552b Low Cost Experimental Kits for Undergraduate Process Control Education

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Undergraduate chemical process control courses typically present a fundamental basis of modern chemical process operation focusing on topics such as dynamic system modeling and traditional feedback control. The theoretical concepts are often dif cult to convey to students, particularly without providing them with the opportunity to actually apply what they have been taught. For this reason, a number of process control experiments have been developed and used across the country to reinforce the material covered in lectures [1, 2, 3, 5, 6, 7, 8]. The hands on experiments provide the students with the opportunity to actively explore the connection between the theoretical content of the course and its application on real physical systems, often with the additional bene t of active learning in a small group environment [4, 9]. Unfortunately, many commercially available experimental systems are complex and thus too expensive, as not all institutions have the resources to provide each student with an adequate opportunity to experiment with such an apparatus. This work addresses this need through the development of a number of simple, extremely low cost experimental systems.

A series of inexpensive experimental kits have been designed for use in undergraduate process control education. Each simple system involves a number of analog and/or digital process inputs and outputs that are both observable and tangible thus lending to their pedagogical value. The kits utilize a USB interface data acquisition board to connect with software packages such as MATLAB/Simulink and LabView. This allows the students to propose and carry out a number of open- and closed-loop activities. One such system involves the use of a DC controlled dimmer to manipulate the intensity of a standard light bulb, which intern affects an adjacent temperature measurement taken using a thermocouple. In this case, students can easily collect open-loop data and model the relationship between the intensity of the light bulb and the surrounding temperature. Additionally, they can implement closed-loop control schemes to maintain the desired temperature at various setpoints in the presence of process disturbances such as cooling caused by the introduction of a fan. These portable kits offer a truly low cost means to incorporate hands on application of theoretical concepts into the typical process control course.

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