Smart Box System (POC) Using Cellular/NB-IoT Technology

Dinanath Dandavate

Bits Institute of Technology and Science, Pilani, Rajsathan, Principal Engineer, C/304, IRIS, Magarpatta City, Hadapsar, Pune, India

Abstract: *The importance of monitoring letter boxes kept at difference places for specific purpose is crucial in this age. Various forms of letter boxes are installed at various places like apartments for personal mails, at ATM centers for cheque drop or credit card bill payment, at public places government post boxes for public use, suggestion letter box kept at offices, apartments and government places. Currently it is being monitored manually, or not utilized regularly, which leads to dead investment in infrastructure. Proposed solution is based on Cellular/Narrowband Internet of Things (NB-IoT) technology to notify user a new mail received in your mail box using twitter application. It gives practical implementation using cellular board provided by Particle Electron Micro-controller and sensors to notify new mail arrival.*

Keywords: NB-IoT, Smart box, Cloud, IFTTT

1. Introduction

Now a days we do many of our communications through emails or smart messaging apps which are available on many smart phones, the frequency of letters that we receives in various boxes located at various places is decreased. There are some open issues with the existing traditional system like notification of mail arrival is not possible, checking of physical mails or bills or notices or suggestions has to perform manually, real-time of received mail is not possible, usage of such traditional mail box system or any other utility box is not possible. Traditional system forces us to invest more in infrastructure, time and money. Scenario like collecting cheques from ATM's cheque drop boxes is very tedious, as bank representative has to visit every ATM places even if there are no cheques at ATMs, which leads to waste of commute time and money. Public post boxes available for public use has the same problem. Post-man individually has to check for any new mail pickup from all post boxes available from certain location every day. Suggestion letter boxes installed at various apartments / public places or at government offices need to check regularly physically.

Therefore a new solution is proposed which solves the above issues and open a new opportunities. Demonstrated solution is based on Particle Electron which is a tiny development kit for creating cellular-connected electronics projects and products. It provides development tools and cloud platform for managing and interacting with your new connected hardware or sensor. In order to communicate with outside world application like Twitter or Gmail, IFTTT (IF This Then That) technology is being used.

2. What is NB-IoT?

The new narrowband radio technology to address the requirements of the Internet of Things (IoT) [1]. The technology standardized by the 3rd Generation Partnership Project (3GPP) is developed to enable a wide range of devices and services to be connected using cellular telecommunications bands. NB-IOT has been designed to offer extended coverage compared to the traditional GSM networks. The use case for such standard is to have a device with a battery life of more than 10 years. NB-IoT is addressing the low power wide area IoT market opportunity using licensed spectrum as it is secure and reliable providing guaranteed quality of service.

NB-IoT is designed simple to reduce device costs and to minimize battery consumption.

3. What is IFTTT?

Abbreviation for IFTTT is an "IF This Then That"[2]. IFTTT is a free web-based service that people use to create applets which are triggered by changes that occur within web services such Gmail, Facebook or Twitter. For example, an applet may notify you when the international space station passes over your house or open the garage when your BMW enters the driveway.

IFTTT is provides services as well as applets. IFTTT is an interface between apps like Gmail, Twitter and device which are nothing but the services. Applets are developed around service that users can turn on. Few companies tie-up with IFTTT to setup a new service for their app and someone can use the services on IFTTT to build their custom applets. For this POC, if micro-controller publishes an event then post a tweet to my configured twitter account a message with time stamp to notify that a new mail has been received.

4. Why NB-IoT?

By 2022, NB-IOT will likely capture over 90% of the LPWAN connections globally. Trouncing rival standards Sigfox and LoRaWAN on the strength of its wider coverage and reliability. LoRaWAN is likely to complement NB-IOT in niche cases, and 5G is unlikely to disrupt the LPWAN space until at lease 2028 [3]. Each technology has advantages and disadvantages, based on business use case and emergency to notifies the arrival new mail or cheque or suggestion/idea paper to smart box is up to individual or organization to use effectively the technology. of Selection

of solution is categorized based on QoS, latency, reliability compared with LoRa [4] as per use case mentioned table 1.

Table 1: Business Use Cases for mail box application

Business Use Case	Selection of technology	QoS	Latency
Personal mail box (Single)	NB-IOT	High	Low
Personal mail boxes at apartments	NB-IOT	High	Low
ATM Cheque drop box	NB-IOT	High	Low
Public post box (Multiple)	LoRa	Low	High
Suggestion/Idea box (Single)	LoRa	Low	High

4.1 Quality of service

As NB-IoT operates in licensed spectrum, it offers better quality of service when compared with unlicensed spectrum, as there will be a data or network traffic due to unlicensed frequencies. Lower the quality of service less the business emergency, higher the quality of service higher the business emergency.

4.2 Latency

Those business cases or applications which need low latency and high data rate can select NB-IoT technology whereas for those applications or business cases which are insensitive to latency and don't have bigger amounts of data to send over the network LoRa is the solution.

5. Methodology

To achieve success in this research work, a system is developed using combination of hardware and software. A infrared reflective sensor TCRT5000 used to detect any paper to be dropped in box. A cellular-connected micro-controller particle electron STM32F205 ARM Cortex M3 is used. IFTTT recipe is used to listen to events generated from micro-controller and post notification on twitter application as shown in figure 1. Micro-controller has provision for NB-IoT subscriber identity module (SIM) slot to insert 2G or 3G SIM. It is assumed that cellular network is adapted for NB-IoT SIM. NB-IoT can co-exist with 2G, 3G, and 4G mobile networks [5].
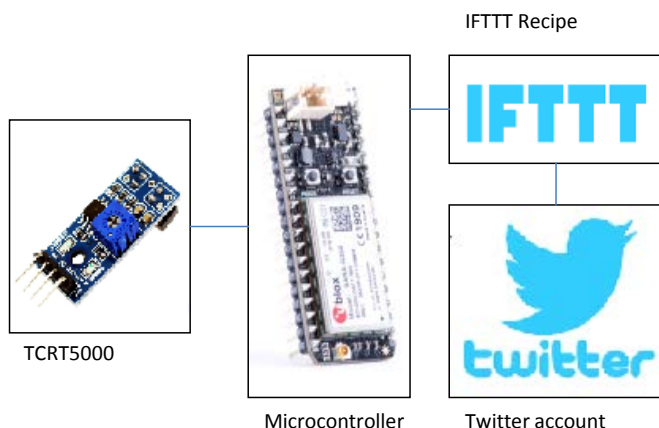

IFTTT Recipe

TCRT5000

Microcontroller   Twitter account

Figure 1: System overview

Steps involved in this model

- TCRT5000 infrared sensor embedded in box to detect paper or letter
- Microcontroller detect digital values of sensor connected to its digital input
- Based on high digital value controller publishes a new event on the cloud for 60 seconds
- IFTTT recipe check for new events generated from micro-controller, as each micro-controller needs to be registered online on particle website to get unique id
- If the event is published with predefined value a twitter message will be prepared by IFTTT recipe to post on pre-configured twitter account
- A new twitter message will be notified on user mobile twitter application

6. Results

The project has been started with the assembling of the sensor as shown in the figure 2 from which a notification of new mail arrival shown in figure 3. A successful installation of such system can be done in suitable premises as per business use case shown in table 1.
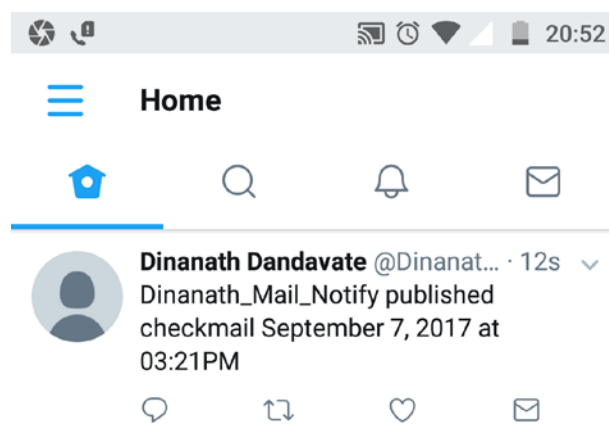

Figure 2: System Assembly

Figure 3: Twitter notification on mobile

7. Conclusion

In this research, a remote notification of new mail or paper

arrival as per business use case was ensured. With a Particle electron STM32F205 ARM Cortex micro-controller it supports 28 general input output pins which can be used to connect more sensor and batteries for every individual post box to provide notification with minor changes in micro-controller code and IFTTT recipe. STM32F205 microcontroller is used for cellular 3G or 2G connection whereas for NB-IoT, SARA-N2 series from ublox can be used [6]. This system can be used to conduct a survey of whether boxes are in really in use to save infrastructure cost using NB-IoT technology.

References

[1] Kevin FLYNN, "NarrowBand IOT," 3gpp.org, para. 1, Sept. 17, 2015. [Online] Available: http://www.3gpp.org/news-events/3gpp-news/1733-niot. [Accessed : Sept. 04, 2017].

[2] Ifttt, "ifttt the beginning", ifttt.com, para. 1, Dec. 14. 2010. [Online] Available: https://ifttt.com/blog/2010/12/ifttt-the-beginning. [Accessed: Sept. 14, 2017].

[3] Michael Essery, "NB-IOT Standard Poised to Take 90% Share of Low-Power Wider-Area Networks for IOT," luxresearchinc.com, para. 4, April 27, 2017. [Online]. Available: http://www.luxresearchinc.com/news-and-events/press-releases/read/nb-iot-standard-poised-take-90-share-low-power-wide-area. [Accessed: Sept. 04, 2017].

[4] Rashmi Sharan Sinha, Yiqiao Wei, Seung-Hoon Hwang, "A survey on LPWA technology: LoRa and NB-IOT," sciencedirect.com, para. Abstract, Mar. 21, 2017. [Online] Available : http://www.sciencedirect.com/science/article/pii/S2405959517300061. [Accessed: Sept. 04, 2017].

[5] GSMA, "Narrowband – Internet of Things (NB-IoT)", gsma.com, para. 3, [Online] Available: https://www.gsma.com/iot/narrow-band-internet-of-things-nb-iot. [Accessed : Sept. 04. 2017].

[6] Ublox, "SARA-N2 series", u-blox.com, table, 2. [Online] Availble: https://www.u-blox.com/en/product/sara-n2-series. [Accessed : Sept. 04. 2017]

Author Profile

Dinanath Dandavate received the M.C.M. & M.S. degrees in Computer Science from Savitribai Phule Pune University in 2001 and Bits Pilani in 2010, respectively. Having major experience in Smart Card Domain for OS development. Currently working with Giesecke & Devrient MS India Pvt. Ltd. in Pune, India.