

Innovation and the Internet of Things: Impacting Farmers Sustainability through Latex Harvesting Optimizations in Thailand

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Abstract - The objective of this paper is to highlight the innovative work of two young entrepreneurs who are working in the field of the Internet of Things. A case study approach will be used to focus upon each example with the goal to illustrating ways that software is being applied to manage ordinary problems and things. Cartographr is an app designed by Colin Gagich who is an engineering student at Mc Master University in Hamilton, Ontario, Canada. Cartographr was designed to track and assist people with disabilities to navigate their way around physical spaces. The app can be downloaded free of charge to any mobile phone. Cartographr applies a site map and icons: Accessibility Alert, Official Alerts and has a Crowd Sourcing feature. The goal is to provide immediate information to users in order to ensure personal safety and easy access to all buildings within the Mc Master University campus. RubberEIS is a concept initially imagined by a Thai student Premchai Kongtham who earned his Bachelor in Computer Sciences at Kasetsart Univeristy in the Sakon province. He grew up in a family who have many rubber trees. His concept was to build a prototype allowing a device to measure the humidity and send a message including the ideal time to farmers on their smartphones / GSM phones early in the morning to start harvesting.

Keywords - Cartographer, Internet of Things

I. INTRODUCTION

A. *Internet of Things (IoT)*

The terms Internet of Things (IoT) and Web of Things (WoT) are synonymous. The vision for the IoT is the application of software via the Internet to manage, and integrate objects in the real world using the Web as a platform for connectivity.

B. *Software as a Service (SaaS)*

Software that enables and facilitates machines, objects and operating systems to communicate, be monitored, evaluated, tracked and maintained for the purposes of doing work. SaaS uses a business model whereby users rent the soft for certain duration of time, they do not own it.

C. *Machine 2 Machine (M2M)*

The capacity or ability of machines to be connected to each other and their operators using software and the Internet as a platform of communication.

D. *Objectives*

The general objective of this paper is to highlight the innovative work of two young entrepreneurs who are working in the field of the Internet of Things. A case study approach will be used to focus upon each case study with the goal of illustrating ways that software is being applied to manage ordinary problems and things.

E. *Implications*

The constantly evolving world of the Internet has given rise to a new age of innovative thinkers who are increasingly able

to close the gap between the physical and digital worlds. The Internet and its boundless potential to foster creativity and innovation has given rise to a new age of grass roots, local entrepreneurs who have ventured beyond the realm of exploring interesting possibilities to the actual development of new realities that are impacting upon the modern world at a rate that is frankly astounding. The researchers in the field of engineering and the trend towards human to thing communication predict that applications of software will result in an explosion of innovation based upon data collection focused on human needs (Lu Tan). Greater access to cost effective systems will alter traditional industry, agriculture, education, the fields of commerce, medicine, systems of transportation and security and most importantly the world of work. The rate of change has created a new paradigm about who is leading the way forward and the rules by which individuals move up the corporate ladder. A new breed of tech savvy locally motivated newcomers are clearly challenging the status quo within today's traditional corporate structure.

II. CASE STUDY: CANADA AND THAILAND

Some individuals use their experience as a hammock. They are content to rest and enjoy the pleasure of accomplishments achieved. For others, experience represents a sling shot that propels them forward and motivates them to take risks and explore new ideas. These are today's innovators and every society has its share of creative lighthouse thinkers. The Internet has fostered a generation of problem solvers who are challenging the status quo and changing the world in wonderful and positive ways.

A. Colin a 21 year old Canadian Entrepreneur with a Problem in his Pocket and a Vision in his Head

For one engineering student the opportunity to participate in a co operative project between two leading Canadian universities has become a personal spring board that at a young age has allowed him to establish his own business,

successfully apply for funding grants to support his ideas and to take his place at the local level as a successful businessman and IT entrepreneur.

B. hitchBOT Project

hitchBOT was a Canadian "hitchhiking robot" created by David Harris Smith of McMaster University and Frauke Zeller of Ryerson University. The delightful little robot was created as a social experiment and was able to successfully hitchhike across Canada and through parts of Europe (*Dave, Paresh*).

The hitchBOT robot was constructed from ordinary things. A plastic bucket formed the torso and featured flexible "arms" made from rubber gloves and flexible "legs" attached to a pair of child's sized rubber boots. The top section of the cylindrical body was transparent and contained a screen which displayed eyes and a mouth. The overall effect was meant to appeal to people with the hope of enticing them into providing a free ride. The strategy certainly worked.

The talking robot was able to engage in a basic level conversation, talk about facts and act as a robotic travelling companion to the motorist who offered a ride. It had a GPS device and a 3G connection, which allowed researchers to track its location. HitchBOT was equipped with a camera, which periodically photographed its journeys. It was powered by a combination of solar power or by cigarette lighter sockets in cars.

III. BRIEF SUMMARY: CARTOGRAPHER APPLICATION OR APP

Cartographr is an app designed to track and assist people with disabilities to navigate their way around physical spaces such as shopping malls, transportation systems and in this case a university campus. Cartogrpahr is a simple app that can be downloaded to a mobile phone.

Like all inventions Cartographr, represents a solution to a problem that was very real to a disabled wheelchair bound student. McMaster University campus is spread out over a large

area that consists of buildings, roads, foot paths with its share of ramps, elevated sidewalks, and cement barriers to accommodate parking. For someone who makes their way around the campus in a wheel chair there are often barriers that represent a significant challenge. As it happened for one young man as he was on his way to take an exam. It was winter and the ramp leading into the building where the exam was scheduled was inaccessible due to the accumulated snow. The result was that the student missed the exam simply because he could not access the building. Unfortunately for this student, this happened twice at two different buildings and for two important exams.

On another occasion the same student had taken the train from his home to the city. The train station has a network of staircases, escalators and elevators to move people from the lower tracks to the ground level exits. On this particular evening the student arrived at his destination at 7:30 on the last train only to discover that the elevator had been out of service. He was trapped in a closed environment with no way to exit. Fortunately he was able to go back and catch the returning train. Otherwise, he would have been alone, stuck on the platform with no way to exit because as it happened the staff had left for the evening and the other passengers on the train had exited the station without noticing that he was in difficulty. It is a fair argument that this situation represents negligence on the part of those responsible for the operation of the train station because clearly a passenger was placed in danger.

One may argue that the examples cited above are the result of oversight. In Canada people are used to the challenges of navigating their way in the snow and ice. Train station employees know that disabled people depend upon the elevator to access the train service. The challenge is that there is no effective system or strategy in place to communicate with individuals alerts about changes or problems that are important to them.

Sharing his story with friends and alarm for his personal safety prompted the development of the Cartographr app. The Cartographr App is built upon a similar app system called waze. This is an app that motorists use to tag issues when driving. Waze provides alerts about traffic congestion, accidents or potential road hazards which enable the driver to alter their route. Cartographr applies the same principles but has adaptations to assist people to get around on a university campus. It was developed with the co operation of McMaster University staff and was supported with a funding grant of \$ 25,000 CN. A functional prototype was created over a period of sixteen months and applied a comprehensive process based upon a trial and error model. Test trails focused upon the app's intended users, feedback from the university staff that represented the investor's needs and input from outside experts.

Cartographr is simple to install and is free to anyone who wishes to download it. The app communicates information on a site map of the university campus and features icons: Accessibility Alert, Official Alerts and has a Crowd Sourcing function.

Information is posted by university staff as an ongoing process to assist disabled users in getting around the campus. The Accessibility Alert feature communicates information related to access to buildings, location of ramps and elevators so that a disabled person can plan their route. The Official Alert is maintained by university staff and provides ongoing updates about potential risks. These include information about walkways that are under construction, closed roads, the temporary presence of heavy equipment. This allows the user to avoid areas that could present challenges to them. The Crowd Sourcing function allows any user to post alerts to caution others about demonstrations, emergency evacuations and situations related to immediate danger.

Though originally developed to support disabled users the Cartographr app is of benefit to everyone. It offers a platform for

ongoing and immediate campus related information flow that allows users to be aware of risks, manage their time and to seek assistance when necessary. From an administrative accountability point of view the app ensures that university staff is able to provide timely information that disabled people and other users have a right to know. The app supports the safety of individuals who are potentially at risk and certainly demonstrates an inclusive tone within the student population and builds goodwill (Colin Gagich).

IV. BRIEF SUMMARY: RUBBEREIS

RubberEIS is a concept initially imagined by a Thai student Premchai Kongtham who earned his Bachelor in Computer Sciences at Kasetsart Univeristy in the Sakon province. He grew in a farmer family who has many rubbers farms; in the Thai context, a rubber farm is merely a plot of land of 1,600 sqm² with ~400 rubber trees.

Thailand is one of the major rubber producers. That commodity is used to make items from tires to latex gloves and condoms. From finance and trading perspectives, the rubber is a commodity mainly traded in Japan (TOCOM). The last decade, the price per kilo rose fast (+4\$) and suddenly tanked (-1\$) to its lowest level in 2014. Those price disparities led to decrease farmer's source of incomes and pushed in-debts farmers below the poverty line. Furthermore, the growth of the rubber requires:

- 1) Patience, more than six years for a tree before harvesting starts.
- 2) Extensive manual interventions because latex is harvested by tapping the rubber tree in a manner that does not harm the tree.
- 3) Harvest is fully dependant from weather and atmospheric conditions. Indeed, the sticky and milky latex has to be harvested at an ideal time at night during a short period of time. The tapping is performed on a bi-weekly basis only.

The last criterion, 'time', was selected to build an Executive Information System dedicated to farmers to increase rubbers production yield and to increase the quality of the latex; counterbalancing the potential risk by supplying more latex than the demand. It has to be noticed that the influence of harvesting time on yield has been studied on many trees and plants worldwide since many decades (González-Molina, Moreno, & García-Viguera, 2008; Rohloff, Dragland, Mordal, & Iversen, 2005; Senatore, 1996); a rubber tree exudes more quantity of latex early in the morning , during the night!

Therefore, what is the ideal time at night to harvest rubber? Answers are depending on the attributes given to the adjective ideal. In that present case, attributes of the adjective ideal were: no rain and a good percentage of humidity.

The concept was to build a prototype allowing a device to measure the humidity and send a message including the ideal time to farmers on their smartphones/GSM phones early in the morning to start harvesting.

The main concern was to create data connections on the GSM network through a standard USB interface due to the impossibility to get access to the Internet and the electricity in the North East of Thailand, in countryside areas where there are no Internet and electric access points. Furthermore, although sending sensor data via the Internet sounded promising, that would incur an unwanted expense of a connection just for some data; farmers cannot afford those additional costs while their incomes are decreasing. However, farmers are often living in villages where the electricity and the Internet are available.

The concept was to select Arduino/Raspberry based devices equipped with temperature and humidity sensors coupled with a GSM shield integrated into waterproof solar panel boxes installed at strategic points within rubber farms, then send data over the GSM data network. Data were then gathered

through a GSM card installed on a computer connected to the Internet located in the village where farmers are living and where farmers have state subsidized internet access points.

The process is pretty easy. The computer gathers and analyses data to compute the ideal time and send a message to family smartphones connected to the Internet via the Asian social network Line (equivalent to WhatsApp).

Outcomes have to be carefully analysed before drawing any conclusions which are forecasted for 2020. Nonetheless, IoT gives the opportunity to build cost effective concepts in developing countries like Thailand.

Summary Statements: Today's innovators are true renaissance thinkers. They demonstrate a curiosity for possibility, and as a result of their vision and capacity to tinker and manipulate ideas with the development and application of new software they are realizing outcomes that are changing society. For them the Internet and Web based platforms represent a tool to manipulate, create new systems and solutions that benefit society.

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