Bluetooth Based Presence Detection

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Abstract: **Bluetooth enabled mobile devices is an excellent and energy efficient method to detect the presence of individuals. This implementation mainly aims at using the computing power of Raspberry Pi, a powerful system on chip, in order to continuously monitor the presence of registered Bluetooth enabled mobile devices, and report the same on a webpage hosted on the local network on a timely basis.**

Keywords: Bluetooth, Presence Detection, Raspberry Pi, Mobile Detection

INTRODUCTION

Bluetooth is an excellent option which can be used to improve the way to detect the way in which objects and even people can be detected. Any device that is Bluetooth enabled can be detected by another Bluetooth enabled device, and this property can be exploited to measure proximity of the two devices. The implementation aims to use Bluetooth enabled mobile device in order to detect the presence of individual based on the proximity from the central Bluetooth module interfaced on the Raspberry Pi system on chip.

Bluetooth, a wireless technology standard for exchanging data over short distances uses short wavelength Ultra High Frequency radio waves in the band from 2.4 to 2.485 GHz from fixed and mobile devices, in order to aid building personal area networks (PANs) was invented by a telecom vendor, namely Ericsson in 1994. It was originally proposed as a wireless alternative to the existing RS-232 data cables as it can connect several devices, effectively overcoming problems of synchronization.

Bluetooth is managed by the Bluetooth Special Interest Group (SIG), that has more than at least 20,000 partner companies, mainly in the areas of telecommunication, computing, networking, and most importantly consumer electronics. IEEE standardized Bluetooth as IEEE 802.15.1, but no longer maintains this standard. The Bluetooth SIG monitors the development of the specification, manages the qualification program, and protects against trademark and its violations. Manufacturers must make any device meet Bluetooth SIG standards to market it as a Bluetooth enabled device. A network of patents apply to this technology, which are licensed to individual qualifying devices and their designers.
Raspberry Pi is a series of card–sized single-board computers designed and developed in the United Kingdom by the Raspberry Pi Foundation with the aim of promoting teaching of basic computing science in high schools and developing countries. Originally Raspberry Pi and Raspberry Pi 2 are developed in several board configurations using licensed and authorised manufacturing agreements with Newark Element14 (Premier Farnell), RS Components and Egoman.

The primary essence and core used to implement the chip's hardware remains the same across all manufacturers. All Raspberry Pi's include the same VideoCore IV GPU, and either a single-core ARMv6-compatible processor or a newer and a more advanced ARMv7-compatible quad-core one (in Pi 2); and 1 GB of RAM (in Pi 2), 512 MB, or 256 MB. They have a Secure Digital (SD) (models A and B) or MicroSD (models A+ and B+) socket for boot media and persistent storage. Recently in 2014, the Raspberry Pi Foundation launched the Compute Module, for use as a part of embedded systems for the same computing power as the original Pi. Early in February 2015, the next-generation Raspberry Pi, Raspberry Pi 2, was released. The new computer board was initially available only in one configuration (model B) that had a quad-core ARM Cortex-A7 CPU and a GB of RAM with remaining specifications being similar to those of the previous generation model B+. The Raspberry Pi 2 retains the same price point of the model B, with the cheaper model A+ remaining on sale. In November 2015, the Foundation launched the Raspberry Pi Zero, a smaller product priced at an even lower price.
The Foundation provides Debian and Arch Linux ARM distributions for download. Tools are available for Python as the main programming language, with support for BBC BASIC via the RISC OS image or the Brandy Basic clone for Linux C, C++, Java, Perl, Ruby, and Squeak Smalltalk.

DESIGN

The overall design centres on the system on chip, Raspberry Pi 2 B. The board is interfaced with an external USB Bluetooth module manufactured by Adafruit, a leading brand of all major system on chip compliant electronic components. Before the interfacing, Raspbean, the operating system compatible with board, was loaded and into it and dependencies such as Python, then the Python based Bluetooth module named Bluez were downloaded and flashed using suitable commands. The external Bluetooth module, was then interfaced with the board. Python scripts used primarily to sense the presence of other

Bluetooth enabled devices, was also used to obtain the unique Bluetooth address associated with every device. Using another Python script, all the detected device's addresses were forwarded to a remote server, located on the same local area network for security and to ensure privacy of the data. In the server, based on the pre defined mappings between the Bluetooth address and a name associated to the name, all unmapped entries were dropped. Along with the addresses, the timestamps of when the data was obtained were also passed in order to indicate the freshness of the data so obtained. The mapped addresses were replaced by their associated names and this along with the timestamp was posted on a webpage, which is accessible only if the device trying to access this data is part of the same network as the server on which the data is hosted. This ensures the security of the data and prevents misuse of the same. As and when data is posted on the webpage, it is also added to a database, which can be later used for analysis purposes.

TESTING AND COMPARISON

The entire set up was tested out with a series of Bluetooth enabled devices and codes in order to compare, not only the ease of execution in terms of the load on the processor, but also accuracy of sensed data, reliability of data and ease of implementation. Several scripts were considered and implemented to check the accuracy with which they sensed the presence of active Bluetooth enabled mobile devices as this is the main point of focus in the implementation. Failure to sense the devices on time, effectively lowers the robustness of the set up whereas, failure to sense the devices accurately compromises on the reliability of the implementation. After careful examination of multiple implementations, the suitable Python script was developed and chosen that ensured that all possible data were collected from the sensors and posted onto the server where further implementation was taken care of. The efficiency of the overall set up was tested using a total of five unique devices and the data was sensed with an accuracy of 80% and reported with the same accuracy, within a 5% variance. The tested devices along with their Bluetooth addresses are shown below in the form of a table.

Bluetooth Address	Device Name
E4:EC:10:60:83:7C	A
F8:84:F2:9E:99:AA	Raja
80:60:07:C7:F3:97	Someone
88:C9:D0:65:41:9B	Nish
C0:EE:FB:54:39:93	PS

Table1 Basic Test Results

RESULTS

Once the devices were tested successfully, most of the also displayed on the webpage as expected, as they had been previously mapped to a name. To test if names that are not present in the map list were also posted, device with Bluetooth address 80:60:07:C7:F3:97 was not given a map entry and it was hence not displayed on the webpage. Also, the devices were periodically moved out of range of the sensor, and some were even turned off, and the expected results were displayed on the webpage with an accuracy of 90% accuracy. The slight offset in accuracy was mainly due to heat dissipated by the module and interference due to other signalling elements.

SCOPE AND FUTURE WORK

The current by itself has great scope in fields of monitoring of objects, both inanimate and animate, as it is a cheaper option compared to other existing alternatives. It can be used to enhance current security levels, by ensuring that sentries posted in a particular area don't leave the area in the given time frame, by constantly monitoring them. Apart from the normal laser beam protection given to objects of high value, if a small Bluetooth button is attached, and constantly monitored by the set up, the security level includes two fold. If a series of these detectors are placed at a consistent and calculated distance from each other and a good "hands of" protocol is configures on them, it can even be used to detect and track movements of even moving objects.

Apart from the above specified advancements, if the database component was successfully implemented, it could have had a greater impact on the analysis of the set up. It could have had a greater impact on the overall working mechanism of the project, as data analysis in almost any field is growing at an exponential rate.

CONCLUSION

Now that it has been established that the Internet of Things is the most hyped emerging technology today, and that the term and the associated technologies is far from new. Given the steady growth in this field, and the simplistic yet arguably efficient design of the Bluetooth based presence detector, it will not be hard to market, and with little work on parameters user interface and some logical extensions, it could even be a great success story. These mind-blowing estimates from companies developing and selling IoT-related products and services, investing time to research and perfect even small implementations that serve some purpose would yield a proportional amount of revenue and recognition, even in the global scale.

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REFERENCES

[1] Jayavardhana Gubbi , Rajkumar Buyya, , Slaven Marusic , Marimuthu Palaniswami, Internet of Things(IoT) : A Vision, Architectural Elements and Future Directions

[2] Friedemann Mattern and Christian Floerkemeier M. Wegmuller, : From Internet of Computers to Internet of Things

[3] Wireless Communication Standards for the IoT : Greengeek White Paper

[4] Wireless Connectivity for the Internet of Things - TI White Paper