# Real-time Display for Machine Status

**香港科技大學 THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY**

**Team Member：** LIU, Xinzhu (EEGBM) DUAN, Yangyang (BCB) LIU, Yuchen (ECE) CHEN, Zhiyu (QFIN) KAO, I-hsuan (PHYS) CUI, Yunpeng (ECOF) LI, Mengyuan (CIVIL)

**Supervisor：** Prof. David Rossiter (CSE)
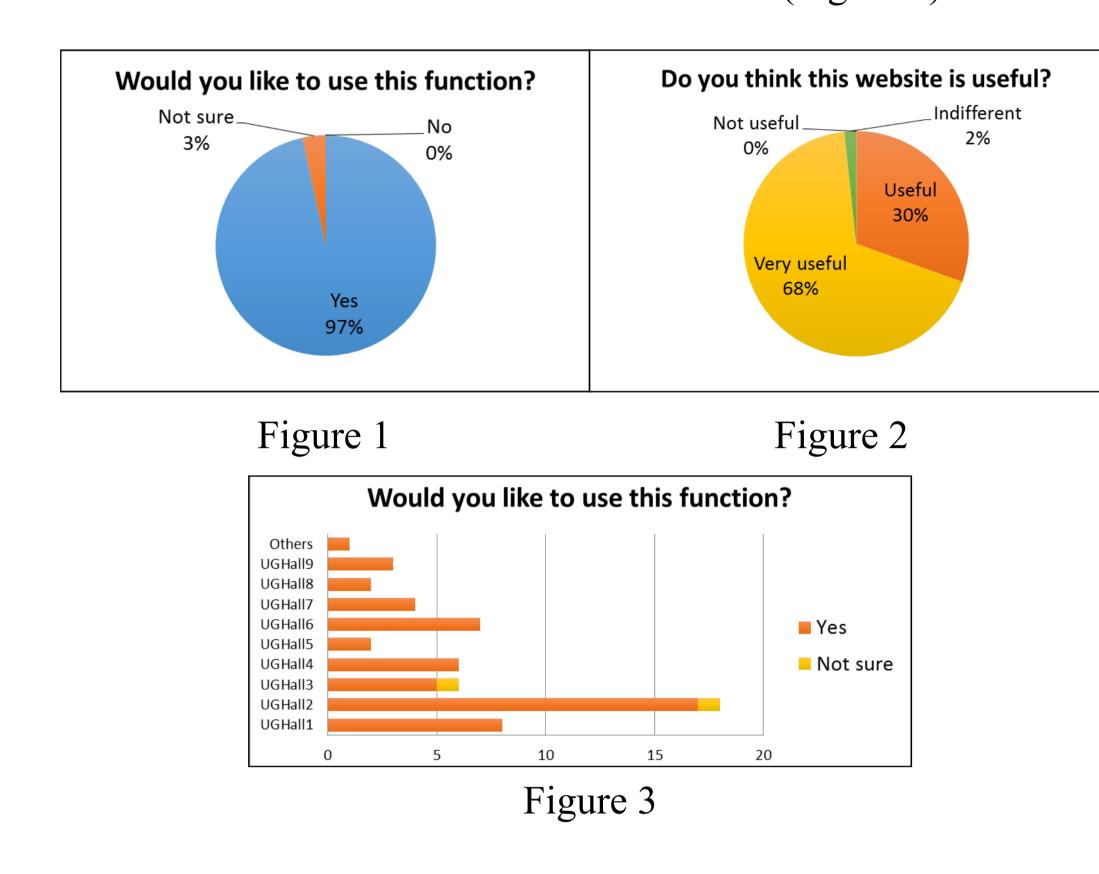
## Introduction

### Overview

Quite a number of HKUST hall residents have complained that there are not enough washing machines on campus. During the busy hours, they may carry heavy laundry baskets up and down stairs serval times to find all the machines occupied. We believe the root cause is the inefficient allocation and use of the washing machines rather than the quantity. So we initiated this project, inspired by the concept of IOT "Internet of Things", hoping to create a free information disclosing and accessing platform to increase the efficiency of public facilities.

### Objectives

- Improve the efficiency of usage of washing facilities
- Help students find available machines and manage their washing schedule
- Improve the Hall living satisfaction level
- Develop a pilot project for potential future business

### The need for such a project

To investigate the need for this system, we made a draft version of website and researched the students' needs. We found that this function is highly appreciated (Figure 1 and Figure 2),.And this is also a common need for residents of each hall (Figure 3).



Figure 1      Figure 2



Figure 3

### Financial Support

This Project is GCE Student Initiated & Organized Projects (SIOP) Fund Awardee.

## Methodology and related information

### Overview

Our project provides the real time availability status of the laundry machines in residential halls through online platform. Two main parts, electronics and website building, are considered in this project. The basic mechanism of the electronics part is the signal transition and forwarding. Vibration sensors' inputs are stick to the laundry machines to collect the signals of the machines. Subsequently, the signals are forwarded from the sensors to Raspberry Pi. A database is programmed in Raspberry Pi with Python to collect and record the electronic signals and translate in text form. After that, the data in Raspberry Pi is transmitted to the ihome server through Wi-Fi. We use html, CSS and JavaScript to design, and frame the website. PHP animates the website and acts as the medium between the database and website to transit the signal. For residents, they just need to check the website to get the availability status for the particular machine and then decide whether to go to wash their clothing . Similar sensor system may be applied to other public areas like parking lots and communal bathrooms etc.

### Vibration sensor

We choose vibration sensors based on three concerns. Firstly, vibration sensors are relatively cheap. Because the status of each washing machine needs to be collected independently, it is very important to control the cost of sensors so that the total price will be acceptable and attractive to be widely used. Secondly, vibration sensors are mechanically easy to understand so they are user friendly. Users can adjust and repair vibration sensors on their own

and little technical knowledge will be needed. Third, vibration sensors can avoid one significant concern of users: privacy. Because no video or photos are collected, the information of each user will be protected.

### Raspberry Pi

We chose Raspberry Pi because it's both functional satisfying and efficient. Raspberry Pi contains a reasonable CPU and both Ethernet and USB ports. Raspberry Pi is also relatively cheap, around 250 HKD, so it will be cost-efficient, with each hall laundry room share a same Pi.

### Python

The output of the vibration sensor is either 1 when still or 0 when vibration. However, when implementing in real life, for the occasional cases that someone may accidentally kick the machine or the adjacent machine is vibrating fiercely, the output of the vibration sensor may not be what we desired it to be. Therefore, a Python program, which is called program A is written to take the summation S(t) of the most recent 100 sample n which is taken every 0.3 seconds.

$$S(t) = \sum_{i=t-99}^{t} n_i$$

A threshold T is set beforehand according to real situation. The Python program will record "Yes" to a txt file when the sample summation is less than the threshold (S(t) <= T refers to vibrating) and record "No" when the sample summation is larger than the threshold (S(t) > T refers to still).

This txt file will be uploaded to Internet by text format by another Python program, program B.

## Data Flow



**Detect vibrating**

No    Is the machine vibrating?    Yes

1      0

Output data

**Data analysis**

GPIO port: Read data from hardware

Digital data

Python Program A: Take the summation of most recent 100 sample And generate a TXT file of "Yes" and "No"

TXT file

Python Program B: Extract the data of the txt file And upload it to the Internet

**Data Display**

PHP program C generates new TXT file And saves in sever

TXT file

PHP program D translates numerical data to displayable sentence

Sentences

JavaScript & HTML/CSS program displays laundry machine states

Laundry machine

Vibration signal

Vibration sensor SW 1801P

Digital data

Raspberry Pi B⁺

Digital data

**HOME:**

**LAUNDRY IN HALL 1**

There are 4 washing machines in your hall.
There are 4 drying machines in your hall.
Washing Machine:

Machine 01: occupied
Machine 02: available
Machine 03: occupied
Machine 04: available

Drying Machine:

Machine 31: occupied
Machine 32: available
Machine 33: occupied
Machine 34: available

UG HALL

ihome server: ihome.ust.hk/~ikao

## Methodology and related information (continued)

### Internet related program

We used different languages for different parts in this project. For data collection and uploading, we used python and run it on Raspberry Pi. And we used html, CSS and JavaScript to build the website. Besides these, we also used PHP to construct the database on the website.

### PHP

As Python program B upload the data from the TXT file that Python A has generated. One PHP file what we called Program C receive the data and generate a TXT file on the Internet, serving

as a server. Another PHP file, program D read the TXT file that's on the Internet and display it on the browser.

### List of items used in this project:

- Raspberry Pi B+
- Vibration sensor: SW 1801P
- Display Screen (TFT color monitor 17.4cm*11.4cm*3.3cm)
- Breadboard
- DuPont Wire
- Multimeter (UT33D)

## Project Photographs



Onsite installation-Raspberry Pi



Onsite installation-vibration sensor



Onsite installation-wire



Demonstration for hall office

## Possible future implementation

### Online booking function

We have considered to add online booking system on the website. However, this function may need to access users' personal information, such as student name or ITSC account. This may draw privacy concerns and may lead to problems. So the team decided to postpone this plan until get proper solutions regarding the issues.

### Potential market

Only by changing the way data collected, this device will be suitable for various potential costumers. Take parking lot for example, we can use ambient light sensors to collect the parking status and upload to website, offering drivers and managers a direct view. Restrooms will be another potential and privacy will be protected since we use none-camera sensors. For all these markets, we provides a cheap upgrade service without complex modification and reassembling and no privacy or safety concern will be included.

## Conclusion

Many residents have been complaining the insufficiency of campus laundry machines. So we initiated this project "Real-time display for machine status" to solve this problem. Our team use vibration sensors, Raspberry Pi and multiple programs and succeed to detect the washing status of machines accurately and upload online for on-time display. This whole system is cheap in cost and is easy for administrators' operation and fixing. No reassembling of machines will be needed and this system offers protection of users' privacy. This product can also be put into market and widely used in public restroom, parking lots and other public zones.