Remote Laboratories with Learning Management System
Abul K. M. Azad(PI), Pramod Kaushik, and Munish Sharma, Northern Illinois University

Introduction
Remote laboratory implies experimenting on real hardware over the Internet. The main drawback of available remote laboratories is the lack of an efficient learning management systems (LMS). Most of the available LMS are planned for lecture classes (online or hybrid) and are not suitable for remote laboratories. Considering this, the authors developed a custom designed remote laboratory with integrated LMS. This poster presents the design and development of the system.

Remote Experimentation
Design of remote experimentation part involves:
• Customization of experiments for interfacing
• Connecting with the switching bank
• Interfacing with a computer via an I/O card
• Development of GUI
• Transform the GUI as a web page

Pedagogical Design
The pedagogical design involves a blended learning approach by synergic combination of four components: face-to-face instruction, cognitive apprenticeship, discovery learning, and experience sample method.

Sample Experiments
There are a number of experiments developed for the project. Two of those are shown here.

a) Flexible manipulator system: Single link manipulator with horizontal plane motion. Goal is to study its behavior as well as controller designs.

b) Roomba Create: Open structure mobile robot development system. Goal is to controlling for indoor surveillance.

Learning Management System
Serves as a portal for remote laboratory delivery as well as management of a course.

Conclusions
The proposed system has been developed with all hardware and software components. A series of testing has now been underway to validate the accuracy and effectiveness of the system. Major challenges for this project are the interfacing of interdisciplinary components while considering pedagogical issues.

Acknowledgments
The authors would like to thank the NSF for the support for the reported work. Most of the work are based on NSF’s CCLI project, DUE-0837138.