

**ISTD 50.001**  
**INTRODUCTION TO INFORMATION SYSTEMS & PROGRAMMING**  
**Fall 2015**

**Project 2: 1-D Internet of Things (IoT) Design Project**

Last updated on 11-Oct-2015

**Introduction**

In 2007, for the first time, the number of network-connected objects (computers, smartphones, printers, etc.) has exceeded the world's population.

This year, according to a survey commissioned by Cisco, there are a total of 25 billion connected objects in the world, compared with a population of 7.2 billion. That makes an average of more than 3 connected objects per person and the figure is likely to be twice as high by 2020.

The Internet of Things (IoT) refers to the concept that many physical objects or "things" embedded with electronics, software and sensors are connected. Network connectivity enables these objects to collect and exchange data, and eventually perform some intelligent and adaptive operations based on the data. IoT allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration between the physical world and cyber world.

So what can we do with the connected objects?

Perhaps a wearable device on a student can sense the physiological conditions and predict the student's engagement level during a class. A motion sensor can remotely monitor the activity of an elderly, and it can send a message to his/her caregiver's smartphone if some anomaly is detected. In the case of heavy traffic, your car can send a message to other party notifying them that you will be late. And new sensors on your bed can monitor your sleep cycles and wake you up during a light stage of sleep. Indeed IoT offers endless opportunities that may affect how people live, work, learn, play, and sleep!



## **Project Requirements**

Working as a team, you are required to propose, design and build a meaningful solution using the IoT concepts, software and system components. The proposed IoT solution should address an open problem under a broad range of themes, including but not limited to:

- Smart classroom
- Smart campus
- Smart care-at-home
- Smart home automation
- Smart office and workplace

Your solution shall make use of the IoT concepts and employ these IoT components:

- Sensing
- Communication
- Data analytics

It is a requirement that the prototype development shall make use of Java extensively.

Basic IoT framework: During the labs in Week-9 to 11, you will learn about how to build a basic IoT framework that includes: basic sensors, Udoo controller, Arduino controller, Zigbee communication protocol, Android and Java based data processing and analytics. The framework can be a convenient starting point for your prototype. Nevertheless, it is not a requirement to use this framework in your prototype. Furthermore, you are encouraged to integrate additional computing components into the basic framework: smart-watch, cloud computing, etc.

Resource and budget for the project: Students will be provided with the devices to build the basic IoT framework. In addition, each team will be given a budget of \$500 to purchase additional IoT devices, electronic components or other items to accomplish the project. The purchase request needs to be justified and raised early, as it takes time to receive the items.

## **Deliverable, Checkoffs, Grading and Rubric**

### **1. Checkoff-1 [10%]: Problem Framing, Initial Solution, Project Schedule**

Problem framing: The team needs to explore the design and problem area, context etc. The team needs to frame and define the problem, present the key requirements and constraints that will guide their design.

Initial solution idea: The team shall take the problem and propose some initial solution ideas.

Project schedule: There should be a schedule for further exploration of the idea, implementation of the prototype, schedule and deadline for parts and components ordering, and testing and debugging.

The team will present these findings in an oral presentation & hand in the slides for further grading.

## **2. Checkoff-2 [15%]: Problem Framing Update and Proposed Solution**

Solution idea: The students should take their problem and explore the design space for some creative ideas using IoT. The students should decide an idea to further pursue. In addition, they should identify the system and device components that are required. They should order parts and components at this stage.

The team will present these findings in an oral presentation & hand in the slides for further grading.

## **3. Checkoff-3 [10%]: Prototype Development**

The team should be in the middle of their detailed design and prototyping. Ideally, they should have some initial testing results. They should be able to prove the key aspects of their solution. The team will discuss the progress with the instructors to obtain checkoff. No formal presentation is needed. The students should include any relevant support material such as system design diagrams or initial prototypes.

## **4. Checkoff-4 [50%]: Final System Prototype**

The team should present their final deliverable. There should be something concrete at the end as the deliverable, not just a paper or theoretical concept. In particular, it is a requirement to have a working prototype that can solve the intended problem to an extent.

The team will present these findings in an oral presentation & hand in the slides for further grading. The team shall also submit the runnable source code, a short report to describe the system design and implementation. The short report shall include workload of each individual, documents of the software and hardware design, future work. Detail format of the report will be announced later.

## **5. Checkoff-5 [15%]: Exhibit**

The team shall set up and demonstrate their prototype at an exhibit. They should present the problem, idea, solution and system design to the visitors.

### **Grading and Rubric:**

Checkoff-1 [10%]: Problem Framing, Initial Solution, Project Schedule

Deliverable / Grading item	Grading criteria	Remark
Problem framing (4%)	<ul style="list-style-type: none"><li>• How well is the description of the area/context/problem/state-of-the-art?</li><li>• To what extent is the problem clearly and concisely defined based on insightful interpretation and compilation of the background information?</li><li>• To what extent is the problem exciting and open to new innovations?</li></ul>	
Requirement	<ul style="list-style-type: none"><li>• How thorough is the analysis of stakeholders' needs and</li></ul>	

analysis (2%)	constraints?	
Initial solution (3%)	<ul style="list-style-type: none"> <li>How well is the description of the initial hints of design direction and potential solution?</li> </ul>	
Project schedule (1%)	<ul style="list-style-type: none"> <li>How well is the project schedule organized and up-to-date with realistic milestones? Are the tasks divided into specific activities and assigned to individuals or groups of individuals?</li> </ul>	

#### Checkoff-2 [15%]: Problem Framing Update and Proposed Solution

Deliverable / Grading item	Grading criteria	Remark
Problem framing update (1%)	<ul style="list-style-type: none"> <li>Summary of the previous problem framing, with possible updates due to further exploration and focus</li> <li>To what extent are needs finding and problem reframing steps succinctly summarized?</li> </ul>	
Proposed solution (6%)	<ul style="list-style-type: none"> <li>To what extent is the solution idea thoughtfully and systematically evaluated?</li> <li>To what extent is the proposed solution innovative and exciting?</li> <li>To what extent is the proposed solution impactful?</li> </ul>	
System design (6%)	<ul style="list-style-type: none"> <li>To what extent do the students apply engineering principles, object-oriented design and modular design to design their system and solution?</li> </ul>	
Further development plan (2%)	<ul style="list-style-type: none"> <li>How thoughtful is the description of the strategy and concrete steps to further develop the proposed solution?</li> </ul>	

#### Checkoff-3 [10%]: Prototype Development

Deliverable / Grading item	Grading criteria	Remark
Development status and quality (8%)	<ul style="list-style-type: none"> <li>How well is the prototype on its way to be a meaningful and innovative solution to the problem statement?</li> <li>Is there clear evidence of converging toward an end solution?</li> <li>Are all essential components or key aspects of the prototype in place or actively developed?</li> </ul>	
Updated project schedule with tracking (2%)	<ul style="list-style-type: none"> <li>How clear is the progress shown?</li> <li>How clear is the schedule / project plan being applied?</li> </ul>	

Checkoff-4 [50%]: Final System Prototype

Deliverable / Grading item	Grading criteria	Remark
System design (10%)	<ul style="list-style-type: none"> <li>To what extent does the prototype make use of object-oriented and modular design to develop the software and system?</li> </ul>	
IoT components (10%)	<ul style="list-style-type: none"> <li>To what extent does the prototype make use of IoT concepts, software and system components?</li> <li>To what extent does the prototype include innovative use of IoT concepts, software and system components?</li> </ul>	
Data analytics (10%)	<ul style="list-style-type: none"> <li>To what extent does the prototype make use of data analytics to process the data?</li> <li>To what extent does the prototype make use of advanced data analytics ideas and techniques?</li> </ul>	
Functional prototype and testing (10%)	<ul style="list-style-type: none"> <li>How well does the final prototype really work and solve the problem?</li> <li>How well can the final prototype work under different operating environments and test cases?</li> </ul>	
User interaction and user friendliness (10%)	<ul style="list-style-type: none"> <li>How easy to use the system? From the end-user perspective and the system operator perspective.</li> <li>Does the user interaction suit the intended application?</li> </ul>	

Checkoff-5 [15%]: Exhibit

Deliverable / Grading item	Grading criteria	Remark
Prototype set-up and demonstration (5%)	<ul style="list-style-type: none"> <li>How well is the prototype set-up and displayed in the exhibition?</li> <li>How well is the prototype demonstrated to the visitors?</li> </ul>	
Presentation (5%)	<ul style="list-style-type: none"> <li>Can the team explain the problem, solution, prototype and system design clearly?</li> </ul>	
Feedback from the visitors (5%)	<ul style="list-style-type: none"> <li>How positive are the feedbacks from the visitors?</li> </ul>	

## Resources

The project requires you to propose, design and develop an IoT solution to solve an open problem. To start, you can find many IoT ideas on the Internet.

<http://postscapes.com/projects>

<http://www.element14.com/community/groups/internet-of-things/blog/2014/12/11/5-awesome-internet-of-things-projects-ideas>

<https://www.quora.com/What-are-some-cool-IoT-ideas-and-projects>