Fuji-chan: A unique IoT ambient display for monitoring Mount Fuji's conditions

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ABSTRACT

Fuji-chan is a simple ambient display device, which uses a wireless internet connection to monitor two important characteristics of Mount Fuji, Japan's largest mountain. This system utilises two internet-based data feeds to inform people of the weather conditions at the peak of the mountain, along with the current level of volcanic eruption risk. We consider the latter information in particular to be of great importance. These two data feeds are communicated via LEDs placed at the top and base of the device, along with aural output to indicate volcanic eruption warning levels. We also created a simple web interface for this information. By creating this device and application, we aim to reimagine how geospatial information can be presented, while also creating something which is visually appealing. Through the demonstration of this multimodal system, we also aim to promote the idea of an "Internet of Beautiful Things", where IOT technology is applied to interactive artworks.

CCS CONCEPTS

•Information systems →Location based services; •Human-centered computing →Interface design prototyping; Information visualization; *Mixed / augmented reality;* **•Applied computing →***Media arts; Sound and music computing;*

KEYWORDS

IoT, disaster information, light installation, Mixed/Augmented Reality, geospatial design, aesthetics, ambient media

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1 INTRODUCTION

Mount Fuji, referred to as *Fuji-san* in Japanese, is one of several active volcanoes in and around Japan's archipelago [5, 8]. We consider this information vital, as not only is Mount Fuji a popular tourist attraction, but our previous research suggests that many people are unaware of the number of active volcanoes in Japan [5], nor that Mount Fuji is also an active volcano. Although several mapping and alert services providing volcanic eruption information already exist, we decided to reimagine how this information can be presented through a novel hardware device. We consider the spread of knowledge of Japan's active volcanoes to be an important exercise — even through non-conventional means, as hiking in mountainous areas is a popular past-time in the country, with both locals and visitors [11]. By determining the behaviour of a real-world object digitally through remote parameters, we consider this to be a novel use of Mixed/Augmented Reality (AR) [7] and IoT [3] technologies. In this demonstration we will exhibit our Fuji-chan device (Figure 4), along with a simple web application (Figure 2) which provides the same weather and volcanic eruption information.

2 CONCEPT OF OUR DEVICE

Generally, geospatial information such as weather is delivered digitally via a map or other software interface. Additionally, hazard information such as volcanic eruption warnings is usually delivered via a map interface or alert system [6]. However, rather than relying on a map interface or conventional software-based approach, we decided to present this information through an ambient display device. We consider this device to be potentially useful and important given that few people seem to be aware that Mount Fuji is

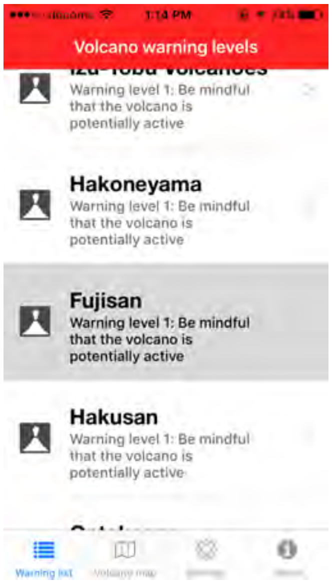

Figure 1: Screenshot of an iOS application that we created as part of our previous research [5]. We are reusing the same data for Mount Fuji in the research described here.

Figure 2: The web interface of our server-side application, which provides information in Japanese and English regarding the level of volcanic eruption risk and the current temperature at the peak of Mount Fuji.

actually an active volcano. Furthermore, Mount Fuji holds a special place in Japanese culture: it has affectionately been painted, drawn and referenced in literature for centuries. Models and other references to the mountain are ubiquitous throughout the country [9]. Although Mount Fuji has not had a major eruption since the 1700s, geo-scientists believe that it is overdue for an eruption [2]. We have created this device, along with a simple web interface, as a way of monitoring eruption activity (and weather) in a simple way through multi-modal output.

Table 1: Volcano warning levels. These colours and their associated meanings are used by the Japan Meteorological Agency (JMA) [8] and other agencies that supply volcanic eruption information in Japan. We are using white light in our system to depict level 1.

Level	Colour	Meaning
5	Purple	Evacuate
4	Red	Prepare to evacuate
3	Orange	Do not approach the volcano
2	Yellow	Do not approach the crater
1	No colour	Be mindful that the volcano is potentially active

Table 2: Colours of the LED at the top of our Fuji-chan device to depict temperature at the summit of the mountain.

Colour	Temperature
Red	20℃+
Orange	10 to 20℃
Yellow	0 to 10℃
White	-10 to 0℃
Light Blue	-20 to -10℃
Blue	<-20℃

We are also aiming to keep this device as simple as possible, drawing on the Japanese Zen tradition of wabi-sabi aesthetics, which emphasises simple, humble forms [4, 10, 12]. We also consider the communication of Mount Fuji's volcanic eruption warning level to be the device's primary purpose. By communicating this information in such a simple way (i.e., any colour other than white at the base of the device means that an eruption has occurred, or will likely occur), means that virtually anyone can understand the warnings. We also hope that this device promotes an *"Internet of Beautiful Things"*, with IOT technology being applied to aesthetically-pleasing interactive works.

3 SYSTEM OVERVIEW

Our Fuji-chan device uses an Arduino [1] Uno Wifi micro-controller board, which connects to a data feed created by an application hosted on our web server. Our data feed provides the current temperature at the peak of Mount Fuji, along with the current active volcano warning level. This information is also available via a simple web interface (Figure 2). The name of our system is a play on the Japanese name of Mount Fuji: *Fuji-san*. However, we have replaced the *san* suffix (which can mean both "mountain" or an honorific equivalent to Mr/Ms/Mrs) with *chan*, which is used as a term of endearment in Japan. The exterior of the device for our first prototype was created with a 3D printer. Similar to other typical depictions of Mount Fuji, blue is used for the mountain itself while white is used for its snowy peak. An overview of the system's flow is shown in Figure 3.

3.1 Web application

We created a simple server-side application in PHP (PHP: Hypertext Preprocessor) which retrieves a GeoJSON (Geo-JavaScript Object Notation) file containing the current volcano warning level for

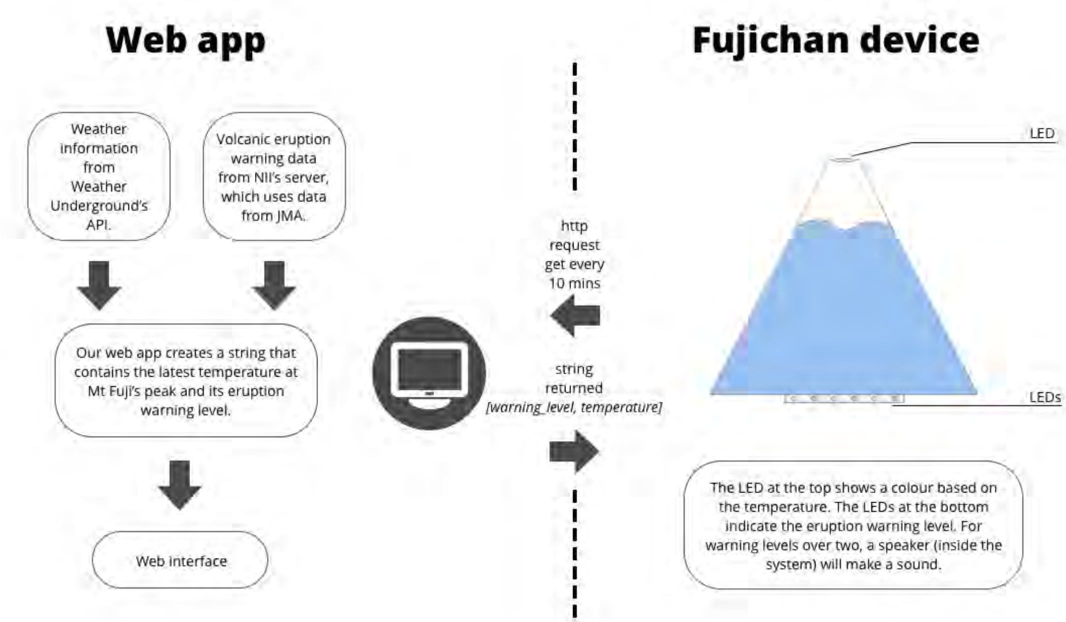

Figure 3: The flow of our system. The web application monitors two data feeds: weather from Weather Underground and volcano warning level from NII. The data is used to control the LEDs of our Fuji-chan device (Figure 4), which checks the web app's data feed every 10 minutes. The data is also displayed on a webpage (Figure 2).

Mount Fuji from Japan's National Institute of Informatics (NII [1]). The following reading from this GeoJSON feed is for Mount Fuji:

```
{
geometry : {
        coordinates : [ 138.727500, 35.360833 ],
        type : Point },
type : Feature,
properties : { level : 1, alt : 3776, status : 11,
        name : Fujisan, id : 314,
        status_string : Level 1:
        Be mindful that the volcano is
        potentially active, }
}
```

Our application also retrieves current weather information for the peak of Mount Fuji from Weather Underground's API (Application Programming Interface) [2]. Output of the web application is also displayed on a webpage (Figure 2) which is accessible on personal computers, smart phones and tablet devices. By providing multi-modal output, we are making this data more accessible.

3.2 System design

At the core of this device is an Arduino Uno Wifi [3], a new version of the Uno board which includes a wifi module on the board. We are using two LED strips (Adafruit Neopixel LED [4]): one at the base which indicates the chance of a volcanic eruption and one with a single Neopixel placed at the top to indicate the current temperature at the peak. Through the Arduino's WiFi internet connection, we are using REST (Representational state transfer [13]) web service for communication between the Arduino and our web application.

The colours of the LED strip at the base are standard colours used in other volcano warning applications [5, 8] (Table 1). The temperature colours are described in Table 2. A small speaker also creates a brief tone for all volcano warnings level two and above (only volcano warnings level two and above are provided on JMA's map [8]) in order to provide aural output in addition to the visual output. The device checks the online data feed every 10 minutes, with the LEDs reflecting any updates in the data feed instantly.

4 DISCUSSION AND FUTURE WORK

Although we are aiming to keep this device as simple as possible, we will consider other digital parameters relevant to Mount Fuji that we can use to manipulate the appearance of this device. However, since we consider communication of the volcanic eruption warning to be its primary purpose, we do not want to add anything that will significantly distract people from this information.

As future work in this area, we aim to consider other (especially Japanese) traditional and cultural artefacts that we can manipulate with different kinds of data through IoT and AR technologies. By applying these technologies, we aim to add new yet rich meaning to objects which people will be already familiar with.

[1] http://www.nii.ac.jp
[2] http://wunderground.com/weather/api
[3] http://www.arduino.org/products/boards/arduino-uno-wifi
[4] https://learn.adafruit.com/adafruit-neopixel-uberguide

Figure 4: The first prototype of our Fuji-chan device. The model is 12cm high and 11cm in diameter at the base. The light at the top indicates the weather conditions (in this case, each image shows white: between -10 and 0°C) at the summit of the mountain, while the lights at the bottom indicate the volcanic eruption risk level (levels 1-5 are shown). Aural feedback via a piezo speaker inside the model is also provided for levels 2 and above.

As for our Fuji-chan device, we will create a better case with higher quality plastic than the 3D-printed version of the initial prototype described here, although we may also consider materials other than plastic. This second prototype will use a smaller micro-controller board and will be approximately half the size of the prototype shown in Figure 4. We will also consider adding a peltier element to the top of the device so as to give users a sense of the temperature at the peak.

5 CONCLUSION

Through the design of this work, we successfully envisaged how geospatial data — particularly relating to hazard warnings — can be presented in a simple yet innovative way. IoT and AR technologies provide a vast number of opportunities for interactive system designers to repurpose data that was formerly only available via software and use it to influence the behaviour and appearance of real world objects. We hope that the example we have provided here encourages others to explore novel, artistic applications of IoT and AR technologies.

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