A Comparative Study of Lora with IoT Deployments

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ABSTRACT

IoT deployments for smart cities and smart buildings have been multiplying exponentially in recent years, benefiting from a steady rise in the number of new technologies that deal with the underlying networking and application challenges in indoor and outdoor spaces. Due to the overlap in their specifications, we are still trying to figure out which of these technologies fits better to certain application domains, such as building monitoring. In this work, we provide a comparative study between IEEE 802.15.4 and LoRa, based on our experiences from using both wireless networking technologies in the context of indoor deployments aimed at IoT-enabled school buildings in Europe. We provide an apples-to-apples comparison between the two technologies, comparing them in some cases in the same building and application context. Although these two technologies initially might not seem to be competing in the same application space, in practice we found out that both have strengths and weaknesses in the specific application domain we have been using them.

Moreover, our LoRa-based networking implementation, on top of Arduino-based hardware, appears to be an option that allows for a robust, reliable and lower overall cost IoT deployment, especially in cases with multi-floor building installations and low bandwidth requirements. We also present a network-level dataset produced from our installations and upon which we based our findings and discussion. We provide data collected from 6 different school buildings, 8 networks and 49 devices, to compare the performance and cost-effectiveness of competing IoT technologies. In that effect, with LoRa we can achieve similar or better link quality to IEEE 802.15.4, with higher data rate and lower costs.

1. INTRODUCTION

1.1 Introduction

IoT deployments for smart cities and smart buildings have been multiplying exponentially in recent years, benefiting from a steady rise in the number of new technologies that deal with the underlying networking and application challenges in indoor and outdoor spaces. Due to the overlap in their specifications, we are still trying to figure out which of these technologies fits better to certain application domains, such as building monitoring. In this work, we provide a comparative study based on our experiences from using wireless networking technologies in the context of indoor deployments aimed at IoT-enabled school buildings. We provide an apples to apples comparison between the two technologies, comparing them in some cases in

the same building and application context. Although these two technologies initially might not seem to be competing in the same application space, in practice we found out that both have strengths and weaknesses in the specific application domain we have been using them. Moreover, our LoRa-based networking implementation, on top of Arduino-based hardware, appears to be an option that allows for a robust, reliable and lower overall cost IoT deployment, especially in cases with multi-floor building installations and low bandwidth requirements.

1.2 Aim and Objective of the Thesis

Aim:

The aim of this study is to conduct a comparative analysis of wireless networking technologies in the context of IoT-enabled school buildings, specifically focusing on LoRa-based networking and an alternative wireless technology. The study aims to evaluate the suitability of these technologies for indoor IoT deployments and provide insights into their strengths and weaknesses within the specified application domain.

Objectives:

- To review the current landscape of wireless networking technologies relevant to IoT deployments in indoor environments.
- To identify and select two wireless networking technologies, including LoRa-based networking, for comparative analysis based on their applicability to IoT-enabled school buildings.
- To develop a comprehensive methodology for conducting an "apples to apples" comparison between the chosen wireless networking technologies.
- To deploy both technologies in real-world indoor environments within school buildings, ensuring consistent conditions for evaluation.
- To assess the reliability, robustness, and performance of each technology in terms of connectivity, data transmission, and responsiveness to IoT sensors and devices.
- To analyze the scalability, cost-effectiveness, and ease of implementation of each technology, considering factors such as hardware requirements, maintenance needs, and overall deployment complexity.
- To document and compare the strengths and weaknesses of each technology based on empirical data and observations gathered during the deployment phase.
- To derive insights and recommendations for stakeholders, including educational institutions, IoT solution providers, and policymakers, regarding the selection and deployment of wireless networking technologies for IoT-enabled school buildings.
- To contribute to the broader discourse on IoT deployments in smart cities and buildings by providing practical insights and lessons learned from the comparative analysis conducted in this study.

2. LITERATURE SURVEY

Survey 1

The Internet of Things, or IoT, is a popular issue that keeps the online community buzzing. Without a doubt, there is a huge market opportunity. There is a lot of marketing hype as a result, with each player prepared to place his technology or strategy as the ideal resolution. It might be challenging for a novice in this sector to develop well-balanced thinking since reports and statistics that are used to support solutions can occasionally appear to be biased or inaccurate. This article aims to present a rational comparison of the key competing technologies and solutions in the LPWAN (Low Power Wide Area Network) segment of the Internet of Things in Europe.LPWAN is covering low-power long-range applications, meaning a range exceeding afew kilometers and data rates from 10bps up to a few kbps. Most of LPWANapplications will be new ones, LPWAN technologies connecting objects for which nopractical connectivity solution existed.

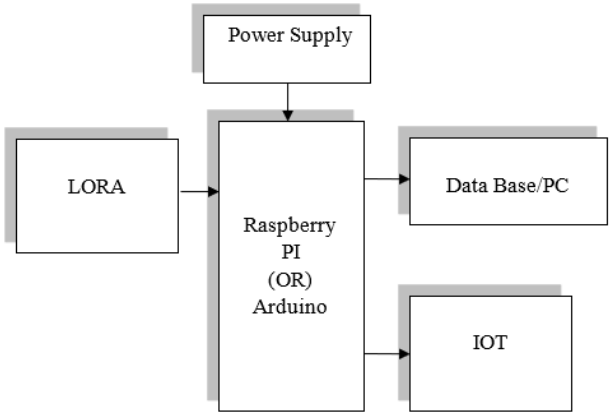
Survey 2

Wireless networks are now a part of the everyday life of many people and are used formany applications. Recently, new technologies that enable low-power and long-rangecommunications have emerged. These technologies, in opposition to more traditionalcommunication technologies rather defined as "short range", allow kilometer-wide wirelesscommunications. Long-range technologies are used to form Low-Power Wide-Area Networks(LPWAN). Many LPWAN technologies are available, and they offer different performances,business models etc., answering different applications' needs. This makes it hard to findthe right tool for a specific use case. In this article, we present a survey about thelong-range technologies available presently as well as the technical characteristics theyoffer. Then we propose a discussion about the energy consumption of each alternative andwhich one may be most adapted depending on the use case requirements and expectations,as well as guidelines to choose the best suited technology.

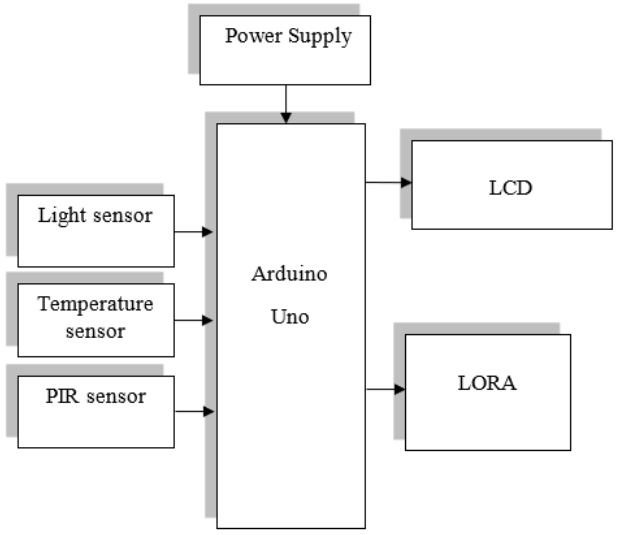
3. PROPOSED SYSTEM

Thanks to a steady increase in innovative technologies that address the underlying networking and application difficulties in indoor and outdoor environments, IoT deployments for smart buildings and smart cities have been growing rapidly in recent years. We are currently attempting to determine which of these technologies is more appropriate for specific application areas, like building monitoring, because of the overlap in their requirements. Our article presents a comparative analysis based on our experiences implementing wireless networking technologies indoors, specifically for Internet of Things-enabled school buildings. We present an apples-to-apples comparison of the two technologies, contrasting them in certain situations inside the same application and building context. Even if at first glance these two technologies might not appear to be competing in the same application space, in reality we discovered that each has advantages and disadvantages depending on the particular application domain in which we have been using it. Furthermore, our LoRa-based networking implementation—which is built on top of hardware based on Arduino—seems to be a viable solution for an IoT deployment that is sturdy, dependable, and less expensive overall—particularly when it comes to installations in multi-floor buildings and low bandwidth needs.

Proposed Model



Section-1



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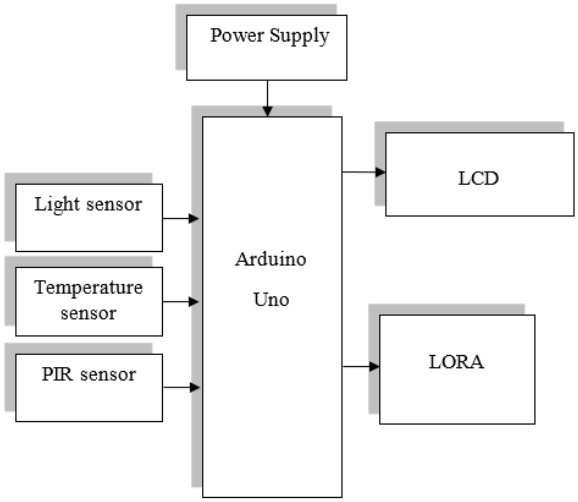
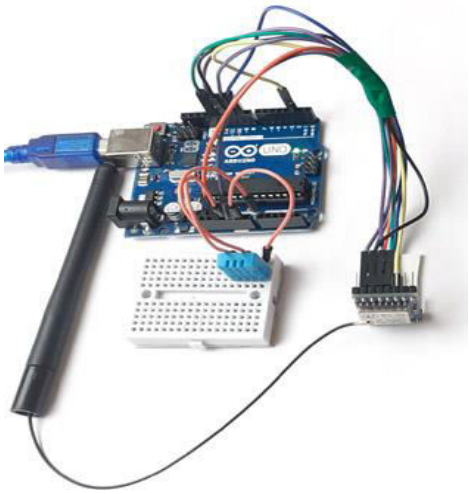


Arduino Uno unit

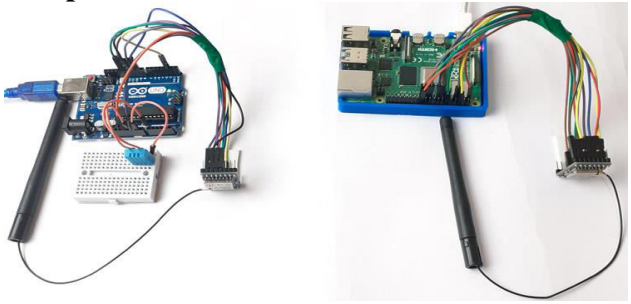


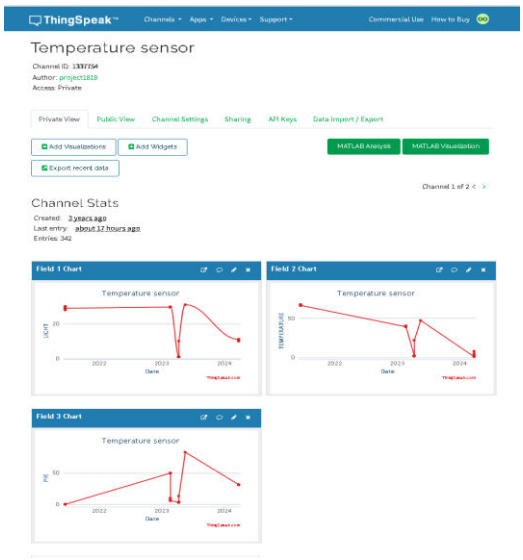
4. RESULTS

Finally, we have successfully implemented the circuit .It can be easily implemented in schools hospital, hotels and local services.

Raspberry pi unit

Complete unit





5. CONCLUSION

Over the years we have built a large IoT infrastructure scaling in every countries. Since our work was originally aimed at energy efficiency in school buildings, this infrastructure is inside buildings of this type, i.e., public buildings with lots of users, which are also present everywhere and with more or less similar characteristics. This activity has been implemented over the course of several years, and practical implications have led us to experiment with different wireless networking technologies like IEEE 802.15.4 in the beginning, and more recently, LoRa. As a result, we were able to make a comparative study, both in an empirical/qualitative manner, as well as in a quantitative one, between these two technologies.

Our experience definitely verifies that this is a viable approach that has several practical merits. Although we did not utilize LoRaWAN, and chose to focus on implementing a more custom approach based on LoRa, we believe our study presents interesting insights to the community

FUTURE SCOPE

- This System can be further extended for automation ON and OFF of appliances depending upon the number of users in the house/office
- This system can be implemented in the hospital and other crowded places to efficiently control the device form the remote location
- Home hospitals may use IOT to monitor and control the environment in real time, depending on the severity of the patient's condition.

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