A Beginner's Guide to The Internet of Things (IoT) 2021

We are able to turn on the lights in our homes from a desk in an office miles away. The built-in cameras and sensors embedded in our refrigerator let us easily keep tabs on what is present on the shelves, and when an item is close to expiration. When we get home, the thermostat has already adjusted the temperature so that it's lukewarm or brisk, depending on our preference. These are not examples from a futuristic science fiction story. These are only a few of the millions of frameworks part of the Internet of Things (IoT) being deployed today.

IoT has redefined the way we interact, communicate, and go about our daily work. From homes to maintenance to cities, the IoT ecosystem of devices is making our world smarter and more efficient. In this guide, we will walk you through everything you need to know about the increasingly connected world of IoT. This guide discusses in-depth:

What is the Internet of Things (IoT)?

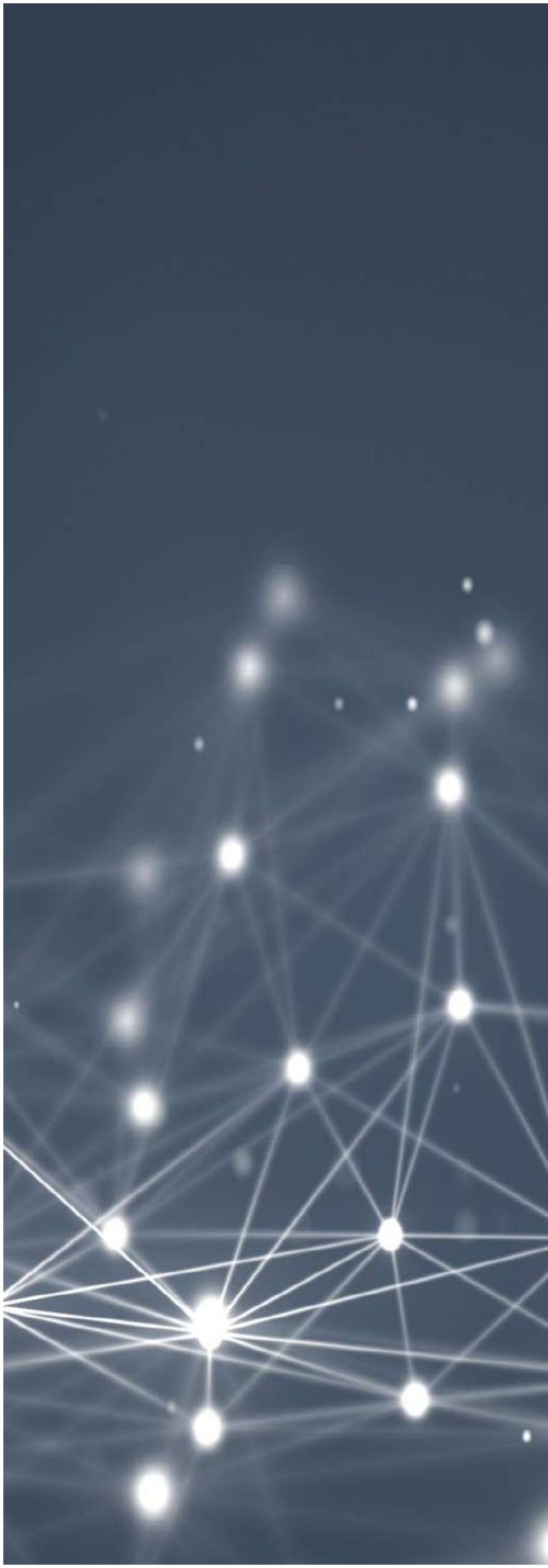
Broadly speaking, the Internet of Things (IoT) encompasses all physical objects - i.e. “things” - that connect to the internet and to other devices.

The definition of IoT is evolving, as the term is increasingly being used to describe objects that interact and “speak” to one another, so we can have the opportunity to be more efficient in how we do things.

More specifically, IoT devices are characterized by their ability to gather data on their surroundings, share this data with other electronic devices, and ultimately, help us, the end-user gain information, solve an issue, or complete a task.

To visualize the concept, think of a time you’ve gone to the restroom in a hotel, and the light has turned on by itself. Ever wonder how that happened? There is probably a motion detection sensor there that detects movement, which automates and connects to the light to turn it on.

This is only one of the simplest forms of an IoT solution, as the technology is now being used to create larger ecosystems such as smart homes and smart cities. If you read your emails through a voice-controlled virtual assistant, measure your steps and heartbeat with a smartwatch, or control your security system through your mobile phone, you’re benefiting from IoT solutions on a daily basis.



The History of the Internet of Things (IoT)

The term Internet of Things was originated by Kevin Ashton in 1999, but the idea has been around for much longer and dates **back to the early 80s** with a Coca-Cola machine at Carnegie Mellon University.

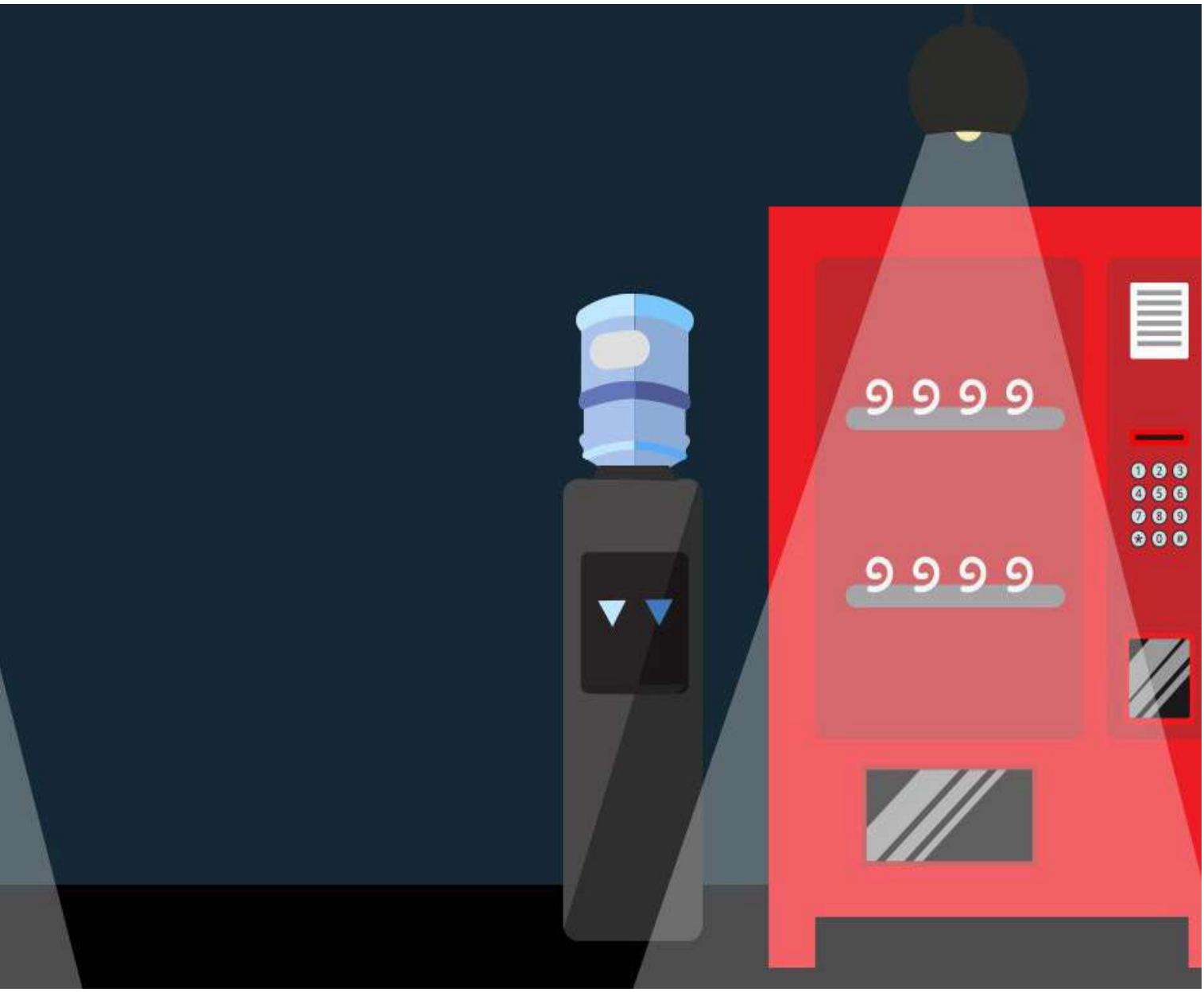
A group of students from the university designed a system to get their campus Coca-Cola vending machine to report on its contents, so they could avoid the trouble of having to check if the machine was out of Coke. Aside from the inventory report, they were also able to make the machines let them know whether newly loaded drinks were cold or not.

Later, In 1990, John Romkey connected a toaster to the internet for the first time. Not long after, another group of students at the University of Cambridge used a web camera to monitor the amount of coffee available in their computer labs.

Then, finally, in **1999**, the term Internet of Things was founded by Kevin Ashton during his presentation for Procter & Gamble, a multinational consumer goods corporation. When working there as a brand manager, Ashton had been assigned to help launch a line of cosmetics. He noticed that a specific shade of brown lipstick always seemed to be sold out, although many employees part of the supply chain would report that color as available in the warehouse.

So, Ashton gave an "Internet of Things" presentation and suggested that each product has a radio frequency identification (RFID) tag that allows the identification and tracking of specific objects throughout the supply chain.

By the **late 2000s to early 2010s**, organizations around the world were starting to become really excited about the Internet of Things – similar to how they're getting enthusiastic about AI and machine learning today. The International Business Machine (IBM) corporation started to work on a Smarter Planet program, McKinsey



began publishing studies on the condition of the Internet of Things technology, and in 2011, Cisco announced that the IoT was "born" around 2008 and 2009 when more machines or objects were linked to the web than there were people on the earth.

The Internet of Things (IoT) was originally most interesting to business and industrial development, where its usage is often referred to as machine-to-machine (M2M), but the focus has shifted on filling our homes and workplaces with smart devices, bringing benefits to almost everyone. As of right now, there are as many as 35 billion IoT devices installed all over the world - and the prospect by the end of 2021 is that the number will reach 46 billion.

Examples of IoT

Depending on their usage, we divide IoT devices into four main categories: **consumer, organizational, industrial, and infrastructure applications.The consumer IoT** refers to the dozens of personal devices, including smartphones, wearable technology, fashion products, and an increasing range of household appliances, that are linked to the internet, continuously gathering and distributing information.

In **organizational settings**, IoT is mostly widespread in the **medical and facilities management field**. Specifically, IoT devices are being used for remote monitoring and for creating emergency notification systems for people, buildings, and assets. The COVID-19 pandemic has also urged the use of IoT for smart cleaning and smart occupancy so that workplaces of all types can return to the office with the help of technology.

Industrial IoT (IIoT) brings devices, clouds, analytics, and people together to advance the execution and productivity of industrial processes. More specifically industrial IoT (IIoT) enables solutions such as equipment monitoring, predictive maintenance, condition monitoring, error detection, and much more.

Last, **infrastructure IoT appliances** enable monitoring and controlling operations of sustainable urban and rural infrastructures like bridges, railway tracks, and on and offshore wind farms. These technologies help the construction industry by cost-saving, time optimization, better quality workday, paperless workflow, and an increase in productivity.

The Internet of Things Ecosystem: How Does IoT Work?

IoT operates over a boundless network, and thus it requires various components to form a cohesive system. We divide these components into three main categories: input, analytics, and output.

First, you need a device that **gathers input** from the real world. This is usually done through sensors that work to gather real-time data from their surrounding environment. They're also often called "detectors", as their main purpose is to detect the slightest changes in their surroundings. For example, Smart ACs or thermostats work through a detector that is able to sense room temperature and humidity and adjust accordingly.

More often than not, these sensors/detectors can also be bundled together as part of a device that does more than just sense things: phones are made up of several sensors such as GPS, camera, compass, fingerprint detection, to help us perform a handful of tasks.

For the sensor to connect to other devices, and ultimately turn data into action, it needs a "medium of transport", which is **connectivity**. Connectivity is responsible for transferring data into the online world. Some of the most popular IoT wireless protocols and standards include Bluetooth, Wi-Fi, DDS, cellular BLE, Z-wave, etc. The choice of the network depends on several factors, such as the desired speed of data, transfer, range, power consumption, and overall efficiency of the network.

After data has been collected and has traveled to the cloud through a communication medium, it needs to be processed. This is the second component of the IoT ecosystem, where all of the "smart stuff", i.e. **context and analytics**, takes place. The basic role of analytical tools is to investigate a situation and form a decision based upon the insight. This can be as simple as analyzing when a room's temperature falls within the desired range, or as complex as, for example, a car that's close to a crash.

The very last element of the IoT system is the **end-user device** or user interface. This is the visible device or application a user uses to access, control, and set their preferences. A user-friendly and attractive design is a major consideration in today's IoT world. Companies are continuously working on the integration of convenient tools, such as touch interfaces, o/r the use of colors, font, voice, to put themselves on solid footing for a great customer experience.

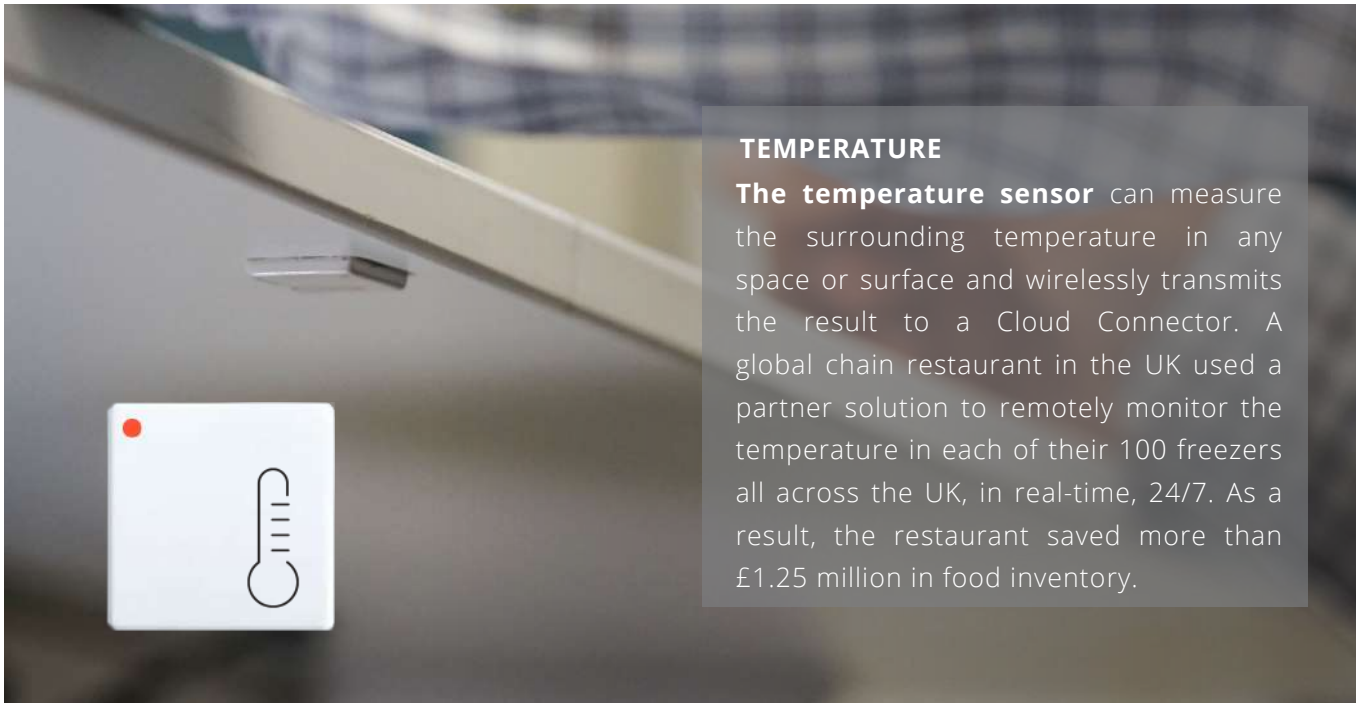
Sensor Technology & IoT

In order for objects to be connected to each other and IoT to come to life, there must be a device that gathers the information that will be transmitted (the input). As we've mentioned, for many applications, this is done through sensors.

Just what sensors are collecting depends on the individual device and its task. But broadly speaking, sensors are tools that detect and respond to environmental changes, which may come from a variety of sources such as light, temperature, pressure, and motion.

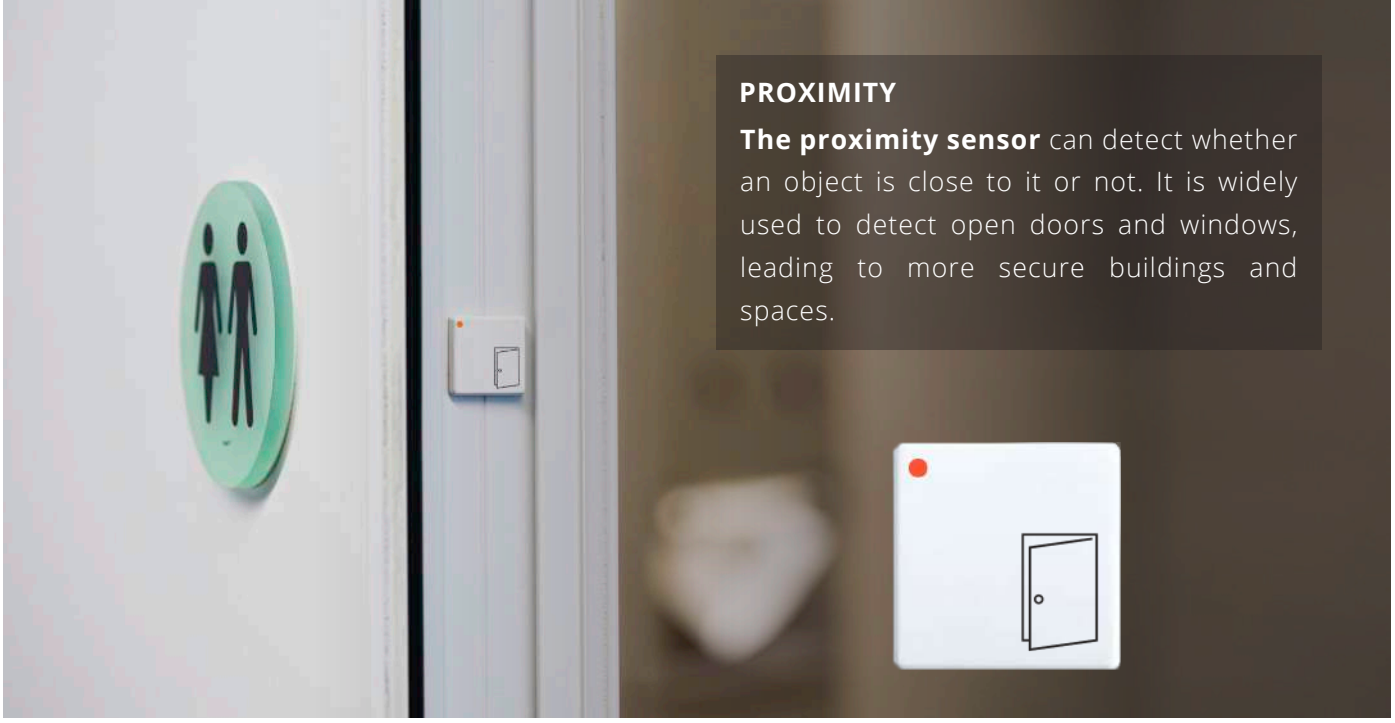
Because of the wide range of inputs IoT sensors are able to gather, they're being used extensively in various fields, and have become crucial to the operation of many of today's businesses. One of the most pivotal benefits of these sensors is their ability to trigger analytical functions that warn you of potential issues, which allows businesses to perform predictive maintenance and avoid costly damages.

To exemplify the value of IoT sensors, let's take our wireless sensors at Disruptive Technologies as case studies. We offer small ingenious sensors for humidity, temperature, water detection, touch, and remote monitoring of your buildings & assets.



TEMPERATURE

The temperature sensor can measure the surrounding temperature in any space or surface and wirelessly transmits the result to a Cloud Connector. A global chain restaurant in the UK used a partner solution to remotely monitor the temperature in each of their 100 freezers all across the UK, in real-time, 24/7. As a result, the restaurant saved more than £1.25 million in food inventory.



PROXIMITY

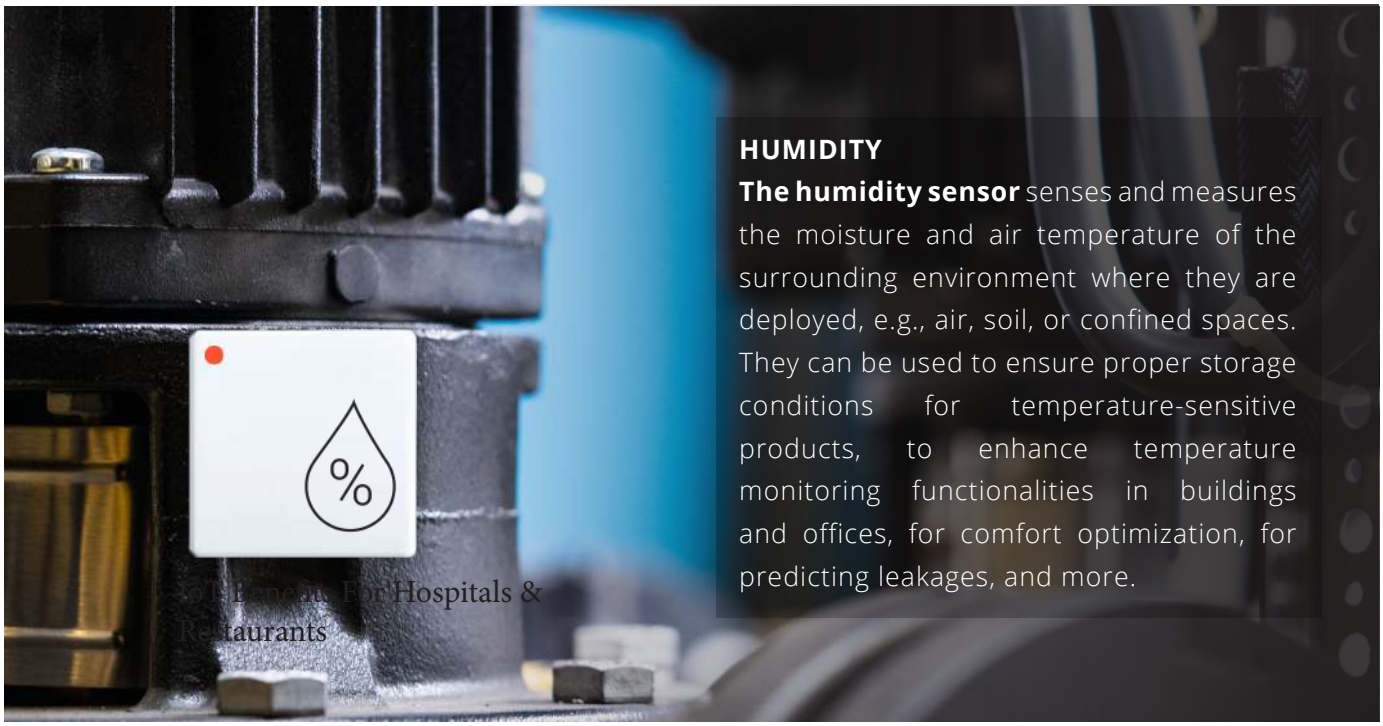
The proximity sensor can detect whether an object is close to it or not. It is widely used to detect open doors and windows, leading to more secure buildings and spaces.

TOUCH SENSOR

The touch sensor is able to detect whenever the sensor is being touched, notifying the user about the event through a cloud server. Dorint Hotels installed touch sensors around their serving areas and washrooms to allow their customers to call servers to place orders or reach staff about hygiene concerns via the touch of a button. Dorint Hotels also saved 8700 KwH per year, by using a partner solution to save data and energy, as it allowed them to adjust the Air Conditioning run time in their server rooms.

WATER

The water sensor is able to detect high water levels or water leaks, and immediately signal that water is coming in contact with the front of the sensor. These devices have been used in utility rooms, grocery stores, and restaurants, to alert management in case of any leaks from fridges, boilers, water heaters, or water softeners.



HUMIDITY

The humidity sensor senses and measures the moisture and air temperature of the surrounding environment where they are deployed, e.g., air, soil, or confined spaces. They can be used to ensure proper storage conditions for temperature-sensitive products, to enhance temperature monitoring functionalities in buildings and offices, for comfort optimization, for predicting leakages, and more.

Want to learn more about how humidity sensors work & what to do with them? We've got a complete guide on humidity sensors, which you can check out.

Benefits of Sensor-Based IoT

IoT Benefits For Hospitals & Restaurants

IoT is a great fit for healthcare and hospital services. For starters, IoT improves **patient comfort**. Through solutions such as smart thermostats, smart beds, and customizable lighting controls, patients can have a more enjoyable experience, reduce stress, and go through faster recovery.

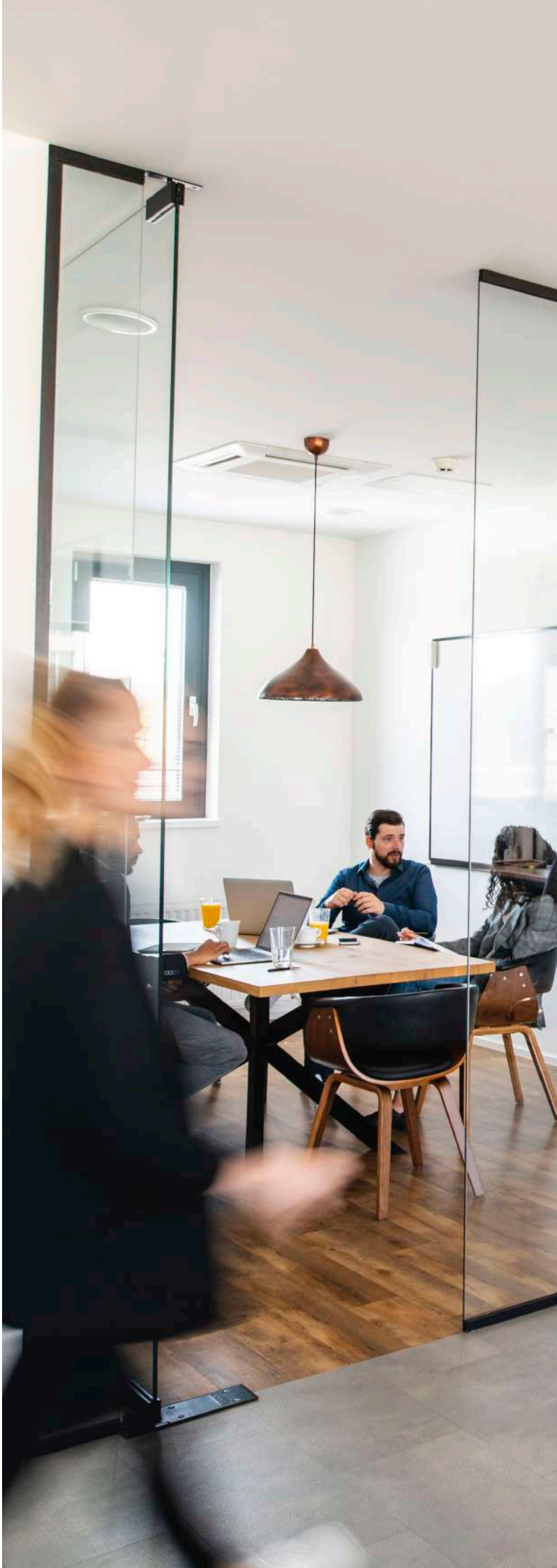
Next, IoT enables **remote health monitoring** and **emergency notification systems** through the use of wearable technology - these include electronic wristbands, advanced hearing aids, wearable heart monitors, and so forth. Such devices allow physicians to monitor their patients with greater precision and ultimately be able to come up with better-informed treatments.

Another extremely important benefit of sensor-based IoT devices in hospitals relates to the **safety of the patients and staff**. Temperature sensors and cold storage ensure food, blood, and medications are stored safely, water sensors prevent potential leaks and hazards, occupancy sensors monitor waiting areas to control capacity, disinfection systems keep areas sanitary, and much more.

For example, UK's National Health Service (NHS) has improved patient safety and reduced costs through sensors that automate daily hospital tasks such as medicine temperature checks, fire door monitoring, comfortable temperatures for patients, and much more.

Another sector IoT has also greatly impacted is the food industry, specifically **restaurants & restaurant chains.**

The most prominent benefit relates to **food safety and monitoring systems**. With IoT temperature sensors, restaurants can remotely monitor their refrigeration 24/7 to make sure temperature changes don't go unnoticed, lowering the risk of spoiled food and food waste. IoT apps can also remotely monitor equipment and troubleshoot potential problems to avoid their failure and the cost of repair. These apps even send restaurant managers recurring reminders to schedule maintenance.



IoT Benefits for Buildings & Workplaces

Due to the pandemic, more than 50% of workers are afraid to return to the office.

That's why real estate and facilities management companies are opting for IoT sensor technology and smart infrastructure, to help reduce some of these Covid-related concerns and risks.

Say, for example, by placing a proximity sensor in bathroom stalls, the sanitary staff can get insights on how often workers use the restroom. Then, the staff can clean whenever there is a need, based on actual bathroom occupancy instead of a manual cleaning routine. This **validates cleaning schedules, optimizes the office's resources, and increases the employee's overall health & well-being**. Proximity sensors can also ensure **safe social distancing**, through reminder alerts to keep workers at appropriate distances from one another, whenever the occupancy of a room starts to increase.

And that's only the tip of the iceberg when it comes to the solutions of remote monitoring for buildings & workplaces. For more interesting benefits, you can head over to our 10-minute read on 9 Benefits of IoT-Enabled Remote Monitoring For Buildings & Workplaces.

IoT Benefits in Industrial Settings

The Industrial Internet of Things (IIOT) uses smart sensors to enhance manufacturing and industrial processes.

One of the most praised benefits of IIoT devices is that they enable predictive maintenance. Predictive maintenance means businesses can schedule their maintenance activities based upon accurate predictions about an asset's lifetime. These benefits result in improved **asset utilization, visibility of the asset's condition, and allows optimal planning of maintenance activities.**

A second important benefit of predictive maintenance is in industrial **facilities management** and smart substations. Sensors can monitor vibrations, temperature, humidity, and other factors that could lead to deficient operating conditions, and alert management so they can take action to fix or prevent damages.

For a more in-depth guide on the importance of predictive maintenance, check out our blog post on Why We Need Predictive Maintenance in Industry 4.0 & How Does it Work.

IoT and Data Security & Privacy

With all these devices consistently gathering everything we do, IoT is susceptible to a lot of privacy & security problems.

The main issues today are **cybercrime and the risks of data theft.** Cybercriminals are constantly evolving and looking for methods to hack passwords, emails, and impersonate staff to malware. And as the pandemic has forced people and businesses to go fully remote, there has been an increased focus on the issue.

IoT's security history doesn't do much to prevent these issues, either, as many IoT devices fail to consider the basic protocols of security, such as data encryption, blocking tags, authentication, and so on. They operate over a long period of time without supervision or updates and work with cheap, low-cost systems that are prone to cybersecurity risks.

With all this being said, there are responsible manufacturers who go the extra mile to fully secure the embedded software or firmware built into their products.

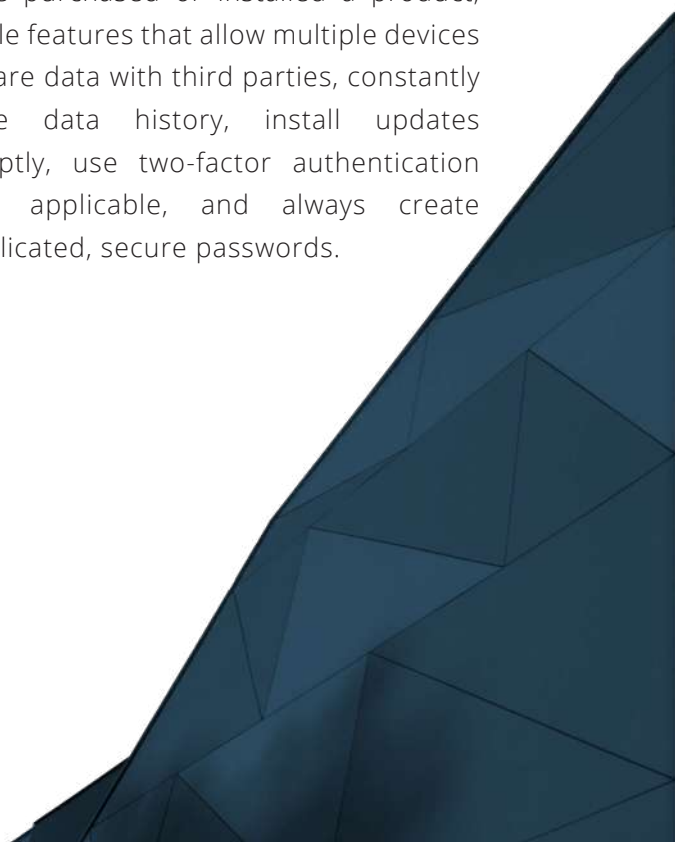
At Disruptive Technologies, we are hyper-aware of these data security & privacy concerns and thus prioritize security and privacy throughout every part of the design and development process for our sensing solution. This includes chip design, sensor design, radio protocol design, cloud services, and APIs. Every layer of the Disruptive Technologies sensing solution is secure, from the individual sensors to the applications processing the data.

So what can you do to own your data and privacy?

The most important step is research - learn about your IoT solution supplier. How well do they comply with federal protocols and regulations? What are their privacy standards? Do they implement any encryption tools?

And as dreadful we know it may be, it's important that you also read the terms of conditions for services, devices, and apps every single time to understand what you are agreeing to.

Then, to reinforce your protection once you've purchased or installed a product, disable features that allow multiple devices to share data with third parties, constantly delete data history, install updates promptly, use two-factor authentication when applicable, and always create complicated, secure passwords.



Wrapping Up IoT

And that's a wrap on our IoT guide!

As the number of devices connected expands, our homes and workspaces will become increasingly overrun with smart products – presuming we are prepared to accept some of the privacy and security trade-offs. Some people will be happy about the upcoming world of advanced things. Others will miss the good old days when a table was indeed just a table.

Megi Hamza

Meg is the Digital Marketer at Disruptive Technologies. She holds a Master of Science degree in Strategic Marketing Management from BI Norwegian Business School. A Marketing and tech nerd, she spreads digital awareness about how to achieve more sustainable and efficient building operations with the world's smallest wireless sensors. Outside of being an IoT enthusiast, Meg enjoys painting, cinema, and the outdoors.