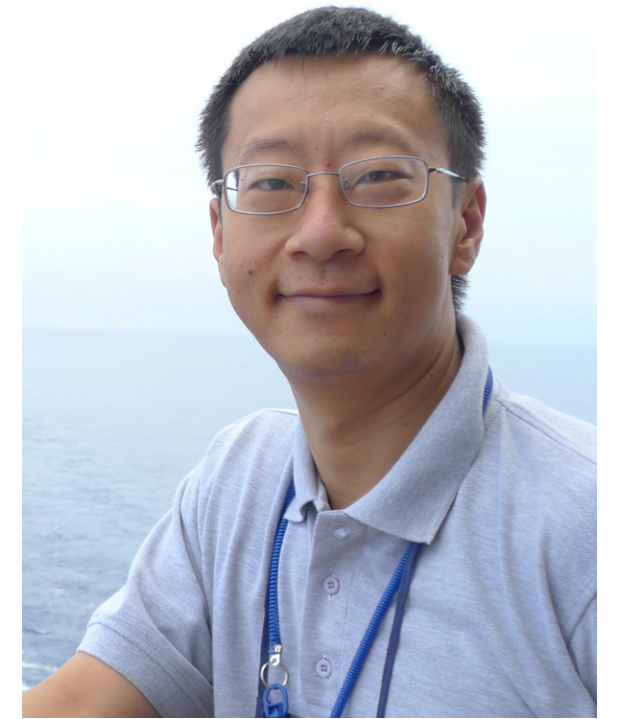


# Developing Security Education Materials for Future Advanced Manufacturing Engineering Workforce

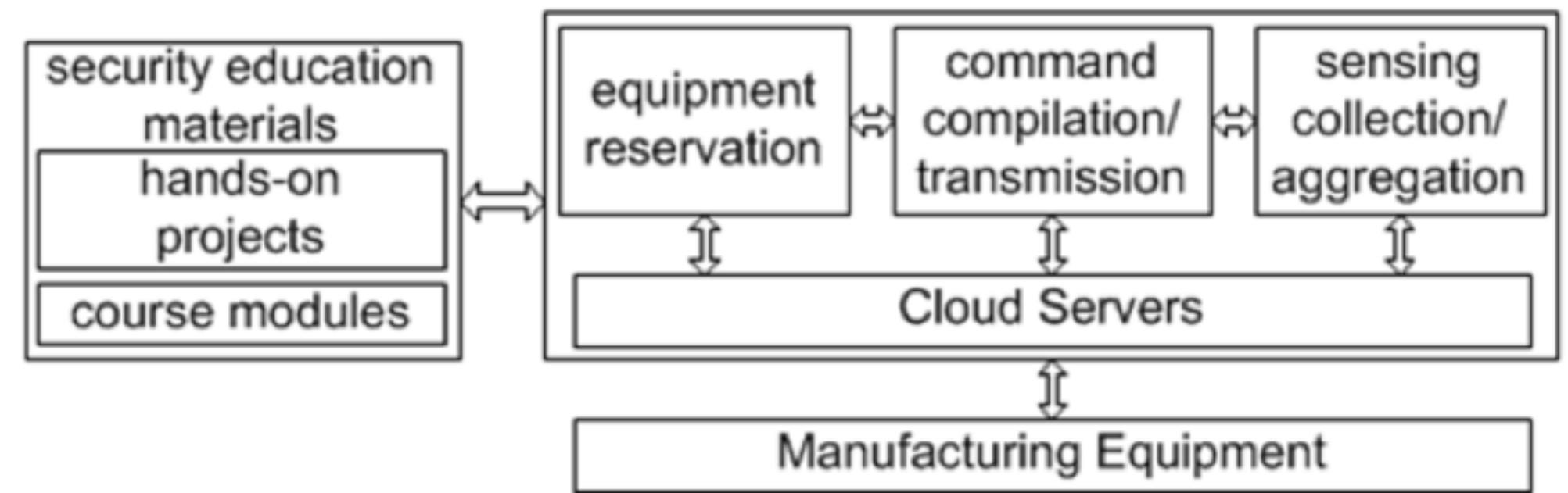


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<https://webpages.uncc.edu/wwang22/Research/projects/AdvancedManu/index-advancedmanu.html>

## 1. Objectives

- Design a comprehensive suite of course modules and hands-on exercises for security education in advanced manufacturing systems;
- Contribute to the establishment of an education and training pipeline for equipping manufacturing workforce with network and information security knowledge;



## 2. Challenge Contents

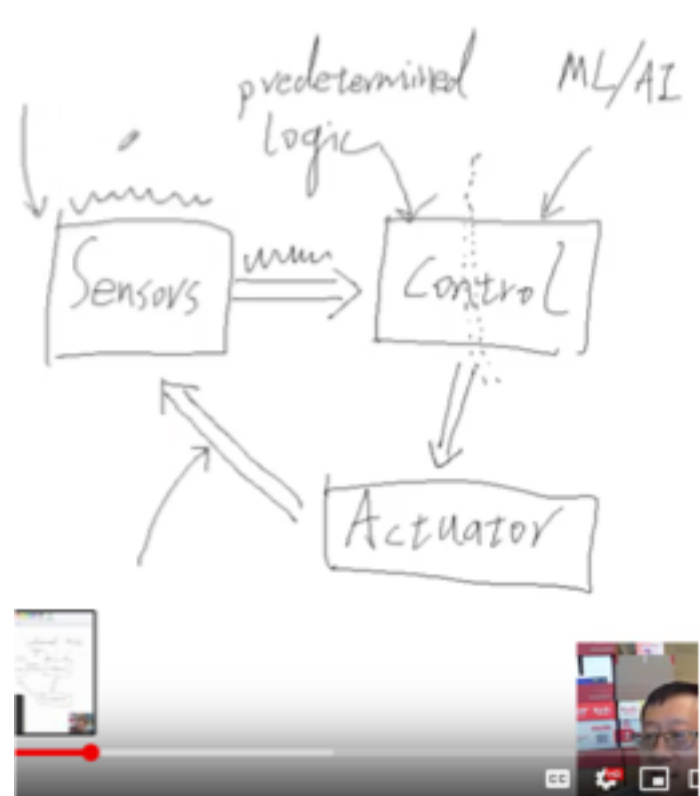
- In 2016, attacks on Industrial Control Systems (ICS) increases about 2000%;
- Limited educational materials or hands-on learning resources are available for security education in AMS;
- A serious challenge for the training of qualified workforce to fill tens of thousands of positions in the fast evolving manufacturing industry;
- The language and problem solving strategies in CS and Engineering majors are often different;

## 3. Scientific Impacts

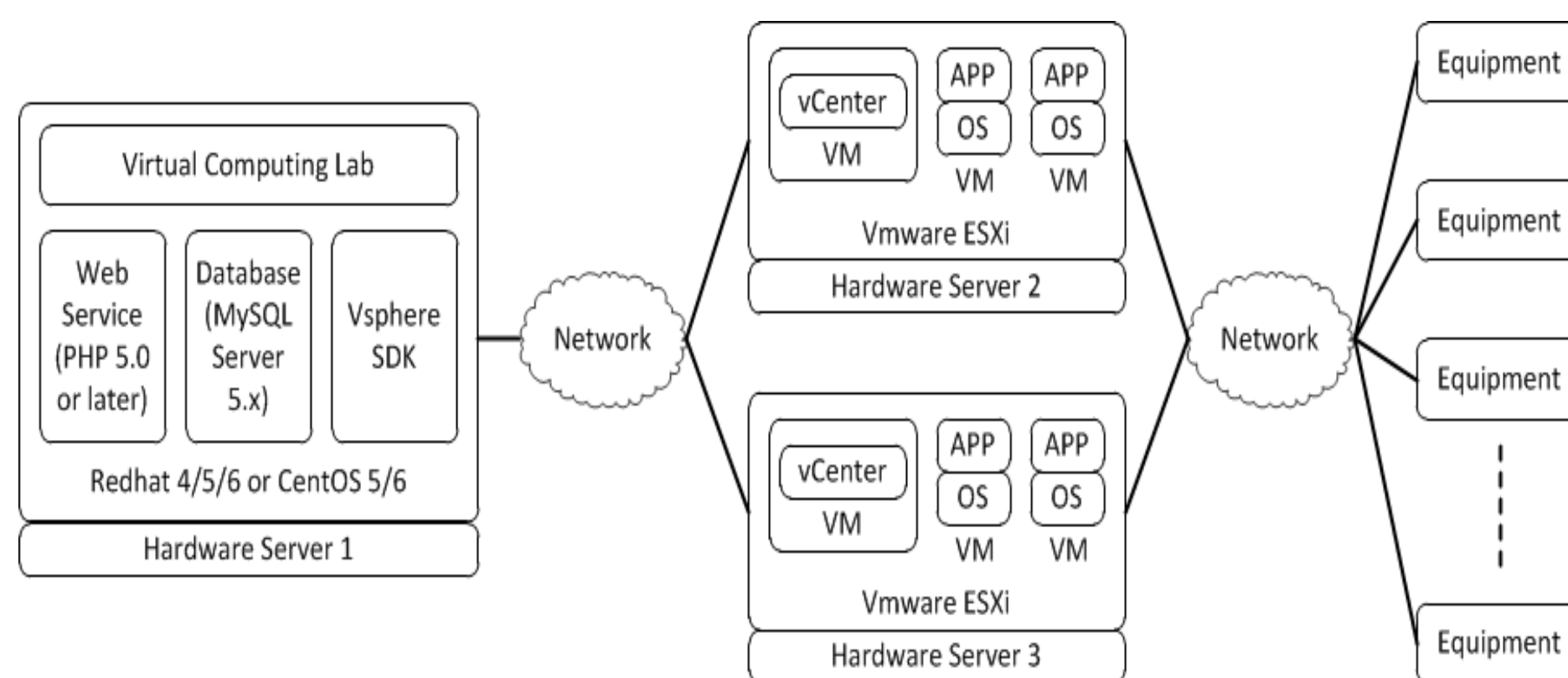
- ICS systems are widely used in major CPS domains such as transportation, power grid, intelligent healthcare, and smart city;
- Non-intrusive security enforcement for legacy systems is essential in these fields;
- This project explores design of educational materials and carries out practices in both CS and Engineering courses;
- Collect experiences and evaluation results for future generalization to other CPS fields;

## 4. Project Deliverables

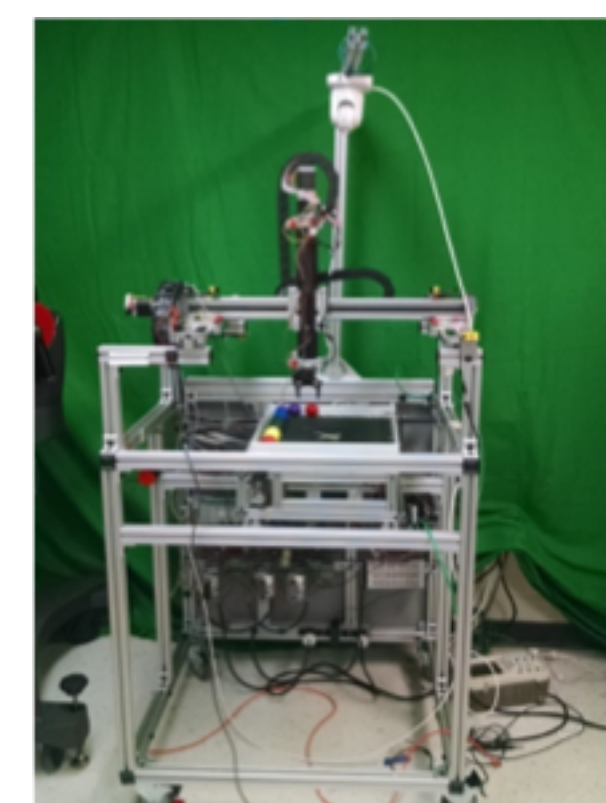
### Course modules



### Experiment platform



### PLC experiments



### Algorithm

```

Input: task T, equipment set E;
Output: equipment assignment E1 to En;
initialization;
for each subtask Ti do
  locate the equipment set {Ei} that can accomplish Ti;
  assume that ||{Ei|| = si;
end
generate all possible assignments for T: Πi si;
calculate cost of all equipment assignment solutions;
sort assignment solutions based their costs;
for each assignment do
  locate other assignments within cost bound (1+α);
  determine whether or not the two assignments can function in parallel;
  if two assignments can function in parallel then
    return the assignments;
  else
    continue to search;
  end
end
Algorithm 1: Identify equipment assignment with remaining capability that can satisfy the cost bound.
    
```

## 5. Impacts on Society

- Small to medium sized manufacturers are essential for North Carolina's economy. Our project provides security trainings for future employees of these companies;
- The approaches and educational materials can be generalized to other CPS systems such as energy industry;

## 6. Outreach Activity

- Presentations are made at industrial partners of UNCC such as Domtar Paper Company;
- Outreach activities at the Launch Lake Norman Asso. that includes tens of small to medium sized companies in Greater Charlotte area;
- Presentations for middle and high school students;

## 7. Quantify Impacts

- Self Efficacy and Self Regulation surveys show that students in both majors benefit from the project;
- Materials are offered to both CS graduate courses and ENGR undergraduate courses, more than 500 students benefited;
- Integrated in new Master's program in Cyber Security;

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