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NOS IoT NFC-based solution

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Abstract

One of the most perplexing discoveries from COVID-19 pandemic was the office building overall energy consumption failing to appreciably drop once staff began working from home. Also, we are witnessing an exponential growing of Internet of Things (IoT) ecosystem but most of them have been implemented for personal usage rather in an enterprise environment. The big challenge in installing a large-scale IoT ecosystem at enterprise level resides on costs, the selection of proper devices, and the management of these devices and users.
NOSIoT NFC-based solution consists of a simple mobile application that will read an NFC tag in a specific workstation. The communication and management are performed through Home Assistant. All the information is stored into a database to calculate the energy consumed by each workstation.
The solution provides an innovative approach for enterprise level, delivering a low-cost end-to-end flow with high flexibility, and easy "Tap&Go". This allows companies to be more climate-friendly and positively contribute for green buildings.

Keywords: IoT, Energy efficient IoT, Smart Home, Sustainable Office; Smart workstations

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1. Introduction

1.1. Motivation

One of the most perplexing discoveries from COVID-19 pandemic was the office building overall energy consumption failing to appreciably drop once staff began working from home. For example, the Empire State Building has practically been empty, but electricity usage fell only 28% [1], which means that buildings management urge to be adapted according to employee's needs in order to be more sustainable and climate friendly.

Although some automations have been implemented at offices buildings to manage lights and air conditioning, unused workstations consuming energy throughout the day are still requiring constant lighting and heating, which is a considerable waste of energy and, consequently, a big trigger to contribute for CO2 emissions. For example, the energy footprint of a laptop in use 8h per day is 150-300kWh, the equivalent of 44-88 kg CO2 per year, meaning 2 trees to offset the emission of a single device [2]. Thus, there is a clear need to fulfil, and a strong market opportunity to facilitate the reduction of CO2 emissions and electricity costs as well [3]. This is even more important in the current geo and economic situation, where Europe needs to decrease its own energy consume to assure that all EU-countries has energy to the winter [4].

With this problem in mind and using the current available Internet of Things (IoT) devices (particularly smart-plugs and lights) combined with NFC technology, NOSIoT solution aims at using NFC tag as a trigger to activate or deactivate a workstation whenever it is to be used by an employee, according to his/her specific profile. Although the application can support other types of technologies to trigger the flow (e.g., QR and Bar codes), NFC technology is simpler and more secure to connect the unconnected and disconnect the connected. It provides a transparent and quick access without cameras to get and store information.

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1.2. Overview

The following Section 2 presents a brief description of the current state-of-art, competition and benefits related to IoT architectures. The proposed solution is described in Section 3. The current results are presented and discussed in Section 4. In Section 5 some final remarks and future work steps are described.

2. State-of-the-art

The "ability to connect the unconnected and the disconnect the connected" is one of the main challenges of the current IoT technologies, particularly in terms of scalability and costs. We are witnessing an exponential growing of IoT ecosystem but most of them have been implemented for personal usage rather in an enterprise environment. The big challenge in installing a large-scale IoT ecosystem at enterprise level resides not only on costs and the selection of proper devices, but also the management of these devices and users. Although some automations have been implemented, the potential of IoT technology has not been well leveraged, mainly in applying this type of technology to workstation management and, consequently, a good way to positively contribute for green buildings. For example, one of the most perplexing discoveries from COVID-19 pandemic was the office building overall energy consumption failing to appreciably drop once staff began working from home [1]. Thus, a "Tap & Go" solution when connecting workstations and making employees' intents clear is necessary, being a good opportunity to benefit of NFC technology since it is very simple, intuitive, and low-cost technology.

Connecting NFC technology with Home Assistant, which is a good gateway to integrate several IoT devices due to its highly interoperability, scalability and manage those devices, brings several advantages for the companies, and finally a simple way to contribute for green buildings and sustainable workstations. To our best knowledge, there are no other solutions available in the market that cover a complete end-to-end flow using NFC tags with an IoT bridge to remotely manage smart workstations in large scale and provide a simple approach to manage emergencies.

Furthermore, and although NOSIoT solution is presented with a connection between NFC and Home Assistant, the solution can be connected to non-Home Assistant bridges using API connectors to communicate with it. In the market, there are some bridges like Hue Philips allowing the integration of Philips and non-Philips devices through iConnectHue [5] or HueEssentials [6]; however, Hue Bridge [7] is very expensive when comparing to Home Assistant [8] (which is open-source and widely used by IoT community), and it is limited to 50 devices which doesn't provide conditions for large-scale environments as companies require. Moreover, the solutions available do not provide information about energy consumption. In the last weeks, some IoT devices have been deployed in the market to monitor the energy savings, but they are not deployed as a packaged and plug-and-play solution, and they are more focused to residential environment.

Thus, as far as the we know, there are no known available NFC-based IoT solutions for enterprise level in the market that provides a low-cost end-to-end flow with high flexibility, modularity, and a clear and easy "Tap&Go" approach NFC-based that allows companies to be more climate-friendly and positively contribute for green buildings.

3. The solution

3.1. Overview

The NOSIoT NFC-based solution consists of a simple mobile application (for both Android and iOS) that will read an NFC tag in a specific workstation. This tag contains information about the workstation the employee wants to activate. After reading that NFC tag, the employee provides additionally required data through the mobile app (e.g., type of profile (8h or 48h)) and applies these configurations. If approved, filled data and status (On/Off) of the workstation is stored into a cloud database, and a message is sent to Home Assistant to switch-on the IoT devices associated with that workstation.

While Home Assistant is responsible for the setup and the management of all IoT devices according to the information provided by NFC Tag, the database will be used to calculate the energy consumed by each employee and will provide the employee with this information not only as a gamification approach but also as a metrics source about the building. Whenever the employee wants to switch-off the workstation, he/she only needs once again to read the NFC tag and deactivate the workstation, following the same technological flow. If by some unspecified reason, the employee forgets to deactivate the workstation, the system, taking into consideration the registered profile, automatically switches-off the workstation and sends a push notification to the employee with this information.

The following Figure 1 presents a simple flow about how the system works, and Figure 2 an illustration of mobile app.

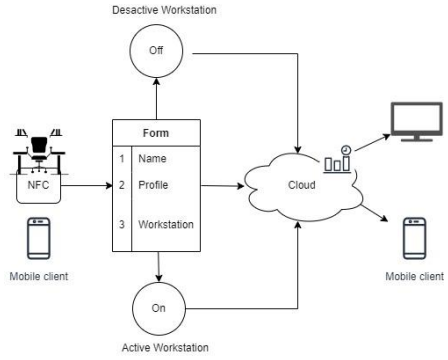

Figure 1. System flow of NFC-based IoT solution.

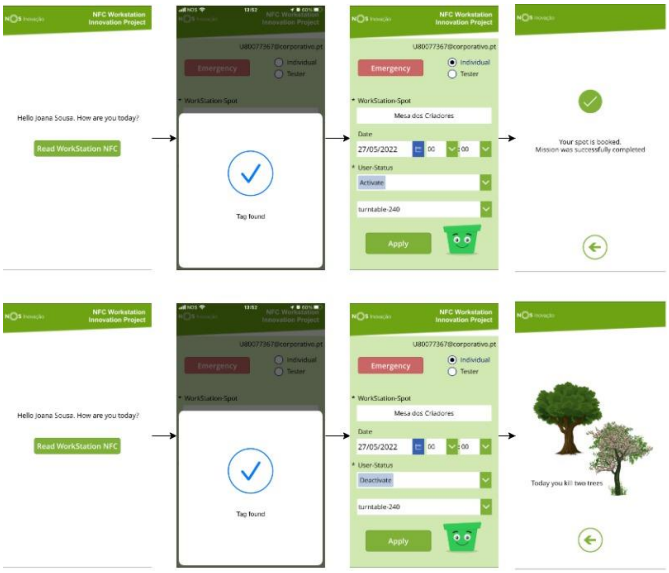

Figure 2. Example of NOSIoT NFC-based solution mobile application.

This app also contains an emergency button. This feature provides not only the path to exit the office when an emergency occurs but also an NFC reader to check-out, i.e., as soon as the employee is out-of-the office, an NFC tag will be read into the meeting spot and this information will be registered into the cloud database. This feature allows assuring that building managers know who and how many people are saved and who and how many people are still in the building, since all the information is centralised into the database created to the sustainable workstations and is associated to each employee.

Furthermore, Home Assistant is also communicating with a Set-Up-Box (STB) which is connected to a big screen giving information about all activated workstations through an isometric projected office plant. Through this TV app (Figure 3), building managers may also manage all workstations.

Figure 3. TV app presenting the active and non-active IoT sensors.

3.2. The Benefit

NOSIoT NFC-based solution allows a quick and transparent way to connect and manage unconnected and unpowered devices through an interoperable, flexible and scalable architecture, which is agnostic to the type/brand IoT devices to control the whole IoT ecosystem. The usage of NFC tag provides an easy "Tap&Go" flow to reflect the employee's intent for managing workstations as well as a transparent trigger to smoothly give energy consumption source about office buildings. Although there are some available IoT bridges in the market presenting a considerable IoT device interoperability, they fail in costs since they are very expensive, and scalability since they are limited to a specific number of IoT devices. The integration of Home Assistant gives flexibility because it is agnostic to the devices, scalability because there is no limitation about the number of devices to be managed/controlled, and low-cost integration because Home Assistant is open-source. Even so, the whole system is prepared to connect other bridges using API connectors. These connectors allow the communication with third-parties solutions, giving NOSIoT NFC-based solution with high flexibility. Moreover, the system also integrates a bi-communication with a Set-up-Box (STB) to provide 2D projected information about the activated workstations in the office building and receive information if building managers have modified any workstation through the STB. The system is also cloud-based, allowing the control and management remotely. The fact that the solution is cloud-based also provides a quick approach to install it in any building. The company only needs to install NFC tag in each workstation and the corresponding IoT device as well as an STB to access building picture. All the configurations are then made remotely. NFC tag is also agnostic to these integrations. From said NFC tag, the system only needs the workstation ID to trigger the flow, and the system will smoothly run according to it.

4. Results and discussion

The current version of solution is still in an early development stage, but basic features are already implemented. The second version will include the "Find me" feature as well as data analytics dashboards in terms of energy consumptions. The solution has been implemented according to innovation sprints, and different stakeholders have been involved and the feedback is positive. However, due to its early development stage, there are not yet quantitative metrics that the team can show, but the goal is to evolve this version into a final service and product to be used by others.

Even so, currently, the solution is installed at NOS office in Lisbon, where employees can use and provide feedback. This feedback is critical to catch-up all improvements needed as well as new features. The feedback is divided into different targeted groups: the employee and organisation.

For the employee, the use of NFC tag allows creating a Tap&Go approach to activate its own workstation according to his/her needs, and has a huge added value on:

- Easily booking his/her workstation.
- Having the power plan according to the usage profile: number of outlets available with the needed timeframe.
- Easily finding co-workers on the building with a "Find Me" option that lets the worker appear on the digital blueprint of the office
- A user-friendly interface to care for plants
- For the organization NOSIoT solution NFC-based provides a user-friendly tool to:
- Real time insight of power consumption by each workstation
- Way of working: how different teams work together and are placed on the office promoting collaboration and creativity
- Occupancy & Optimization of the workspace: check unused desks or meeting rooms that can be repurposed, introducing diversity in the workspace
- Self-Check in emergency

5. Conclusion and future work

The "ability to connect the unconnected and the disconnect the connected" is one of the main challenges of the current IoT technologies, particularly in terms of scalability and costs.

NOSIoT NFC-based solution is well positioned in terms of innovation addressing the usage of NFC tags to connect unpowered and unconnected objects as well as the disconnect the powered and connected objects, giving intelligence to building management systems and a simple way to scale-up IoT solutions at enterprise level, contributing for green buildings with a low-cost technology.

NOSIoT solution presents a clear Tap & Go solution for easily and intuitively connecting and disconnecting devices according to the employee's intent without need of handshaking or data entry requirements, implementing a simple tap and go process to initiate action through NFC tag. The system also integrates a bi-communication with a Set-up-Box (STB) to provide 2D projected information about the activated workstations in the office building and receive information if building managers have modified any workstation through the STB. The fact that the solution is cloud-based also provides a quick approach to install it in any building. The company only needs to install NFC tag in each workstation and the corresponding IoT device as well as an STB to access building picture. All the configurations are then made remotely. NFC tag is also agnostic to these integrations. From said NFC tag, the system only needs the workstation ID to trigger the flow, and the system will smoothly run according to it.

Although this solution was thought for enterprise level, it can be easily adapted to home-environment. Considering the current geo and economic situation in Europe, which will imply a drastic decrease in the energy consumption (approximately 15-22%) to assure that all Europe will have the necessary energy to the winter, solutions that help in this management will have a rapid but huge market opportunity. IoT Solutions that can help end-users in management effectively its own energy according to their routines and needs have now its own opportunity, and NOSIoT NFC-based solution is a good example of what could be the next stage of IoT market at home.

6. Conflict of Interest

The authors declared that they do not have any conflict of interest.

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