ENVIRONMENTAL MONITORING

**IOT Deployment and its Challenges**

IOT deployment is expanding out from consumer-based applications such as [smart home devices](https://itchronicles.com/iot/the-connected-home-how-secure-are-your-gadgets/) and wearables to applications in the areas of public safety, emergency response, industrial automation, autonomous vehicles, and the Internet of Medical Things (IoMT). Many of these are mission-critical processes with life or death implications — so it’s essential to get it right.

## A Three-Part Strategy for IoT Deployment

Several factors come into the successful deployment of an IoT system and its connected devices, including security, interoperability, power or processing capabilities, scalability, and availability.

**A general strategy for implementation consists of three phases:**

### 1. Consult

Having determined whether you will buy your IoT infrastructure or build it out yourself, it’s essential to first consult with the internal or external team responsible for running the project and establish a road map for your IoT deployment.

At this stage, it may be a good idea to conduct a pilot program testing the validity of your ideas and providing a foundation for the strong business case you’ll need to present to management when negotiating for the required project resources.

### 2. Develop

This is also the period during which you or your external contractors will be building out the [cloud platform](https://itchronicles.com/what-is-cloud-computing/) and setting up the analytics framework. These processes will typically involve configuring analytics, cognitive services, artificial intelligence (AI), and machine learning (ML) platforms to tackle features relevant to your business, and developing the interfaces for consumer-facing web platforms, applications, and data visualizations.

### 3. Deploy

The consultation phase should have yielded assurances that your development team or external contractors can install, support, and service all the necessary infrastructure and equipment during the crucial period of initial implementation.

## IoT Deployment At Scale

With [smart cities](https://itchronicles.com/events/smart-cities-citizens-need-to-drive-transformation/), connected global enterprises, smart transport systems, and ecosystems of wearable devices on the horizon, attention has also to be given to large scale IoT deployments. Key factors to consider relate to five main areas:

### Devices

For larger-scale IoT deployments, expect a mix of new and legacy devices employing different technologies and serving multiple purposes. This variation makes interoperability a key requirement.

Any aspect of the deployment that works exclusively with only one vendor, one platform, or one technology should be avoided. This will safeguard against incompatibility problems and proprietary lock-in.

### 2. Connectivity

All devices on the network need to support your preferred connectivity standard. While many deployments default to Wi-Fi, a project may have specific needs or require connectivity in areas where Wi-Fi isn’t available. In such cases, cellular connectivity may be a preferred option, as it typically offers low power consumption and long battery life for devices, and greater accessibility.

### 3. Device Management

Connectivity, industry standards, and protocols assume vital importance in device management for large-scale deployments. Regulated open standards developed with the IoT industry in mind are the safest bet. Strong, flexible, and reliable protocols will enable your device management solution to cope with the sheer scope of the deployment and any changes that may affect it in the future.

### 4. Data Processing

Though it’s tempting to parcel data from a large-scale deployment into manageable smaller packages, this can lead to the creation of silos with no connection to each other.

Instead, all data should be aggregated and accessible via a centralized platform. This will also give system administrators a “big picture” view of the deployment.

### 5. A Flexible Management Platform

A myriad of devices with multiple sensors and actuators collecting reams of data every second of every day requires a versatile platform to manage it all. This platform should be flexible enough to accommodate different solutions and able to adapt to future changes.

## IoT Deployment Challenges

### Connectivity

A seamless flow of information to and from devices, infrastructure, applications, and the cloud is vital to successful IoT deployment — particularly where mission-critical operations are involved. The complexity of wireless connectivity with its still-evolving set of standards can complicate matters as much as managing a diverse set of devices.

Flexible design and testing solutions capable of assessing devices with many radio formats are necessary for meeting this challenge. Solutions should be simple, low-cost, and capable of application during both R&D and manufacturing phases.

### Continuity

This aspect mainly concerns battery life and methods of extending it for IoT devices. Long battery life is a desirable attribute for consumer IoT goods. Battery life of five or ten years is commonly expected for industrial IoT devices. And for medical IoT devices such as pacemakers, battery failure simply isn’t an option.

To prolong battery life and [ensure continuity](https://itchronicles.com/business-continuity-planning-a-guide-to-create-an-effective-bcp/), integrated circuit (IC) designers need to design the circuits with deep sleep modes that consume minimal current and reduce clock speed and instruction sets. Systems that operate on low battery voltages are also desirable.

### IoT Deployment Challenge:

### Compliance

There are radio standards and global regulatory requirements to which IoT devices must comply. Compliance testing includes radio standards conformance and carrier acceptance tests, and regulatory compliance tests such as RF, EMC, and SAR tests.

Testing can be complicated and time-consuming, often requiring designers and manufacturers to seek in-house pre-compliance test solutions to meet product release schedules.

### Coexistence

Wireless congestion or the overcrowding of radio channels is a logical consequence of billions of IoT devices competing for bandwidth. Standards authorities have developed testing methodologies to evaluate device operations in the presence of other signals.

For IoT deployment, coexistence testing is crucial in measuring and assessing how a device will operate in a crowded, mixed-signal environment and assess the potential risk to maintaining wireless performance in the presence of unintended signals.

### IoT Deployment Challenge:

### Cybersecurity

To date, little has been done to address the over-the-air or OTA vulnerabilities afflicting IoT devices. OTA and potential endpoint vulnerabilities should be identified using a regularly updated database of known threats or attacks, and devices should be tested on the basis of these same criteria for response and anomaly detection.

# Internet of Things (IoT)-Based Environmental Monitoring and Control System for Home-Based Mushroom Cultivation

## Abstract

The control and monitoring of the environmental conditions in mushroom cultivation has been a challenge in the mushroom industry. Currently, research has been conducted to implement successful remote environmental monitoring, or, in some cases, remote environmental control, yet there is not yet a combination of both these systems providing live stream images or video. As a result, this research aimed to design and develop an Internet of things (IoT)-based environmental control and monitoring system for mushroom cultivation, whereby the growth conditions of the mushrooms, such as temperature, humidity, light intensity, and soil moisture level, are remotely monitored and controlled through a mobile and web application. Users would be able to visualize the growth of the mushroom remotely by video and images through the Internet.

## Introduction

The Internet of things (IoT) could be defined as a network for the implementation of independent federated services and applications characterized by a high degree of autonomous data gathering, event transfer, network connectivity, decision making, responding to feedback, and interoperability [[**14**](https://www.mdpi.com/2079-6374/13/1/98#B14-biosensors-13-00098)]. The internet develops the integrated network while the things integrate the generic object into an easy access framework. In other words, the IoT provides a new platform that connects computing devices, mechanical or digital machinery objects, animals, and people with unique identities (UIDs) for data exchange without the necessity of human-to-computer or human-to-human interaction [[**15**](https://www.mdpi.com/2079-6374/13/1/98#B15-biosensors-13-00098)]. the objects [[**17**](https://www.mdpi.com/2079-6374/13/1/98#B17-biosensors-13-00098)].

## Methods and Materials

The development of the IoT based environmental control and monitoring system, as well as the cultivation of the mushrooms, were conducted in housing near the campus of the University of Nottingham Malaysia, Jalan Broga, 43500 Semenyih, Selangor, Malaysia, for a period of 4 months from January 2022 to April 2022.

#### Selection of Mushroom

The grey oyster mushroom was selected as the cultivation object among the edible mushrooms, due to the availability of prepared mushroom grow bags, the absolute ease of the cultivation process, the mushroom’s chemical tolerance and tolerance of a wide temperature range, as well as its ability to grow in a short period of time with high yield [[**28**](https://www.mdpi.com/2079-6374/13/1/98#B28-biosensors-13-00098)]. The mushroom growing bags used for the cultivation of the grey oyster mushroom were purchased from a supplier located at Pahang, Malaysia.

#### Web and Mobile Application

As the entire IoT based environmental control and system started with the acquisition of specific data from different sensors and the camera unit, the control algorithm enabled the automated control system to take appropriate actions, based on the data obtained from the sensors and the user input, to monitor and control the environmental conditions within the cultivation chamber. The data collected from the sensors and camera module were then sent to the cloud to enable remote monitoring. The system was developed with the aid of Arduino IDE, Geany and Thonny.

#### Analysis

After the configuration of the hardware and software to the IoT-based environmental control and monitoring system, several experiments were carried out to determine the performance of each sensor. The data were recorded and compared to laboratory instruments.

## 4. Conclusions

The development of the IoT-based environmental control and monitoring system, as well as the cultivation of mushrooms were successfully implemented in this work. The system enables the user to monitor and control temperature, humidity, light intensity, and soil moisture level within the cultivation chamber through a mobile and web application, Blynk, while the user is able to visualize the growth of the mushroom remotely by video and images online. The accuracies of the four different sensors were compared with their respective laboratory instruments, where the data was processed through calculation, such as mean absolute percentage error (MAPE) and R square value.

# Real-Time Environmental Monitoring Platform for Wellness and Preventive Care in a Smart and Sustainable City with an Urban Landscape Perspective: The Case of Developing Countries

## Abstract

Smart and sustainable communities seek to ensure comfortable and sustainable quality of life for community residents, the environment and the landscape. Pollution is a key factor affecting quality of life within a community. This research provides a detailed insight into a successfully developed and deployed framework for an environmental monitoring platform for an urban study to monitor, in real time, the air quality and noise level of two cities of the Dominican Republic—Santo Domingo and Santiago de Los Caballeros. This urban platform is based on a technology range, allowing for the integration of multiple environmental variables related to landscape and providing open data access to urban study and the community.

## 1. Introduction

Smart and sustainable cities are an expression of the multiple domains of urban life in which technology and policies can be applied to a community within their landscape [[**1**](https://www.mdpi.com/2073-445X/11/10/1635#B1-land-11-01635)]. The vision has progressed to focus on the alignment between policies related to human capital, education, economic development, territorial and governance, and how these could be improved with the use of ICT [[**2**](https://www.mdpi.com/2073-445X/11/10/1635#B2-land-11-01635)]. To become a smart and sustainable community, its development must combine ICT with territorial, human and social capital, along with broad economic policies [[**3**](https://www.mdpi.com/2073-445X/11/10/1635#B3-land-11-01635)]. Currently, the development of smart cities seeks to ensure a comfortable and sustainable quality of life for the residents of the community, the environment and their landscape [[**4**](https://www.mdpi.com/2073-445X/11/10/1635#B4-land-11-01635)]. This creates a bigger emphasis on the sustainability of the community and the surrounding territories [[**5**](https://www.mdpi.com/2073-445X/11/10/1635#B5-land-11-01635)].

.

## 2. An Environmental Monitoring Platform for Urban Studies in a Smart and Sustainable City

The link between health complications and poor air quality or prolonged exposure to noise level has been extensively established [[**8**](https://www.mdpi.com/2073-445X/11/10/1635#B8-land-11-01635),[**18**](https://www.mdpi.com/2073-445X/11/10/1635#B18-land-11-01635),[**19**](https://www.mdpi.com/2073-445X/11/10/1635#B19-land-11-01635),[**20**](https://www.mdpi.com/2073-445X/11/10/1635#B20-land-11-01635),[**21**](https://www.mdpi.com/2073-445X/11/10/1635#B21-land-11-01635)]. Citizens’ awareness of pollution levels and how to adapt their behavior as a response has become a new focus. In Oslo, Norway, a group of sensors were deployed in kindergartens to plan children’s outdoor activities depending on the pollution levels [[**22**](https://www.mdpi.com/2073-445X/11/10/1635#B22-land-11-01635)]. Kumar et al. [[**23**](https://www.mdpi.com/2073-445X/11/10/1635#B23-land-11-01635)] measured the impact individual vehicles had during drop-off and pick-up time at a school compared to other times of the day by measuring the air quality at different points in the school with the purpose of promoting commuting in their student population. This shows the importance of environmental pollution awareness among citizens of a smart and sustainable community.

## 3. Methodology

The platform was designed for the Dominican Republic, a country located in the Caribbean, forming part of the Greater Antilles. The country occupies the eastern part of the island of Hispaniola. The Dominican territory is divided into 32 provinces, of which the city of Santo Domingo is its capital and biggest city, and the city of Santiago de los Caballeros is the second largest in terms of population and economic contribution. The city of Santo Domingo has a population of more than 2 million inhabitants. The second largest is Santiago, a city in the center of the country, with great industrial and agricultural development and a population of approximately 1.5 million [[**54**](https://www.mdpi.com/2073-445X/11/10/1635#B54-land-11-01635)]. The platform was designed following the architecture described in this section.

## Results and Discussion

This section presents two case studies showing how the platform can be used to create awareness in a community with regard to the effect of pollution. For the first case study, we used data obtained from the platform limiting the dates between 22 and 24 June 2020. For the second case study, we extended the date range from 18 May 2020 to 26 January 2021.

## Conclusions

There are many challenges when developing and deploying an environmental monitoring platform for air quality and noise level. On one hand, the platform must be flexible to interact with different environmental variables, accessible so that a community can easily use it, and secure to establish trust. Another aspect is how to interact directly with the community to create awareness of pollution and the impact they have in surrounding territories. Different strategies are required to reach the community. In this work, we present a framework for developing such a platform and how it can be used to understand both natural phenomena and human behavior impact on the pollutant and our territories.