ISSN 2320 - 2602
Volume 4 No.6, June 2015
International Journal of Advances in Computer Science and Technology
Available Online at http://www.warse.org/ijacst/static/pdf/file/ijacst03462015.pdf

A Study using Internet of Things Concept toward Engineering Education

Hasnim Harun[1] and Abdullah Mohd Zin[2]
[1]Politeknik Kota Kinabalu, Sabah Malaysia, hasnim@yahoo.com
[2]Universiti Kebangsaan Malaysia, Selangor Malaysia, amz@ftsm.ukm.my

ABSTRACT

In this paper, we look at Internet of Things (IoT) concept and try to implement it in engineering education. IoT have been implemented in many areas like smart wearable, smart home, smart city, smart environment and smart enterprise. However in engineering education not many has been associated to IoT. As we know, engineering education consist of theory and practical lab. In this paper, the design and development of IoT based lab experiment will be explained and discussed. The experiment will be using Arduino Yun and Temboo API Provider where when the student takes the experiment, an e-mail will be sent to the lecturer to alert and as a record for the student take the lab experiment.

Key words : Internet of Things, Remote Lab, Virtual Lab, E-Learning, Engineering Education

1. INTRODUCTION

The term of Internet of Things (IoT) was first invented in 1998 which is a network of networks where typically, a large number of objects or sensors are connected through communications and information infrastructure to provide value-added services. Thus, we could see from the definition that connectivity among devices is a critical functionality that is required to fulfil the vision of the IoT. The main factors behind it are the potential and advanced system that the IoT will bring to the society. It assured in creating a world where all the objects around us are connected to the internet and therefore the communication to each other with minimal human intervention. The ultimate aim is to create a better world for human beings, where the objects around us understand our desire and hence act accordingly without any explicit instructions.

2. INTERNET OF THINGS

The functionalities of the IoT solution in the market will be discusses in this section. Between the areas IoT are used is Smart Wearable. Wearable solutions are designed for a variety of functions as well as for where on a different of part of body such as the head, eyes, wrist, waist, hands, fingers, legs or embedded into different element of attire. The Iot solutions are group by the body part on which the solution must be worn.

The other area is Smart Home. In this category, the solution convey the meaning where occupants will experience a convenient and pleasant living at home. Some smart home solution also focus on assisting elderly Hand(gloves) Finger (rings) Wrist (watch/ bands) Eyes (glasses) Legs (socks) Foot (shoes) Head (helmet) Body (cloth) Waist and chest (Band)[1]. there were different body parts that are known aimed by wearable IoT solution in the industry market place where people in their daily activities and on health care monitoring[2]. Due to the large market potential, the smart home solutions are developed rapidly and making their way into the market. From the academic angle,smart energy, and resource management, human-system interaction, and activity management, have been some of the major foci.

Other area for IoT is Smart City. Towns and cities assist and satisfy half of the world's population which creating prodigious pressure and have effected on every aspect of urban living[3]. Cities have large attentions of resources and facilities. The pressure towards the efficient city management has triggered many kinds of smart city that have been run by both government and private sector businesses to spend in information and communication technologies that will able to find sustainable solutions to the growing problems. Smart grid is one of the domains in which academia, industry, and governments are interested and invested significantly[4].

Smart environment with it's Air Quality Monitoring Air quality is a community led sensor system that help the community to have better air quality. The Smart Enterprise Iot solutions are generally designed to support infrastructure and more general purpose functionalities in industrial places such as management and connectivity. Transportation and Logistic used a solution developed to support real time shipment tracking. The IoT solution are the context includes location, temperature, light, relative humidity and biometric pressure is collected and processed in order to enhance the visibility of the supply chain. HiKoB collects real time measurement such as temperature gradients, within the road, current outdoor temperatures, moisture, dew and frost point from sensors deployed in roads and provides traffic managements, real time information on traffic conditions and services for freight and logistics[5]. Nonetheless, Cantaloupesys[6] allows the occupants to keep track of stocks in vending machine remotely. Thus, timely and optimal renewal of strategies are determined from context information that related to usage patterns.

3. LAB EXPERIMENT AS INTERNET OF THINGS

Internet of Things can be applied toward engineering education too. The lab experiment can be connected to Internet and the lab experiment will be "Internet of Things".

A mechanism to detect whether the student have conducting the lab experiment will be added to the experiment, so the lecturer can know who have done and who's don't. In this experiment, e-mail will be sent to the lecturer to alert him.

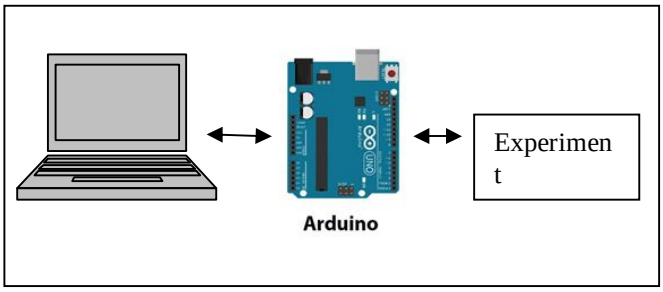

Figure 1: Hardware Requirement

Figure 1 above shows the essential components and the design of the experiment. And Figure 2 below shows the design of the experiment.

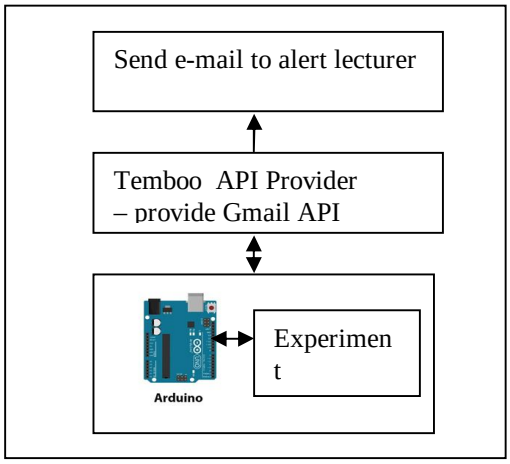

Figure 2: Design of IoT Lab Experiment for detecting student conducting an experiment

The development processes of the experiment are implemented by two Phases, at hardware part and software part.

Phase 1: Hardware Setup

A laptop is needed for a student to write Arduino sketch and upload the coding to the Arduino board.

Arduino Yun has been chosen because its capability having a linux machine and connecting to internet feature.

An experiment connected to the Arduino Yun

And special purposed connection from experiment to Arduino Yun for the lecturer to detects whether the student have conducting the experiment or not.

Arduino Yun needed to be setup to connect to the wifi/Internet.

Phase 2:. Software and Web Setup

After hardware has been setup, some software and web setup are needed.

Gmail Setup

To setup Gmail API, we must have Gmail account. To authenticate with Google, you'll want to enable 2-Step Verification and generate an App Password for Temboo. By Sign in to your Google Account settings page by clicking on your name or picture in the upper right corner of the screen and then clicking Account then choosing Signing and 2-Step Verification. After successful you'll be prompted to create an App Password. In the Select app dropdown menu, choose "Other", and give this app a name (e.g., IoTApp). Click "Generate" and we'll be given a 16-digit passcode that can be used to access your Google Account from Temboo.

And make sure our Arduino Yun are connected to the Internet at this time.

Temboo Setup

The experiment use Temboo (www.temboo.com), a third party API provider to be use by a programmer. The Temboo API is called CHOREO and also providing Google API, whereby after registering and setup our google drive API, we can use it through Temboo.

The next step was to run the **Google > OAuth > InitializeOAuth** Choreo, specifying the Client ID from the app you registered at Google and the following Scope: https://spreadsheets.google.com/feeds/

The InitializeOAuth choreo will return an authorization URL and a callback ID (required for the FinalizeOAuth step).
Open a new web browser, navigate to the authorization URL returned by the InitializeOAuth Choreo, and click "Accept" to grant the app access to your Google account.

Run the **Google > OAuth > FinalizeOAuth** Choreo, specifying the callback ID returned earlier by the InitializeOAuth Choreo. This process will return a Refresh Token which can be used along with the Client ID and Client Secret to authenticate with Google.

Arduino Yún must connected to the Internet at this time.

Temboo will generate the header file and the Arduino sketch code as Figure 3 below.

```
#define TEMBOO_ACCOUNT "hasnim"  //
your Temboo account name
#define TEMBOO_APP_KEY_NAME "IoTApp"  //
your Temboo app key name
#define TEMBOO_APP_KEY  "1bdda9391a7a4d11a
d097f3bb7db611b"  // your Temboo app key
```

Figure 3: Temboo.h

Generated Temboo arduino sketch code to be used to call Gmailv2 API are shown in Figure 4 below.

The sketch uses SendEmail Choreo as shown in Figure 5.

```
#include <Bridge.h>
#include <Temboo.h>
#include "TembooAccount.h" //
contains Temboo account information

// Note that for additional security and
reusability, you could

// use #define statements to specify these values
in a .h file.

// your Gmail username, formatted as a complete
email address,

const String GMAIL_USER_NAME =
"hasnim@gmail.com";

// your Gmail App-Specific Password

const String GMAIL_PASSWORD =
"password";

// the email address you want to send the email
to,

const String TO_EMAIL_ADDRESS =
"hasnim@gmail.com";
```

Figure 4: Segment of arduino generated sketch code

```
Serial.println("Running SendAnEmail...");

      TembooChoreo SendEmailChoreo;
      SendEmailChoreo.begin();

 //set Temboo account credentials
SendEmailChoreo.setAccountName(TEMBOO_
ACCOUNT);
SendEmailChoreo.setAppKeyName(TEMBOO_
APP_KEY_NAME);
SendEmailChoreo.setAppKey(TEMBOO_APP_
KEY);



SendEmailChoreo.addInput("Username",
GMAIL_USER_NAME);
SendEmailChoreo.addInput("Password",
GMAIL_PASSWORD);
SendEmailChoreo.addInput("ToAddress",
TO_EMAIL_ADDRESS);
SendEmailChoreo.addInput("Subject", "Lab 6:
Sensor Data – By Student001");

   SendEmailChoreo.addInput("MessageBody",
"Hello, The Sensor Data Successful");

   unsigned int returnCode =
```

Figure 5: Temboo Choreo – Google Drive API , AppendRowChoreo is declare and been used

Experiment Setup

A simple experiment has been implemented by connecting sensor to pin analog 0 arduino Yun. The student will write sketch coding to get sensor data and then at the same time an e-mail will be send to their lecturer to inform/alerting their lecturer that his student is performing an experiment. Showing in Figure 6 below is the segment of Arduino sketch code to get the sensor data.

```
unsigned long getSensorValue() {
return analogRead(A0);
```

Figure 6: Segment of sketch code to get sensor data

4. DISCUSSION

Although the experiment is quite simple, the purpose of it is to demonstrate the possibility and concept of Internet of Things can be implemented toward engineering education by using a suitable and selected hardware and software i.e. Arduino Yun and Temboo API provider which provide Gmailv2 API. The most important element in Internet of Things lab experiment is a mechanism to alert and capabilities to logging experiment data when the student do the experiment.

5. CONCLUSION

The design of Internet of Things lab experiment has been successfully develop. The new approach of taking lab experiment can open many possibilities in managing lab usage and student time table. The setup of this Internet of Things lab using Arduino Yun as microcontroller and Temboo as an API provider and Google Gmail was mean to alerting lecturer when their student do the lab experiment. The selection of hardware and software used and the design was a perfect combination because of easy and fast development phase to develop many more Internet of Things lab experiment.

REFERENCES

1. A. Dohr, R. Modre-Opsrian, M. Drobics, D. Hayn, and G. Schreier, **The Internet of things for ambient assisted living**, in Information Technology: New Generations (ITNG), 2010 Seventh International Conference on, 2010, pp. 804–809.
2. E. Gaura, J. Brusey, M. Allen, R. Wilkins, D. Goldsmith, and R. Rednic, **Edge mining the internet of things**, Sensors Journal, IEEE, vol. 13, no. 10, pp. 3816–3825, Oct 2013.
3. A. Athreya and P. Tague, **Network self-organization in the internet of things**, in Internet-of-Things Networking and Control (IoT-NC), 2013 IEEE International Workshop of, June 2013, pp. 25–33.
4. L. Atzori, A. Iera, and G. Morabito, **From smart objects to social objects: The next evolutionary step of the internet of things**, Communications Magazine, IEEE, vol. 52, no. 1, pp. 97–105, January 2014.
5. A. Zanella, N. Bui, A. Castellani, L. Vangelista, and M. Zorzi, **Internet of things for smart cities**, Internet of Things Journal, IEEE, vol. PP, no. 99, pp. 1–1, 2014.
6. C. Perera, A. Zaslavsky, P. Christen, and D. Georgakopoulos, **Sensing as a service model for smart cities supported by internet of things**, Transactions on Emerging Telecommunications Technologies (ETT), vol. 25, no. 1, pp. 81–93, 2014