10

RSAWORKS: Things that "Tweet" in South Africa

Laurie Butgereit, Louis Coetzee, John Hay, Johann Hugo, Kim Gush and *Meraka Institute, CSIR*

Abstract

The "Internet of Things" is the phenomenon of more and more "things" being connected to the Internet (as opposed to people getting connected to the Internet). Although the concept of "Internet of Things" includes bidirectional access ("things" giving information about themselves and people or software then controlling those "things"), creating "things" that "tweet" is a common first step in joining the growing "Internet of Things". This paper discusses a project where researchers in South Africa attempted to get a wide variety of "things" to "tweet" there statuses automatically.

Introduction To "Internet of Things"

More and more objects are becoming embedded with sensors or are becoming labeled with machine readable visual codes. These sensors or codes could be RFID (Radio Frequency Identification) tags, other wireless devices, commercial bar codes, or QR (Quick Response) Codes to name just a few.

With the "Internet of Things", the objects which are so labeled are expected to become active participants on the Internet. They are expected to become active participants in business, information processes, social processes where they are enabled to interact and communicate among themselves and with the environment [de Saint-Exupery, 2009].

Many "Internet of Things" technologies are already being used. Luxury cars often have satellite tracking systems along with devices to allow security companies to immobilize the car if it senses that the car has been stolen [Mellor, 2007]. Shipping companies use RFID tagging to expedite movement of parcels. Aircraft have transponders enabling air traffic controllers to monitor their movements.

Introduction to Twitter

Twitter is a microblogging service where users can "tweet" about any topic they wish with a 140-character length limit. Users can follow another person or can be followed by other people. Messages sent on Twitter are called "tweets". Followers receive the "tweets" of the people they follow [Kwak et al, 2010].

As the "Internet of Things" grows, more and more "things" are beginning to "tweet" their status. The Tower Bridge in London "tweets" whether it is open or closed and which ship is passing by [Böhringer and Gluchowski, 2009]:

http://twitter.com/towerbridge

The Lovell Telescope at Jodrell Bank (also in the UK) "tweets" information about what it is observing [5]:

http://twitter.com/lovelltelescope

Enthusiasts have connected toasters to the internet so that they "tweet" their status.

http://twitter.com/mytoaster

And even plants can "tweet" their need for water.

http://twitter.com/pothos

This project, RSAWORKS, is an attempt to get as many "things" in South Africa "tweeting" as possible using a unified platform.

Introduction to Beachcomber

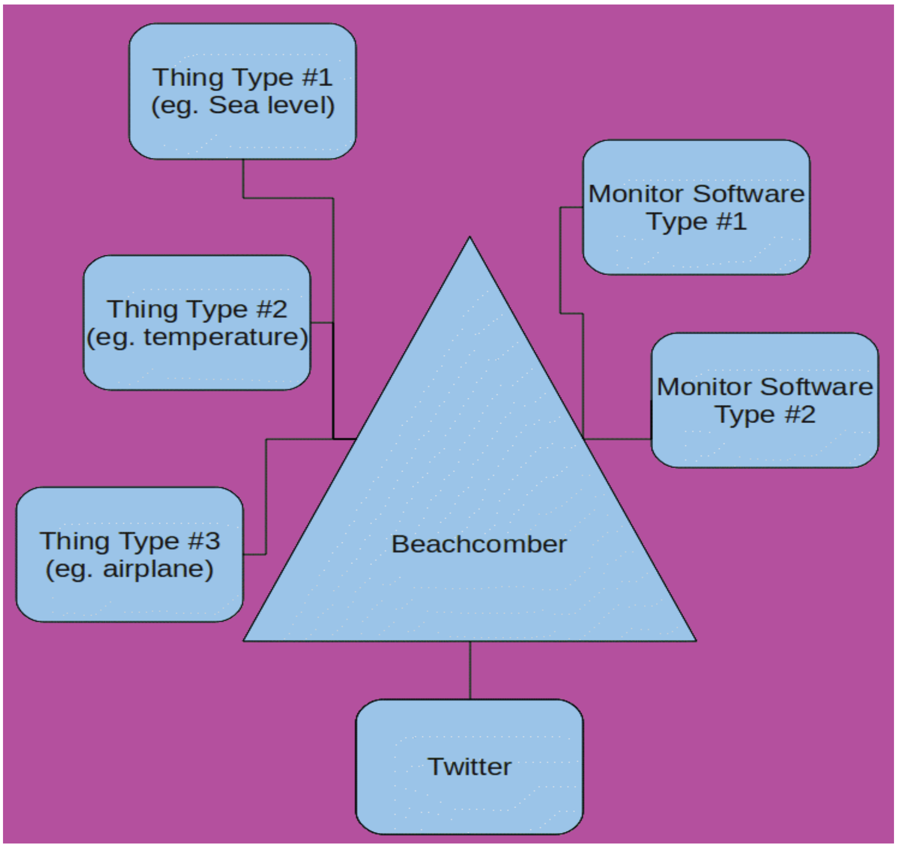
Beachcomber is a Java JEE application which allows Bearer Agnostic Chatter on a wide variety of channels. It is a platform which attempts to allow the "Internet of Things" to communicate with the "Internet of People". This communication is mediated through a specified business process. Beachcomber has been used in a number of "Internet of Things" applications and it was the obvious choice for this project [Butgereit et al, 2011].

Illustration 1 shows the configuration of Beachcomber. Beachcomber allows three way communication between people (indicated by the bottom side of the triangle), "things" (indicated by the left side of the triangle), and business processes (indicated by the right side of the triangle).

Beachcomber allows for a wide variety of protocols to communicate with people (including XMPP, MXIT, Email, HTTP) and a wide variety of protocols to communicate with "things" (including HTTP, Email, QR Codes, etc). The business processes are easy to write and implement.

For the specific case of this project, only one communication protocol was necessary for communicating with people : Twitter. Other communication channels to people could have been implemented using Beachcomber but that was not the goal of the research.

Illustration 1: Beachcomber 3-way configuration



Research Framework and Methods

RSAWORKS used a Design and Creation research methodology as defined by Oates [Oates, 2006]. The Design and Creation research methodology is an iterative methodology containing five steps:

1. Awareness – the recognition and statement of a problem
2. Suggestions – tentative ideas on how this problem might be addressed
3. Development – implementation of these tentative ideas or suggestions
4. Evaluation – assessment of the developed item
5. Conclusion – consolidation of results

This iterative methodology was traversed for each new "thing" which was connected to the platform. For example, when the researchers first attempted to have a laptop "tweet" the status of the battery, the five steps were

1. Awareness – the status of the laptop battery needed to be "tweeted"
2. Suggestions – it was suggested that a script be written that monitored the battery and then used HTTP to transmit the information to the platform
3. Development – the laptop script was developed and the Beachcomber platform was modified to cater for incoming HTTP requests
4. Evaluation – the development was assessed
5. Conclusion – the results were consolidated

It is important to note that the steps are traversed a number of times.

South African "Things" that "Tweet"

At the time of writing this document, there are ten things regularly "tweeting" their statuses on the RSAWORKS project using the Beachcomber platform. These ten things are using four different communication channels to the platform. These four different channels can be summarised as:

1. HTTP client requests by Beachcomber to existing websites
2. HTTP servlet requests from smart objects to Beachcomber
3. Smart objects communicating via private GPRS networks to an intermediary server which then automatically emails the data to Beachcomber
4. Specialised electricity monitoring hardware which communicates via wireless to base stations which forward pictorial information to Beachcomber using TwitPic

Each of these four channels will be described in detail.

It is important to note that RSAWORKS is an ongoing project and additional channels may be available at the time of the presentation of this work.

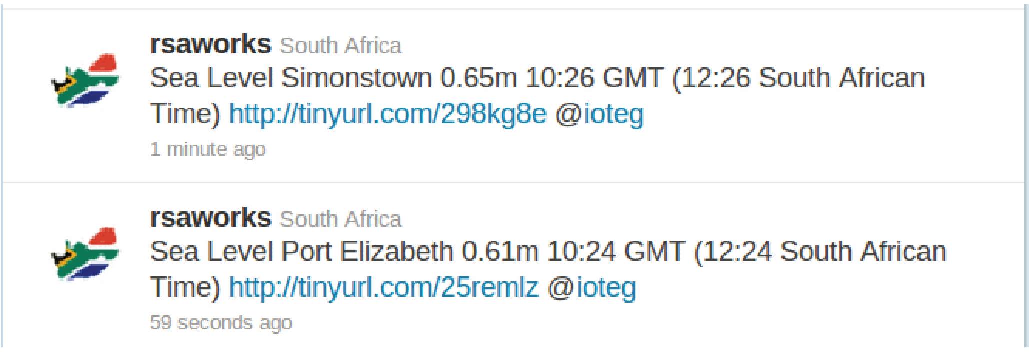
HTTP Client Requests

The Beachcomber platform can be easily configured to poll other websites which already publish real-world "thing" data. This was one of our first iterations of the Design and Creation research methodology. This input channel was primarily used to test feasibility of using the Beachcomber platform for this project.

Three websites were accessed for "thing" information.

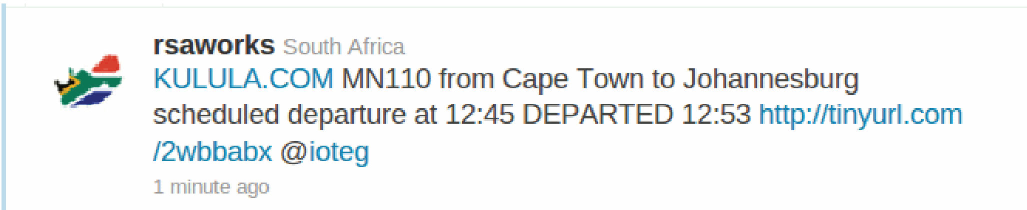
The Global Sea Level Observing System provides coordination for global and regional sea level networks in support of oceanographic and climate research. The Intergovernmental Oceanographic Commission in conjunction with the Flanders Marine Institute have developed a web-based global sea level station monitoring service for viewing sea level data received in real-time [Merrifield et al, 2009]. Five of those sensors are in or near South Africa: Port Elizabeth, Durban, Simonstown, and Marion Island. During the course of our testing, the Durban sensor was offline. Beachcomber was configured to monitor that site and post relevant information on Twitter. Illustration 2 provides examples of those "tweets".

Illustration 2: Sea Level "tweets"



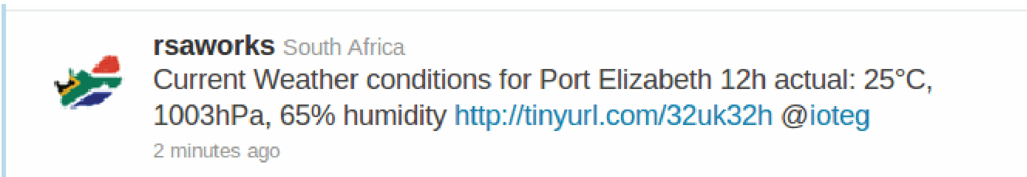
Another interesting site which publishes relatively real-time data was the Airports Company of South Africa. The status of flights between Johannesburg and Cape Town were updated on their website within minutes. This enabled Beachcomber to get more or less real-time data and forward it to Twitter. Illustration 3 provides an example of such "tweets".

Illustration 3: Airflight "tweets"



The South African Weather Service also published weather data for major South African cities. This data was not immediately updated by the Weather Service and was often a few hours old. Illustration 4 provides an example of the weather "tweets".

Illustration 4: Weather "tweets"



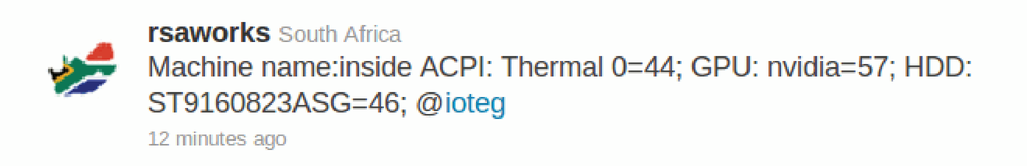
By accessing information which was already published on the Internet, this iteration of the Design and Creation research methodology allowed the researchers to work out any major problems with the Beachcomber platform and still profile interesting information about "things" that are working in South Africa.

HTTP Servlet Requests

The subsequent iteration of the Design and Creation research methodology was to allow smart objects to send information about themselves to the Beachcomber platform whenever the smart object deemed it appropriate. This meant that the Beachcomber platform did not have to poll for the information.

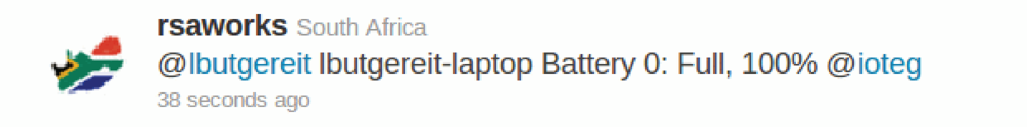
This enabled the researchers to plant the idea of a "Green IT" project with friends and coworkers where it would monitor temperatures inside of the laptops around the organisation. Coworkers could voluntarily install additional software on their laptop to monitor these temperatures. This additional software would then automatically send the information to the Beachcomber platform which would forward it to Twitter as can be seen in Illustration 5.

Illustration 5: Laptop temperatures "tweet"



Continuing with the idea of "Green IT", laptop battery levels could also be monitored as can be seen in Illustration 6.

Illustration 6: Laptop battery status "tweet"



Any smart object which could make an HTTP request would be able to "tweet" its status using Beachcomber.

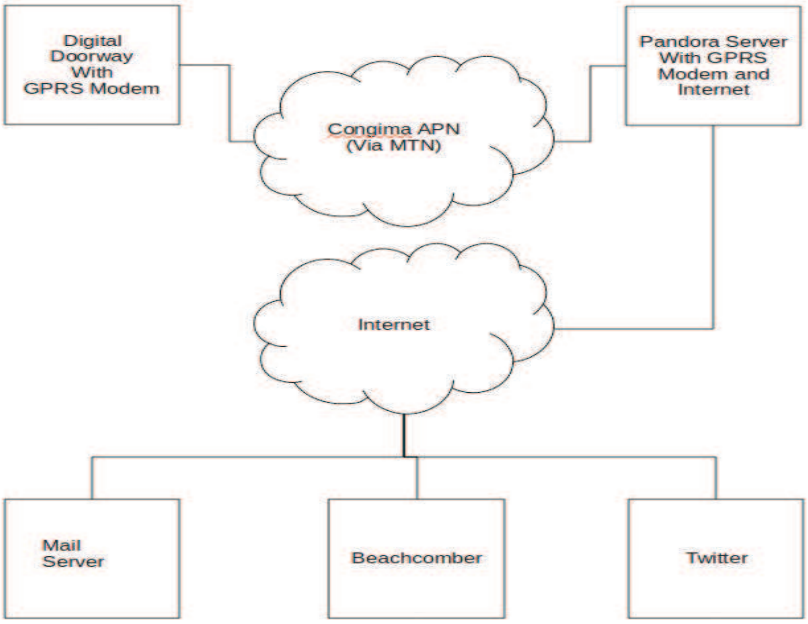
GPRS to Email

The Digital Doorway initiative addresses the computer literacy needs of residents of South Africa. The Digital Doorways are robust computer kiosks which are placed in areas where the residents do not traditionally have access to computer systems. This includes rural areas and township areas [Gush et al, 2004]. The majority of the Digital Doorways were not connected to the Internet.

The researchers on the Digital Doorway project developed a method for monitoring the installed Digital Doorways without connectivity to the Internet. They installed watch-dog boxes on three of the Digital Doorways. These independent watch-dog boxes which communicated via GPRS (General Packet Radio Service) on a private network to an intermediary server which also had a GPRS modem. This intermediary server was connected to the Internet. This intermediary server would then email this information to a specific email address which Beachcomber monitored. The circuitous route of the data from the Digital Doorway to Twitter can be seen in Illustration 8

When the email was received, Beachcomber would then post the information on Twitter as can be seen in Illustration 7.

Illustration 7: Digital Doorway "tweets"



Electricity Consumption

Prior to the implementation of Beachcomber and RSAWORKS, two researchers at Meraka Institute independently began monitoring their electricity consumption of their personal homes. They had previously installed commercial monitoring equipment "Current Cost". The "Current Cost" monitoring equipment has been used by other organisations for Green IT applications [Mattern et al, 2010].

As can be seen in Illustration 9 the "Current Cost" monitoring equipment included sensors with associated clamps which went around the mains cables (and no electrician was required to install it). Multiple sensors could communicate via a wireless protocol to a "Current Cost" base station.

The base station had USB (Universal Serial Bus) support which allowed the researchers to move the data from the base station to an intermediary server and then on to the Internet. These researchers had already done extensive work in plotting their home electrical consumption. All that was left for the scope of RSAWORKS project was to post the images of these graphs on Twitter.

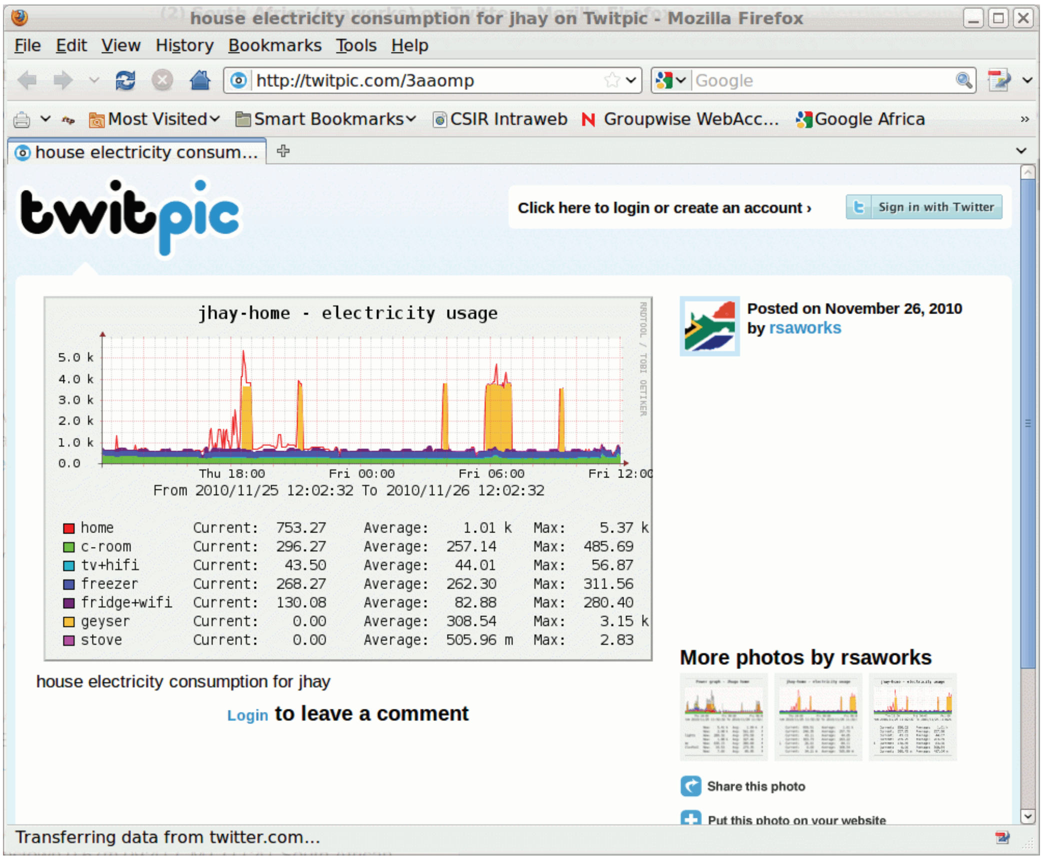
Illustration 9: "Current Cost" hardware (Image Credit:www.currentcost.co.uk)

This was done through the use of Twitpic. Twitpic is a Twitter add-on application which allows users to email images to a specific address. Twitpic will then store the images and provide links as can be seen in Illustration 10

Illustration 10: Twitpic "tweets"

These links provide the actual home electricity consumption graphs as can be seen in Illustration 11

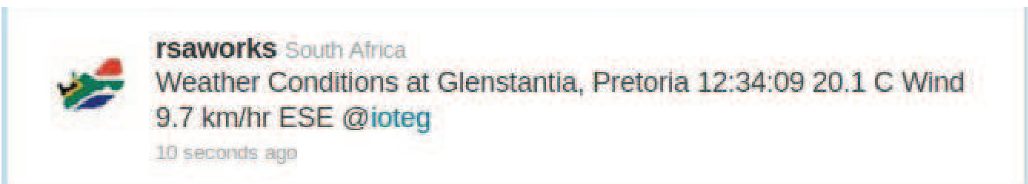
Illustration 11: Electricity consumption graphs



Local Weather Stations

One of the researchers at Meraka Institute installed a LaCrosse WS2355 weather station at his home which provided more or less realtime information about local weather conditions as can be seen in Illustration 12

Illustration 12: Local weather conditions



Security

One of the most widely discussed concerns about the growing "Internet of Things" is security of information and privacy of the individuals. This topic warrants a paper all on its own. However, a number of security measures were introduced even for this initial "Internet of Things" project.

These were the measures taken:

1. The IP (Internet Protocol) address of all incoming HTTP requests were validated against a database table. Only requests coming in from IP addresses which had entries on the table were forwarded to Twitter.
2. The email addresses of providers of information were also validated against a database table. Only data received from email addresses which had entries on the table were forwarded to Twitter.

How can these "Tweets" be used?

People use Twitter for different reasons. Java et al [Java et al, 200] determined that there were four major user intentions found on Twitter. These four intentions are:

1. Daily chatter – posts about daily routine
2. Conversations – posts directed to specific other users
3. Sharing information/URLs – posts which share links to other websites
4. Reporting News – posts which report latest news developments

Twitter posts to RSAWORKS could be generally categorized in group 3 – sharing information and links to other websites.

Grouping of "Tweets"

This project was an initial step in learning about the "Internet of Things". For the scope of this project, all "tweets" were sent to one Twitter Feed, RSAWORKS. Obviously, a more realistic situation would be to group similar "tweets" into their own Twitter feeds. For example, a Twitter feed could monitor house electrical consumption while another Twitter feed could monitor computer temperatures.

Conclusion and Future work

The "Internet of Things" is the next step in ubiquitous computing. More and more smart things are being connected to the Internet.

This project, RSAWORKS in conjunction with Beachcomber, was an initial project to see how many different types of "things" in South Africa could be posting their status on Twitter. This project must be considered to be an entry-level project to the "Internet of Things" because it only collects information. It was deemed to be a learning experience for the researchers involved.

Future work will involve collecting information from many more and different types of "things". There are ongoing negotiations with organisations and we hope to report positively on this at the presentation of this paper in Kampala.

References

BUTGEREIT, L., and COETZEE, L., 2011. Beachcomber: Linking the "Internet of Things" to the "Internet of People. Proceedings of IST-Africa, 2011, may 11-13, Gabarone, Botswana.

BOHRINGER, M., and GLUCHOWSKI, P. 2009. Microblogging. Informatik-Spektrum, Vol. 32, No. 6, pp. 505-510.

DE SAINT-EXUPERY, A. 2009. Internet of Things.

GUSH, K., CAMBRIDGE, G., and SMITH, R. 2004. The Digital Doorway-minimally invasive education in Africa. ICT in Education Conference.

JAVA, A., SONG, X., FININ, T. 2007. Why we twitter: understanding microblogging usage and communities. Proceedings of the 9th WebKDD and 1st SNA-KDD 2007 Workshop on Web Mining and Social Network Analysis, August 12-15, 2007, San Jose, California, pp. 56-65.

KWAK, H., LEE, C., PARK, H. 2010. What is Twitter, a social network or a news media?" Proceedings of the 19th international conference on World wide we, April 26-30, 2010, Raleigh, North Carolina, USA, ACM, pp. 591-600.

LOWE, S., Jodrell Bank Centre for Astrophysics, The University of Manchester,"

MATTERN, F., Staake, T., and Weiss, M. 2010. ICT for green: how computers can help us to conserve energy," Proceedings of the 1st International Conference on Energy-Efficient Computing and Networking, ACM, pp. 1-10.

MELLOR, B. 2007. A world of connections," The Economist, 2007,

MERRIFIELD, M., ARUP, T., ALLEN, A. 2009. The global sea level observing system (GLOSS)," OceanObs, Ocean Information for Society: Sustaining the Benefits, Organizing the Potential, Community White Papers, pp. 21–25.

OATES, B.J. 2006. Researching information systems and computing," Sage Publications Ltd, 2006,