system. A stepper motor will be required to mount the controller board to and perform controller testing.  The MCU software will be written in C++ and will not require additional software resources other than the manufacturers IDE. Open-source software will be used for schematic and PCB layout requiring access to a computer.  The main experiment to be performed is the comparison of the developed control board with an existing controller such as the Pololu A4988 with data being collected on the accuracy, speed and audio noise of the motors being driven. The software algorithms will be validated in MATLAB before implementation in C++. The final hardware will be tested using correct probing techniques with an oscilloscope against competing algorithms.  test multiple control algorithms on the same motor to get a fair comparison, and say something about the constants throughout experiments here.  d – Expand this into paragraphs.  Tasks   * Complete WHS risk assessment * Meet with workshop staff to discuss project * Component selection (feedback system) * Design of schematic and PCB   + Design of schematic   + Design of PCB including all trace routing and GERBER generation * Order parts * Order PCB * Develop control algorithm that implements feedback into the driver control * Develop MCU Software * Testing of Hardware * Testing of Software * Testing of System |
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| **4. Resources Required:** (Expand to a half a page maximum) |
| This statement should identify any materials (software/hardware) or access to infrastructure required to complete the project.  As the MCU software will be written in C++, it does not require any additional software other than open-source software. will be used for schematic and PCB layout requiring access to a computer. This will not require any purchase of parts.  Being a hardware-based project, there will be the purchase of components through the SECTE Store. As the focus of the project is on a low-budget control system, it is envisaged that the budget will remain below $350 as required.  To test the hardware and software control system, access to a laboratory will be required to use equipment such as power supplies, oscilloscope, multimeters and function generators. To ensure that the developed system can be tested against comparable control systems used in research and the real-world, access to a laboratory will be sought out after completing the relevant WHS induction. |

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| **5. Literature Planner:** (Expand to a two page maximum) |
| Attach as an appendix |

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| **6. Mind Map:** (single A4 page) |
| Attach as an appendix |

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| **Student Signature**  ***Declaration by the student: I have understood the feedback provided to me by the supervisor.*** | | |
|  | **Signature** | **Date** |
| **Student Name:** |  |  |

**A marked assessment rubric will be appended once completed**