



Microsoft Research

Faculty  
Summit

**2014** 15<sup>TH</sup> ANNUAL



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# Faculty Summit

**2014** 15<sup>TH</sup> ANNUAL

In-situ Research Using Connected Devices—  
Challenges and Opportunities



# Breakdown

Quick introduction and update – *Arjmand Samuel, Microsoft Research*

Using Lab-of-Things for Wearable Computing Research and IoT Education –  
*Nilanjan Banerjee, University of Maryland, Baltimore County*

Building Applications for IoTs: Operational Experiences with LoT – *Affan Syed,  
FAST-NUCES, Pakistan*

# Lab of Things Team



A.J. Brush



Danny Huang



Jaeyeon Jung



Ratul Mahajan



Ray Matharu



Dimitris Papanikolaou



Amar Phanishayee



Arjmand Samuel



James Scott



Muhammad Shahzad



Chenguang Shen

# Lab of Things

Lower the barrier to conduct research and teach classes that use connected devices in homes and beyond

## LoT enables

- Interconnecting off-the-shelf and custom devices
- Scaling field studies through automated monitoring, updates, and data collection
- Sharing data, code, and participants with fellow researchers

# Lab of Things Features

Released July 2013

- Platform: BOLT storage system, modular driver and scout model, app execution model
- Device drivers: Zwave, WIFI and web Cameras
- Sample Apps: Alerts, Camera Viewer, Sensor app
- Cloud services: Monitoring portal, Cloud storage

Released since

- Cloud services: Alert, Email
- Devices: Gadgeteer, Arduino, Kinect, BLEProximity, Hue Bridge , Door jamb, Envi energy driver
- Sample Apps: Switch, Arduino
- Platform: Web services connectivity, BOLT update, remote update



# Lab of Things Usage

## Research

Ongoing academic research  
deployments ~50

## Research Domains

- Healthcare
- Smart Home Design
- In-place Aging
- Wearable Computing
- Energy Management

### **Kinect-based intervention for patients with Parkinson's disease**

**PI:** Jeffrey Haddad and Jessica Huber, Purdue University

**Award:** [Microsoft Research SEIF 2014](#)

### **Sharing of the Internet of Things in Smart Homes**

**PI:** John Stankovic, University of Virginia

**Award:** [Microsoft Research SEIF 2014](#)

### **Smart Homes/Home Automation projects**

**PI:** Kamil Hawdziejuk, PhD student, Institute of Fundamental Technical Research, Polish Academy of Sciences

**Blog:** [Kamil Hawdziejuk's Blog](#)

### **SOLACE (Supporting Older Low-ses Adults and their Caregivers Electronically) deployment using Lab of Things**

**PI:** [Kay Connelly](#), Indiana University

**URL:** <http://phitlab.org/>

### **Supporting User Control of Intelligent Home Systems**

**PI:** [Mark Newman](#), University of Michigan

**URL:** <http://mwnewman.people.si.umich.edu/projects.html>

### **Evaluating Smart Home Sensor Technology and the use of HomeOS for Monitoring Mobility Among Community-Dwelling Older Adults**

**PI:** [George Demiris](#), University of Washington

### **Wearable Multi-Sensor Gesture Recognition in Assistive Devices for Paralysis Patients**

**PI:** [Nilanjan Banerjee](#), University of Maryland

**URL:** [Mobile, Pervasive and Sensor Systems Laboratory](#)

**Course:** [CMSC 691: Systems for Smart Home Automation](#)

### **Scalable Radiator Valve Control for HomeOS**

**PI:** [Mike Hazas](#), Lancaster University

**URL:** [Project Webpage](#)

### **Intelligent Agents for Home Energy Management**

**PI:** [Alex Rogers](#), Southampton University

**URL:** [Project Webpage](#)

### **Intelligent and Scalable Monitoring/Control Platform for Home Energy Management**

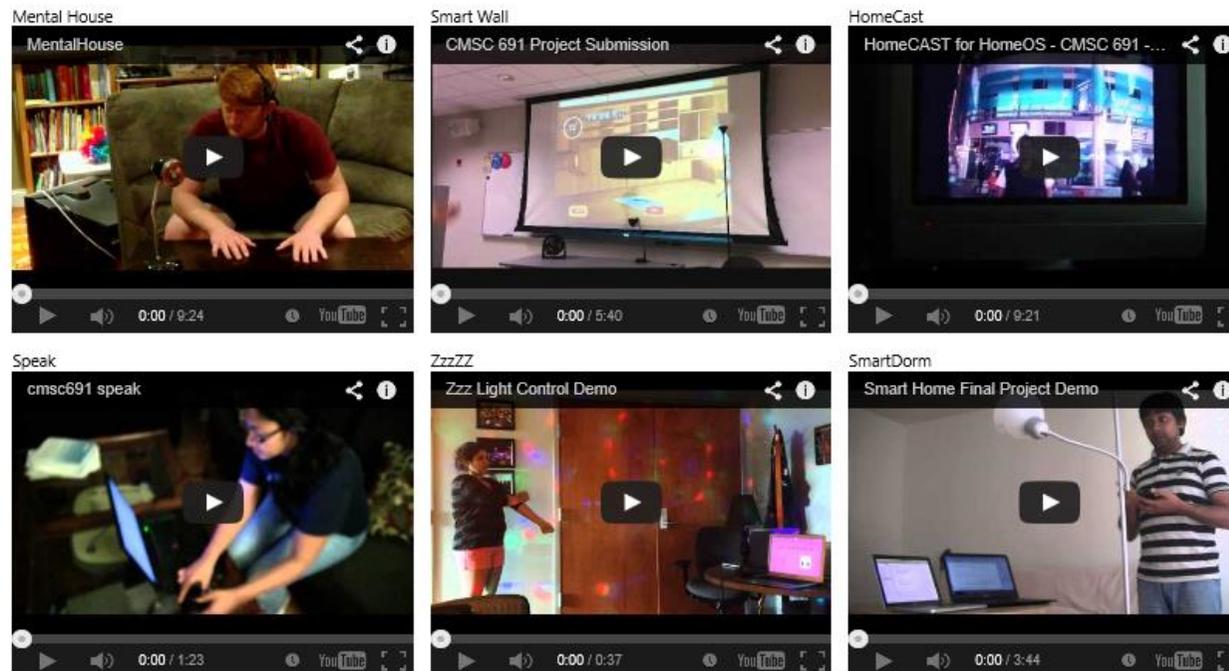
**PI:** [Lanshun Nie](#), Harbin Institute of Technology

# Lab of Things Usage

## Teaching

Close to 80 students working on Lab of Things related projects

Class Projects: Systems for Smart Home Automation  
(University of Maryland)



[www.lab-of-things.com/community.html](http://www.lab-of-things.com/community.html)

<http://www.lab-of-things.com/community.html>

# Get Started – Documentation

Getting Started - Introductory Videos



**Topic:** What is the Lab of Things?  
**Speaker:** Arjmand Samuel

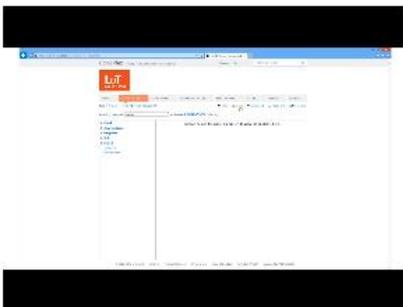


**Topic:** Demo of the Lab of Things  
**Speaker:** AJ Brush

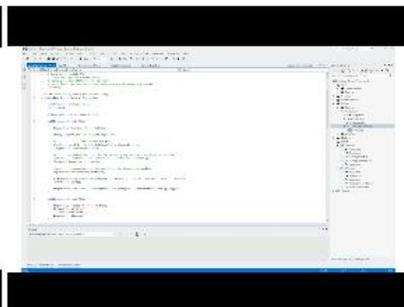


**Topic:** Architectural overview of the Lab of Things  
**Speaker:** Ratul Mahajan

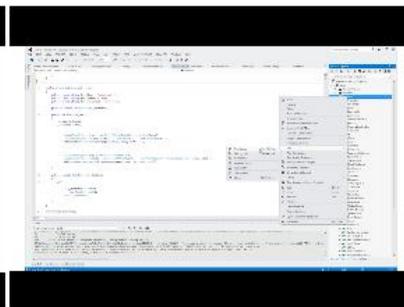
Working with the Lab of Things code



**Topic:** Getting started with the Lab of Things  
- code overview  
**Speaker:** Ratul Mahajan



**Topic:** Developing applications for the Lab of Things  
**Speaker:** Ratul Mahajan



**Topic:** Contributing code to the Lab of Things  
**Speaker:** Ratul Mahajan

[labofthings.codeplex.com/documentation](http://labofthings.codeplex.com/documentation)

## Contents

[Getting Started with Lab of Things](#)

[Configure a Development Environment](#)

[HomeOS Software Architecture](#)

[Z-Wave Driver for HomeOS](#)

[Lab of Things Remote Management Portal](#)

[HomeOS Configuration Files](#)

[How to: Create a Scout](#)

[How to: Create a Driver](#)

[HomeOS Roles](#)

[How to: Create an App](#)

[How to: Deploy a Study](#)

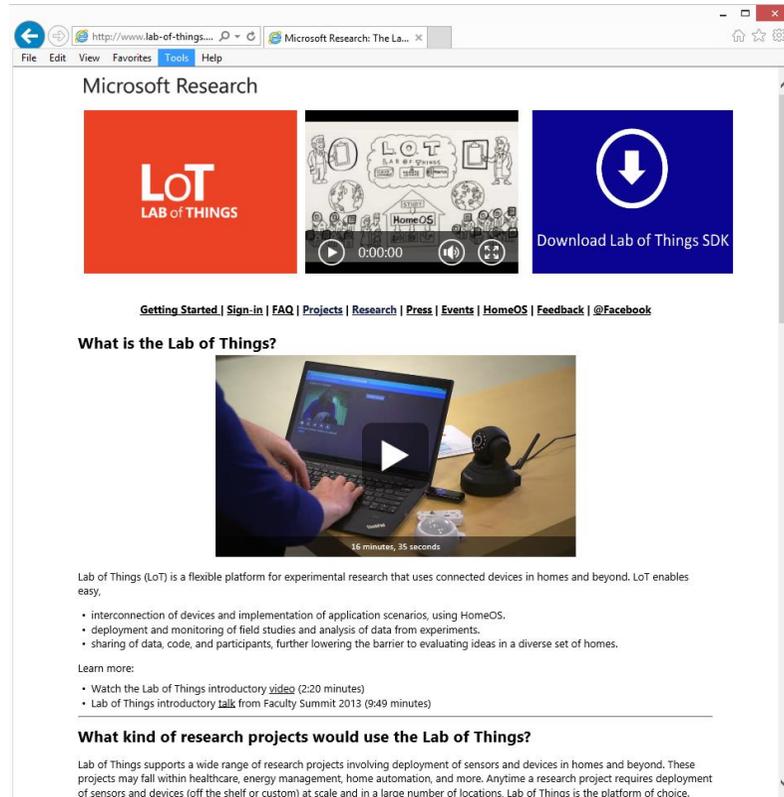
[How to: Store data using Bolt](#)

[How to: Remotely Update Home Hubs](#)

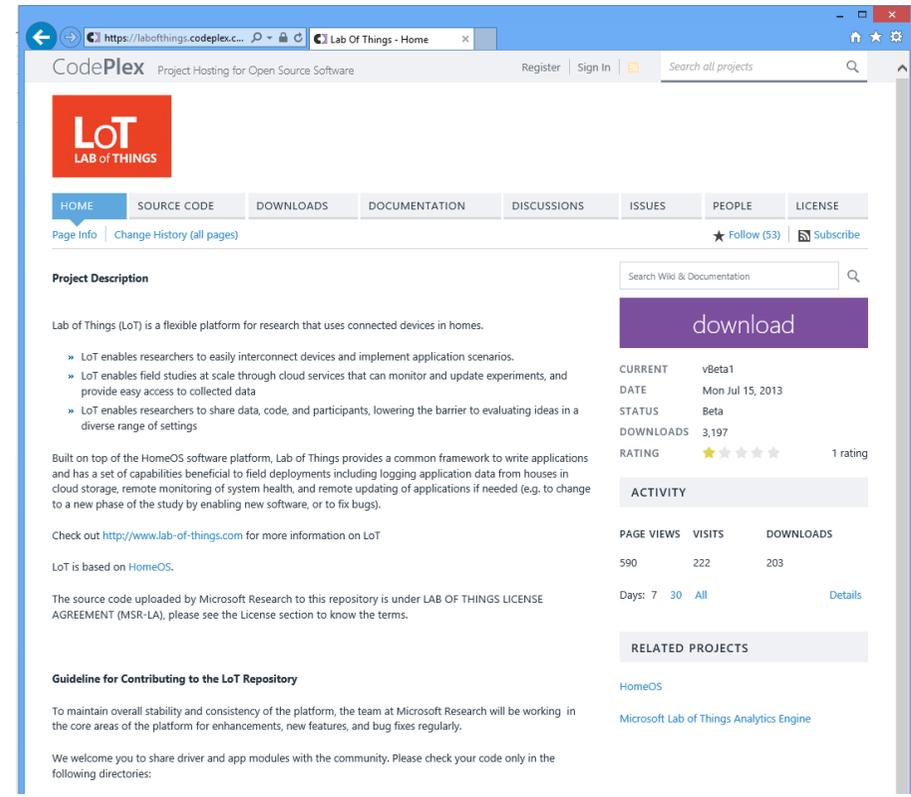
# Get Started with the Lab of Things

<http://www.lab-of-things.com>

<https://labofthings.codeplex.com>



The screenshot shows the Microsoft Research website for Lab of Things. At the top, there's a navigation bar with 'File', 'Edit', 'View', 'Favorites', 'Tools', and 'Help'. Below that, the 'Microsoft Research' logo is visible. The main content area features three large buttons: a red 'LoT LAB of THINGS' button, a video player showing a diagram of the Lab of Things architecture, and a blue 'Download Lab of Things SDK' button with a download icon. Below these buttons, there's a navigation menu with links for 'Getting Started', 'Sign-in', 'FAQ', 'Projects', 'Research', 'Press', 'Events', 'HomeOS', 'Feedback', and '@Facebook'. The section 'What is the Lab of Things?' includes a video player showing a person using a laptop with a camera. Below the video, there's a paragraph describing Lab of Things as a flexible platform for experimental research. A bulleted list highlights key features: interconnection of devices, deployment and monitoring of field studies, and sharing of data. A 'Learn more:' section lists two introductory videos. The 'What kind of research projects would use the Lab of Things?' section explains that the platform supports a wide range of research projects involving sensors and devices in homes and beyond.



The screenshot shows the CodePlex repository page for Lab of Things. The page has a blue header with the 'CodePlex' logo and navigation links for 'Register', 'Sign In', and 'Search all projects'. Below the header, there's a 'LoT LAB of THINGS' logo and a navigation menu with tabs for 'HOME', 'SOURCE CODE', 'DOWNLOADS', 'DOCUMENTATION', 'DISCUSSIONS', 'ISSUES', 'PEOPLE', and 'LICENSE'. The main content area is titled 'Project Description' and includes a search box for 'Search Wiki & Documentation'. A large purple 'download' button is prominent. Below this, there's a table of project metadata: CURRENT (vBeta1), DATE (Mon Jul 15, 2013), STATUS (Beta), DOWNLOADS (3,197), and RATING (1 rating). An 'ACTIVITY' table shows PAGE VIEWS (590), VISITS (222), and DOWNLOADS (203). A 'RELATED PROJECTS' section lists 'HomeOS' and 'Microsoft Lab of Things Analytics Engine'. The 'Guideline for Contributing to the LoT Repository' section states that the team at Microsoft Research will be working in the core areas of the platform for enhancements, new features, and bug fixes regularly. A final paragraph welcomes users to share driver and app modules with the community.

# Lab of Things

- Download: **Lab-of-things.com**
- Join **www.facebook.com/groups/labofthings/**
- Feedback/suggestions: **lab-of-things@microsoft.com**

Microsoft®  
**Research**



