# Implementing IoT Technology in Practice: Monitoring the Supply Chain for Sustainable Operation

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*Abstract:* The Internet of Things (IoT) is proliferating, with thousands of new sensors and equipment going live each month. Despite its lengthy evolution, the Internet of Things has only recently begun to take off in the mass market due to low-cost, reduced-power elements, ubiquitous web access, and high business and consumer interest. The Internet of Things includes anything from intelligent kitchen appliances to smart buildings, smart lighting on streets to automated manufacturing processes, and adaptive home heaters to autonomous vehicles. This research concerns studying and applying Internet of Things (IoT) technology to monitor the supply chain and achieve more sustainable operations by ensuring accurate and real-time data monitoring. In this context, an experimental device is developed to read the values of selected physical quantities from the wine supply chain environment through appropriate sensors. The values are then sent to an IoT platform to facilitate the remote monitoring of the above physical quantities and extract valuable insights from the large volume of data generated. The results show that crucial information can be gathered in real-time, enabling quick decision-making and ensuring safer and more sustainable supply chain operations.

*Key-Words: Internet of Things; Supply Chain; Sensors; Real-time Monitoring; Sustainability*

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## 1 Introduction

The Internet of Things (IoT) is a system of linked devices, electronic and mechanical machines, items, and living beings, that have unique identifiers (Unique Identifiers – UIDs) and can transfer information through a network without the requirement of human-to-human or human-to-computer interaction. A thing in the internet of things could be a human wearing a smartwatch, a farm animal with a micro / nano transmitter, a vehicle with integrated sensing devices that alert people when gas leakage is detected, or any other organic or artificial entity that can be appointed an Internet Protocol (IP) identifier and can transfer data over a network [1–3].

IoT enables individuals to live and work more efficiently and acquire total control over their life. IoT is vital for companies in addition to providing mobile smart devices for operation automation [4]. IoT enables organizations to monitor their systems' performance in real-time, delivering data on anything from machine performance to supply chain and logistics procedures[5]. The Internet of Things allows companies to streamline operations and cut personnel expenses. In addition, it lowers waste and enhances service delivery, reducing the cost of production and delivery of goods and enhancing the transparency of consumer interactions. Consequently, IoT has become an essential technology and will keep growing as increasing numbers of organizations see the possibilities of interconnected devices to enable them to survive and thrive[6].

The IoT network is rapidly expanding, with countless new devices and sensors coming into play each month. Despite its relatively long track record, the Network of Things is only now commencing to take off due to the availability of low-cost, low energy needing solutions, extensive network access, and the high level of business and consumer interest [7, 8]. The Internet of Things includes anything from intelligent kitchen appliances to smart buildings, tracking devices in distribution networks to healthcare monitoring devices, and adaptive heaters to self-driven vehicles [9, 10].

Today, more than ever, developing IoT applications is becoming more cost-effective, simpler, and much more generally accepted than ever before, resulting in modest waves of advancement throughout the market. IoT is advancing as an intriguing premise for the coming years. This can be seen in today's applications, such as automated vehicles and smart homes, which are constantly becoming more effective and accessible [11, 12]. The retail industry and the supply chain generally have a considerable potential to become more intelligent. Proximity advertising through Beacons and innovative inventory management technologies used in stores with no cash registers are prime examples [6,13]. However, IoT devices and apps in retail usage extends beyond the buying experience. It allows hotel, food, and beverage service providers and other companies to monitor their resources and gather valuable data. This can give merchants complete control over their supply chain operations by automating many manually performed actions. [14]. Thus, business owners can avoid placing large orders, effectively limit staff members who abuse their privileges and manage logistics and trade costs more efficiently. The above benefits, in turn, lead to high adoption rates of all IoT products along the supply chain [15]. The benefits of IoT in supply chain management are summarized as follows [16–18]:

- enhanced supply chain transparency
- automated check-in and check-out of goods
- monitoring the location of the goods and the storage conditions in the warehouse
- preventive maintenance of the equipment
- inventory management and theft prevention
- improving the shopping experience and customer service
- detection and early notification of any problems during transport
- warehouse demand notification
- route optimization

This research builds on the massive potential of the supply chain sector and presents an application of Internet of Things (IoT) technology to monitor the supply chain and achieve more sustainable operations by ensuring accurate and real-time data monitoring. To achieve this goal, it is necessary to use a few critical parts of an Internet of Things application, such as Sensors and Deployment Boards, for reading the potential of physical quantities, converting them into electrical potential/voltage, translating them into data, processing and sending them, and IoT Platforms, which allow the end user to monitor the desired variable within the supply chain. This research differs from most existing ones by connecting theory with practice as it has a theoretical contribution and presents a working IoT application developed to demonstrate a simple, flexible and cost-effective solution for more sustainable supply chain operations.

In the remainder of the paper, in section 2, the architecture of the Internet of Things is analyzed, including the necessary components and some information on how each layer works. Section 3 presents the basic parts that make up a typical Internet of Things application. More specifically, this section provides information on the sensors, actuators, development boards and IoT platforms necessary to develop any IoT application. Finally, section 4 concerns the case study of the research and includes a description of the parts that make up the developed experimental setup, as well as the way of its implementation, i.e., the circuit and the codes that were created for connecting devices and communicating. Finally, the developed dashboard is presented through which users can monitor, in real-time, the values of the selected physical quantities.

## 2 IoT Architecture & Characteristics

As seen in Figure 1, an IoT ecosystem includes internet-enabled, smart devices that employ intelligent systems such as processing units, sensors, and devices that communicate to collect, transmit, and act on environmental data. IoT devices exchange the sensor data they acquire by connecting to an IoT Gateway, from which the information is either transferred to the Web or processed in a local environment. Occasionally, these devices connect with other interconnected smart objects and act in response to the data they receive [19]. Most tasks are performed by equipment without interaction between people; however, individuals can engage with these devices to make them work, provide them with directions, or monitor the information. These web devices' connection, infrastructure, and protocols significantly rely on the deployed IoT applications. IoT may also utilize artificial intelligence (AI) and machine learning (ML) technology to make data-collecting procedures more dynamic and efficient [20].

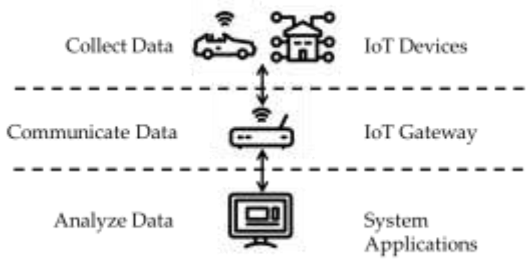


Fig. 1: IoT Ecosystem

Established decades ago, the Transmission Control Protocol (TCP) / IP protocol stack is currently used by the World wide web to interact among nodes. Nevertheless, the Internet of Things links thousands of items, increasing bandwidth and necessitating significantly greater storage space. Moreover, IoT confronts several privacy and security difficulties[19]. Thus, the newly suggested Internet of Things (IoT) infrastructure must handle various elements, such as scaling, interoperability, dependability, service quality, etc. [20]. Considering IoT links each and every individual in order for them to exchange information, internet traffic and data transfer will expand dramatically. Therefore, the growth of IoT depends on technological progress and the creation of new applications and economic models. The fundamental IoT architecture consists of five levels, as seen in Figure 2.

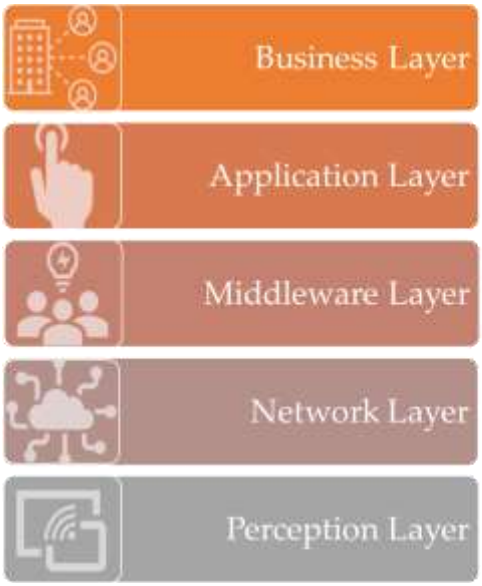


Fig. 2: Basic IoT Architecture

This basic IoT architecture consists of five main layers [21]:

1. Perception Layer: This is also referred to as the "device layer". Material entities and sensing devices constitute its composition. Depending on the manner of object detection, the sensors may be RFID, 2D-barcode, or infrared sensors. This layer is primarily focused on the recognition and information gathering of entities via sensing devices. Depending on the kind of devices, the information may be associated with a plethora of physical aspects. The gathered information is subsequently sent to the network layer for safe transmission to the data processor.
2. Network Layer: This is often referred to as the transport layer. This layer transmits the information collected by the sensing devices to the data processor securely. The communication method may be cable or wirelessly, depending on the sensing devices. Consequently, the network layer sends data from the perception layer to the middleware layer.
3. Middleware Layer: This layer oversees managing IoT services and database connections. This layer gathers information from the network layer and stores it in a repository. It analyses the input, performs omnipresent computations, and makes choices automatically based on the outcomes.
4. Application Layer: This layer enables global application administration based on item information processed in the middleware layer. Applications of IoT have a vast variety and may include smart buildings and cities, smart cultivations, smart supply chains, etc.
5. Business Layer: This layer is accountable for controlling the IoT ecosystem, encompassing apps and data. It develops business strategies and models using information collected from the application layer, including graphs, diagrams, etc. The true success of an IoT ecosystem also depends on effective business strategies, and this level helps determine subsequent decisions and business strategies based on examining the outcomes.

## 3 Components of an IoT Application

The world of the Internet of Things (IoT) continues to grow and evolve rapidly, effectively framing the capabilities of the cloud. Broadly speaking, IoT is a network of physical objects that exchange data over the internet. Every advancement in the IoT market leads to an increase in businesses benefiting from the technology, which is becoming more and more advanced over time. The benefits of IoT cannot be ignored, with its use in sectors ranging from home automation and agriculture to medicine and supply chains. Technology has the potential to assist different businesses with multifaceted requirements [22, 23]. This section presents the main components necessary for developing any IoT application.

Sensors are the leading component, and today, more than ever, are used in a plethora of industrial operations. Industrial enterprises and organizations have been using various kinds of sensors, but the invention of the Internet of Things has taken the evolution of sensors to a whole different level. IoT platforms operate and deliver various types of intelligence and data using a wide range of sensors. They serve to collect data and send and share it across a whole network of connected devices. All this collected data allows devices to operate autonomously, and the entire ecosystem is becoming increasingly "intelligent" every day [24].

By combining a set of sensors and a communication network, devices share information with each other and improve their efficiency and functionality. For example, Tesla vehicles. All the sensors in a car record the information they receive from the environment, which they upload to a vast database. The data is then processed, and all important new information is sent to all other vehicles. It is an ongoing process through which an entire fleet of Tesla vehicles becomes smarter every day [25, 26]. The primary sensors used in industrial IoT applications are for receiving data and monitoring the following physical aspects:

1. Temperature
2. Proximity
3. Pressure
4. Water Quality
5. Chemical Properties
6. Gas
7. Smoke
8. Infrared Rays
9. Fluid Level
10. Image Transformation
11. Motion Detection
12. Acceleration
13. Gyroscope
14. Humidity
15. Optical Rays

Another critical component is the actuators. In IoT, actuators provide the ability to perform a physical action or movement based on data coming from one or more sensors. The transformation of the data collected by the sensors into action follows the following sequence [27]:

- Sensors that detect sense a change occurring in the natural world.
- Sensors turn event-related data into electrical impulses sent to a controlling device, whose system calculates when and what action is required.
- The controlling device commands the actuator to execute the needed motion.
- The actuator performs its function by transforming electricity into real action.

For instance, an Internet of Things application that controls a fridge contains sensing devices that read its temperatures. As designed, the sensors provide heat information to the management unit. The control mechanism checks these measured data compared to the preset ideal temperature range. If the data is above or below this spectrum, the management system transmits an order to an actuator to activate or deactivate the fans. In several IoT solutions, the sensor, controller, and actuator are distinct physical components that connect through wireless or cabled networking and a Web service. In other instances, these three components are incorporated into a single physical device. A basic definition of an actuator is a mechanism that converts power into activity or movement [28, 29].

As the IoT ecosystem grows, so does the need for IoT development boards, which can be used for both testing and mass production. A development board is only a component that connects containing electrical circuits and hardware intended to facilitate experimentation with a specific microcontroller. IoT developers mostly utilize them to construct trials before launching the finished versions. There are three classes of IoT boards [30, 31]:

1. Microcontroller-based boards: These boards include a miniature computer built on a metal oxide semiconductor circuit chip.
2. System-on-chip (SoC) boards: An SoC board incorporates all the required electrical parts and circuit system components on a single Si chip.
3. Single Board Computers (SBC): A SBC is a computer constructed entirely on a single printed circuit board. It contains all functional computer components and is mainly used for demonstrating purposes.

IoT platforms are the last component essential for every IoT solution. The Internet of Things (IoT) platform industry is expanding, with the value of the worldwide IoT market anticipated to reach $1.1 trillion by 2026 [32]. This significant growth in demand for IoT applications is due to the rise of IoT solutions and other associated components. IoT sensors and many connected components need a coordinator - IoT platforms - to collaborate and operate smoothly within the same ecosystem and provide the highest potential competitive advantages. IoT platforms are middleware systems that link IoT solutions to the cloud and enable smooth data interchange across the network. They serve as intermediaries between the application layer and the hardware resources. There are currently several IoT platform suppliers on the marketplace and every one of them has its unique method for simplifying and scalability IoT integration and administration [33].

## 4 Case Study: Developing an IoT Application for the Wine Supply Chain

It was decided to select the wine supply chain as a case study for developing an IoT application. This specific supply chain needs significant improvements for traceability and protection against counterfeit activities as it is highly vulnerable. Moreover, ineffective traceability may lead not only to economic losses but also to severe health risks as wines are found to be frequently adulterated. In the present case study, it was decided to monitor the temperature and humidity conditions of wines to ensure that no quality deterioration exists during the aging process of the wines. However, to effectively combat counterfeit activities, many more physical aspects would be required to be monitored.

Figure 3 presents the selected IoT components as they were analyzed in section 3.

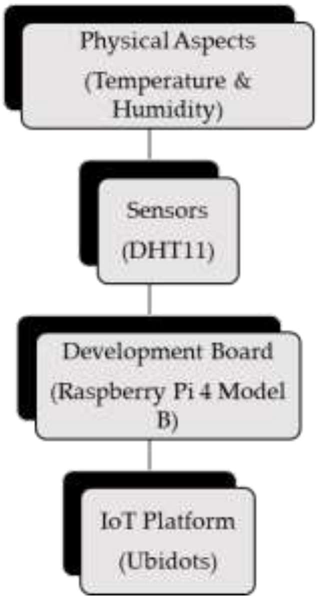


Fig. 3: Selected IoT Components for the Case Study

A Digital-output, relative Humidity, and Temperature (DHT11) sensor monitors the temperature and humidity prevailing inside the storage area. There are many different versions of this sensor. In the present work, a sensor of this type with four pins was used. The DHT11 is a relative humidity meter. The definition of relative humidity is the ratio of the quantity of water vapor in the air to its saturation point. At the saturation point, water vapor condenses and collects on surfaces, generating dew. The saturation point varies with air temperature. Cool air can trap less water vapor before saturation occurs, unlike warm air which has a higher saturation point. The relative humidity is expressed as a percentage. In other words, condensation occurs when we have 100% relative humidity, while when we have 0% relative humidity, the air is completely dry.

The DHT11 measures the electrical resistance between two electrodes to detect water vapor. The moisture sensing device is a moisture-retentive substrate with surface-mounted electrodes. When the substrate absorbs water vapor, ions are discharged from its surface, increasing the conductivity between the electrodes. The ratio of the change in resistance between the two electrodes to the relative humidity is proportionate. Lower relative humidity raises the resistance between the electrodes, while higher relative humidity reduces the resistance. The DHT11 uses a Negative Temperature Coefficient (NTC) temperature sensor to monitor temperature (thermistor). Thermistors are a type of resistor whose value is affected by temperature much more than ordinary resistors. The thermistor used in the DHT 11 is NTC, which means that the resistance decreases with increasing temperature.

Using jumper cables and a breadboard, the DHT11 sensor is connected to the Raspberry Pi through the General-Purpose Input/Output (GPIO) pins. Specifically, pin 2 is a serial data (SDA) pin used for data transfer and is connected to GPIO 17, pin 1 is a Voltage Common Collector (VCC) pin related to power and is connected to GPIO 3V3 power, which provides an output voltage of 3.3V, pin 4 is a Ground (GDN) pin connected to GPIO Ground, while pin 3 is Not Connected (NC) somewhere as it has no functional purpose for the external circuit. To get the data from the sensor, the dht11.py library was used which is imported at the beginning of the code. First, the numbering method that will be used to determine the GPIO pins through which communication takes place between the sensor and the Raspberry Pi, specifically GPIO 17, is determined. In this particular case, the Broadcom (BCM) numbering method GPIO.BCM is used where the various GPIO pins are identified by their number, i.e., for GPIO 17 we simply write 17. Another way of numbering is GPIO.BOARD in which the identification of GPIO pins is done by writing the number of the position as they are physically arranged with the numbering starting from 1 and reaching up to 40. Then, using the dht11.py library, we construct an object of the DHT11 class inside the above library. Creating the above object requires determining the GPIO pin to which SDA pin 2 of the sensor is connected. Finally, it is possible to read the temperature and humidity values through the read method.

Raspberry Pi 4 Model B was used as a development board in this work. Raspberry is a credit card-sized computer developed by the Raspberry Pi Foundation in Great Britain and first sold in 2012. Although initially promoted as a means of teaching computer science in developing countries, it has also seen great commercial success in other areas, such as robotics. This has led to the release of several versions, including improvements over previous versions in terms of computing power, using a faster processor and more RAM, as well as Raspberry connectivity, with Wi-Fi and Bluetooth integration, without the need to add an external adapter.

Finally, Ubidots was used as a development platform. Ubidots is a platform that supports the development of IoT applications. It enables the user to record, monitor, and manage in real-time the data collected by the sensors through any networking technology, and turn it into useful information. In addition, it allows configuring actions and alerts based on the state of the system as determined through sensor readings. It also offers powerful data visualization tools, some of which were utilized in the current implementation. Finally, the platform is available in two versions. The first is for personal or academic use and is complimentary, while the second, which comes with more features, is for businesses and requires paying fees. The complimentary version of the Ubidots platform, Ubidots STEM, was used in the current work.

To transfer the data from the sensor through the Raspberry Pi to the Ubidots platform, the MQTT communication protocol was used, which is a publish-subscribe protocol as opposed to the more widespread HTTP communication protocol, which is of the get-request type. This protocol consists of three entities, the publisher, the subscriber, and the broker. Communication using this protocol is done through topics. Specifically, the publisher publishes some values on a topic. On the other hand, the subscriber subscribes to a topic to be informed about its prices. Finally, the broker manages all the publications in the various topics from the publishers and then informs the subscribers in each topic about the new prices.

To connect the Raspberry Pi to the Ubidots platform through the MQTT communication protocol, we first created a device on the Ubidots platform named "raspberrypi". Then we created two variables in this virtual device, one with the name "temperature" and one with the name "humidity". In this way, we created the necessary topics in which the Raspberry Pi will publish the new temperature and humidity values that the sensor reads. Finally, The UbidotsIoTDevice class was developed as a wrapper of the "paho – mqtt" library, which enables connection to an MQTT broker to publish and receive messages by subscribing to topics using the MQTT communication protocol. The above class aims to hide, as much as possible, the complexity involved in the process of creating code to establish communication between an internet-enabled computing device and the Ubidots STEM platform from the user-programmer. The body of the UbidotsIoTDevice class is listed in Appendix A.

Figure 4 presents the physical circuit as it was developed. In addition to the sensor and the Raspberry Pi, together with its GPIO Extension Board to avoid damage to the GPIO pins, a breadboard and jumper wires were used to implement the circuit.

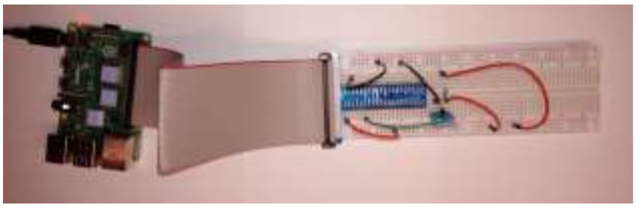

Fig. 4: The Physical IoT Circuit

A breadboard is a board used to make temporary circuits. It has multiple holes in horizontal or vertical groups that share the same potential through metal cables that connect them and are under the plastic cover. The great advantage of this board is that it offers a quick, direct, and non-permanent way of connecting and disconnecting electronic components to each other without any risk of damaging them, provided that the various components are handled with the required care. This makes it the most efficient way to test circuits.

As far as jumper wires are concerned, they are simple cables with the appropriate configuration at their ends, either pins or recesses, thus allowing the possibility of connecting two points without welding. They are usually used together with a breadboard to change the wiring of a circuit directly. There are three types of jumper wires: Male to Male, Male to Female, and Female to Female. The difference is that the male termination corresponds to a pin, while the female termination corresponds to a socket (each cable has two terminations).

Additionally, an appropriate code was developed in the PYTHON programming language to read the temperature and humidity values from the Raspberry Pi 4 Model B development board through the DHT11 temperature and humidity sensor. This code is also used for sending the values from the Raspberry Pi 4 Model B development board to Ubidots STEM platform using the

UbidotsIoTDevice class. This code is presented in Appendix B.

Finally, to create the interface through which the user will be able to monitor the temperature and humidity values in real-time during the transfer stage, the tools offered by the Ubidots STEM platform environment were used. The interface is shown in Figure 5. On the left, in the two widgets, the user can read the temperature and humidity values in real-time, while on the right, in the two graphs, they can monitor the evolution of these values over the last 24 hours.

Fig. 5: Dashboard for Monitoring Temperature and Humidity Values

## 5 Conclusion

It has been predicted that the demand for IoT technology will grow much faster to cover billions or even trillions of wireless devices and sensors in the coming years. However, this increase will depend to some extent on the ability of manufacturers to reduce the cost of IoT devices while also meeting all users' needs. The developed IoT application attempted to present a cost-effective solution for measuring temperature and humidity in the wine supply chain. The application uses a DHT11 sensor that measures temperature and humidity. The sensor is connected to the Raspberry Pi 4 Model B development board using a GPIO Extension Board, a breadboard, and jumper wires. The development board connects to the Ubidots platform through the developed UbidotsIoTDevice class. Finally, the appropriate PYTHON code enables reading temperature and humidity data from the sensor. The IoT application was tested in a lab environment and both the temperature and humidity data were confirmed to be highly accurate.

The developed application is a simple, flexible, and cost-effective method to monitor temperature and humidity in the wine supply chain. Applying such solutions in business operations presents a massive opportunity to build a sustainable and prosperous future. IoT technology may help organizations reduce their environmental effect, adjust to a new context, and increase their production and effectiveness. Notably, in the supply chain, IoT technology can significantly reduce the carbon footprint of activities and lead to a more efficient use of available resources.

The application proposed in this work can be used, with some additions and improvements, throughout the supply chain, even in crops or fields, to monitor soil temperature and humidity. To install the device in an outdoor environment, it is necessary to place it in a waterproof housing and to be powered by a rechargeable battery, possibly connected to a photovoltaic panel, so that charging is done automatically. It can also be expanded so that, in addition to the monitoring part, it also implements automation, such as the automatic notification of companies when the temperature and humidity levels go beyond the permissible limits. In fact, the notification can be made in real-time so that the necessary measures are taken immediately, and the quality of the products is not altered.

In addition, the application can be enriched relatively quickly with a variety of other suitable sensors to enable efficient monitoring of the entire supply chain. Examples of sensors that could be used are motion sensors to detect attempted sabotage, chemical sensors to detect changes in the quality of wine, fluid level sensors to detect attempts to dilute wine, accelerometers, and gyroscopes to detect unwanted movements and even location devices to monitor the wine transportation. Therefore, as it becomes clear, IoT technology presents a massive potential for more accurate, safe and sustainable supply chain operations.

## 6 Appendix A: UbidotsIoTDevice Class

**---Start of Code---**

```
import paho.mqtt.client as mqtt
import socket
import time

# Ubidots
HOST = "things.ubidots.com"
PORT = 1883
TOPIC = "/v1.6/devices/"

class UbidotsIoTDevice:
```

```
def __init__(self, device_token: str,
  device_label:  str, *variables_to_subscribe:
  str):
   self.__connected = False
   self.__subscribed = False
   self.__published = False
   self.__reconnected = -1
   self.__device_token = device_token.strip()
   self.__device_label =
  device_label.strip().lower()
   self.__variables = dict()
   for variable in variables_to_subscribe:
   self.__variables[variable.strip().lower()] = -1
   self.__client = self.__create_mqtt_client()
   self.__create_subscriptions()

def __del__(self):
   self.__client.loop_stop()
   self.__client.disconnect()

def __on_connect(self, client, userdata, flags, rc):
   if rc == 0:
      self.__connected = True
      self.__reconnected += 1
      if self.__reconnected:
         self.__create_subscriptions()

def __on_subscribe(self, client, userdata, mid,
 granted_qos):
   self.__subscribed = True

def __on_publish(self, client, userdata, mid):
   self.__published = True

def __create_mqtt_client(self):
   client = mqtt.Client()
   client.username_pw_set(username=self.__devi
   ce_token, password="")
   client.on_connect = self.__on_connect
   client.on_subscribe = self.__on_subscribe
   client.on_publish = self.__on_publish
   while not self.__connected:
      try:
         client.connect(host=HOST, port=PORT)
         client.loop_start()
         time.sleep(1)
      except socket.gaierror:
         pass

   return client

def __create_subscriptions(self):
   for variable in self.__variables.keys():
         callback = self.__create_callback(variable)
         self.__client.message_callback_add(TOPIC
         + self.__device_label + "/" + variable +
         "/lv", callback)
         while not self.__subscribed:
 self.__client.subscribe(TOPIC + self.__device_label
+ "/" + variable + "/lv", qos=1)
time.sleep(1)
self.__subscribed = False

   def __create_callback(self, variable):
      def on_message(client, userdata, message):
         self.__variables[variable] =
float(message.payload.decode("utf-8"))

      return on_message

   def read(self, variable: str):
      return self.__variables[variable.strip().lower()]

   def write(self, variable: str, value):
      while not self.__published:
          self.__client.publish(TOPIC +
          self.__device_label + "/" +
          variable.strip().lower(), value, qos=1)
          time.sleep(1)
      self.__published = False
```

**---End of Code---**

# 7 Appendix B: PYTHON Code for Data Gathered from the Raspberry Pi 4 Model B

**---Start of Code---**

```
# modules

import RPi.GPIO as GPIO

import dht11

import time

from Ubidots_IoT_Device import
UbidotsIoTDevice

# numbering scheme

GPIO.setmode(GPIO.BCM)
```

```
# pins

dhtPin = 17

# sensors

myDHT = dht11.DHT11(dhtPin)

# globals

delay = 10

# Ubidots IoT Devices

raspberrypi = UbidotsIoTDevice("BBFF-iGovTvMQDrbISlaUE5KkEs6qyZhTcJ", "raspberrypi")

# main

while True:

    result = myDHT.read()

    if result.is_valid():

        raspberrypi.write("temperature", result.temperature)

        raspberrypi.write("humidity", result.humidity)

        time.sleep(delay)
```

**---End of Code---**

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