# IoT application in Pet Tracking

## Introduction

During the global lockdown imposed amid the Covid pandemic, the pet industry witnessed remarkable growth, driven by people's desire for companionship and safety. Having jumped on the pet train, I was surprised by how quickly the little 'fluff ball' (Dory the cat) became an integral part of the family, evolving into a constant companion, almost like a daughter. As with most of us, this growing fondness also heightened the anxiety for her safety, particularly the very real fear of her wandering out and getting lost. My research to address this concern and find Dory in case she is ever lost led me to IoT (Internet of Things).

## What is IoT?

Internet of Things (IoT), as the name suggests IoT is an interconnected network of things; things here can refer to devices, sensors, objects, animals, and people who can communicate with each other. The main concept of IoT is to make smart things that can gather data through sensors, communicate the data between devices and action upon it when required using actuators with minimal to no intervention by humans. Still confusing? ok imagine a sensor that detects brightness of an environment and tell a bulb to turn on, or a microphone that picks up a double clap and sets a romantic setting (dimmed lights and romantic music) for you and your significant other. IoT makes things super convenient, efficient, and impressive. It's like having little helpers all around you, making life easier and more fun. So, instead of you telling things what to do, they can figure it out on their own and do it for you! How amazing is that?

Thanks to its convenience, efficiency, and ability to work non-stop, even in remote locations, IoT has been embraced by almost every aspect of modern life. It finds applications in various domains, ranging from on-body medical devices to advanced military weapons systems to tags used for tracking locations (including Pet trackers).

However, it is not all sunshine’s, it also comes with some challenges. One of the biggest worries is security and privacy since having many connected devices can make data breaches and unauthorized access more likely. Additionally, making sure that different devices and platforms can work together smoothly, known as interoperability, is another important challenge that needs attention to ensure everything functions seamlessly and works well together.

## IoT in Pet Tracking

Being able to run remotely and efficiently means that IoT devices are widely used in Pet Tracking, with as many different types of trackers as types of animals. It is not quite as simple as buying a tag, putting it on your pet and forgetting about the anxiety of losing your pet. We need to consider a few key elements when getting a tracker to get the perfect one for your pet.

### Size

The Initial things to consider are the size of the pet and the size of the tracker. While a few hundred grams may be acceptable for a tracker on a camel, that same weight would render a parakeet immobile and uncomfortable. Thus, it's crucial to opt for a tracker that your pet can carry without any strain. Moreover, the tracker should be compact and streamlined so as not to hinder your pet's natural movements.

### Battery

Another pivotal aspect is the tracker's ability to maintain consistent functionality without demanding frequent recharging. Having a tracker that necessitates daily removal for charging can prove bothersome. Such a requirement not only limits the time frame for tracking a lost pet but also adds an extra layer of inconvenience. To maximize efficiency, the tracker should be capable of prolonged operation on a single charge, ensuring that you have ample time to locate your furry companion if needed.

### Range & Accuracy

The tracker should boast an extended tracking range while maintaining accuracy. An ideal tracker isn't confined to a mere couple of meters outside your home; it should be able to track your pet wherever they venture. Additionally, the tracker's accuracy is paramount. Relying on a device becomes a challenge if it is inaccurate.

### Data Security & Privacy

This is an aspect that often is overlooked and dismissed as not relevant to many of us. But let's pause and consider: would you feel comfortable with a stranger having access to your location and daily routines? When we think about our bond with our pets, it becomes apparent that someone who gains access to our pets' tracking information could deduce quite a bit about our lives. For instance, they could estimate the times we take our pets for walks or even figure out our travel plans by tracking our pets' movements.

While it's true that most of us might not be high-profile targets, the issue at hand isn't about that. It's about preserving our privacy when we choose to. Our privacy is something valuable and should not be underestimated. Similarly, our pets' privacy matters too. Just as we cherish our personal space and the ability to control what we share, we should extend the same consideration to our pets. They deserve their own sense of space and privacy.

### Network Connectivity

The type of network connectivity used is also an important factor to consider. We have many different options to select from such as Cellular, RFID, Bluetooth, WiFi and LoRaWAN. Each of these has their own advantages and short comings, which we will have a quick look into.

#### Cellular

This is the connection that we use to operate our cellphones. Having been widely used this type of connection has a well-established infrastructure in the urban world, this translates into a wide coverage area for our pets. As any of us who used a Map application to travel in a city will know this also means that cellular tags can be used for real time tracking. This along with the coverage area makes this an ideal option for pets that travel.

As for it short comings, some of these trackers consume power a lot and it does require a subscription plan which can add up with time.

#### RFID

Radio Frequency Identification (RFID) is often used for close-range identification. This is usually done with microchips implanted under the skin, some countries mandate pets to be microchipped before travelling to them. RFID’s help by allowing animal shelters or vets to identify a lost pet who can in turn contact the owner. These trackers can last a lifetime and are inexpensive.

However as mentioned before this is a close-range identification device as such it is not suitable for real-time tracking over distances, and this relies on the pet being found by an animal shelter or vet with RFID scanning ability. Furthermore these tags need to be registered properly in the correct databases to be of use.

#### Bluetooth

This is again a very familiar technology, it is a short-range wireless technology that is used to connect devices in close proximity. Bluetooth consumes ultra-low power, is low cost, small in size, secure and provide easy connections with smart phones or other devices. New Bluetooth provide a range of approximately 150 meters or more in open fields. Apple AirTag’s uses this technology.

Given Bluetooth offers an extended range it is still has a limited range. Furthermore, it requires proximity with a tracking device or devices to work.

#### WiFi

WiFi uses your home WiFi connection to track your pets, this is ideal for indoor tracking however as it has a limited range it is not suitable for outdoor tracking.

#### LoRaWAN

Long Range Wide Area Network is a long range low power network protocol. It's specifically optimized for devices that need to send small amounts of data over long distances while consuming minimal energy. LoRaWAN operates on unlicensed radio frequency bands (868Mhz or 915Mhz), and is able to cover from 5-15 Km, making it suitable for a wide range of applications, including pet tracking. LoRaWAN is also optimized to low data rates (Max 27kbps) which is sufficient to provide periodic updates on location data. It also provides a secure connection.

However, It should be noted that LoRaWAN requires a network infrastructure to be setup, and the initial setting up can be complex. This also means that people living in places where such infrastructures are not in place will opt for one of the other options.

### Other Features

Some other features that may be required are waterproofing which becomes a must for animals that will go into a body of water. Other things like being able to connect to an app on your smart phone or ability to act as a key for your pets litter box.

## Is Pet trackers useful?

The effectiveness of trackers is something that all pet owners will be concerned about, as it ensures the safety of our companions. The simple and short answer to this question is “yes, it is useful”. Pet trackers not only serve as a source of reassurance for pet owners but also play a pivotal role in the successful recovery of lost pets. While it is important to note that they do not guarantee a 100% success rate, they undeniably contribute significantly to reducing the number of lost pets.

Let's delve into the concrete evidence supporting the utility of pet trackers. Actual research conducted in the United States provides us with valuable insights. Over a five-year period, it was observed that approximately 15% of cats or dogs were reported as lost. Within this distressing statistic, 14% of the lost pets were successfully identified and subsequently reunited with their owners through the utilization of RFID (Radio-Frequency Identification) technology[1]. It is worth highlighting that many of the pets were either found through diligent neighborhood searches or simply made their way back home on their own accord. Cats were a significant portion of the self-returning pets. This data shows us that pet trackers, even those relying on RFID, have a tangible impact on the recovery of lost pets, this is without the active tracking functionalities that more advanced devices offer.

To put these statistics into perspective, let's consider a sample size of 1000 pets. Within this group, 21 pets were successfully identified and reunited with their owners solely due to the implementation of RFID technology, with all its limitations. Note that from another study by Vienna’s largest animal shelter it was identified that 25% of the RFID used were correctly registered, severely undermining the identification or lengthening the identification and return to owner process[2].

## Conclusion

In summary, the integration of IoT devices, with their diverse range of trackers, has proven to be a game-changer in the realm of pet tracking. These technological marvels offer invaluable tools that not only alleviate the concerns of pet owners but also significantly enhance the chances of reuniting us with our lost animal companions.

Looking ahead, the continual growth, development, and establishment of various IoT infrastructures pave the way for a secure future in locating our lost companions. This ongoing evolution ensures that the path for pet tracking remains in safe hand and is guided by innovation and security.

In this age of seamless connectivity, the recovery of lost pets moves beyond being a distant hope and steps into the realm of likelihood. Here, technology works hand in hand with us, the dedicated pet owners. As IoT devices pave the way to a future prioritizing safety and security, we can confidently progress, secure in the knowledge that the deep bond shared between us and our pets will persist unbroken, even when faced with unforeseen circumstances of temporary partings.

## References

1. Weiss E., Slater M., Lord L. 2012 Frequency of lost dogs and cats in the United States and the methods used to locate them [Online]. Animals. 2012;2:301–315. doi: 10.3390/ani2020301 [[Article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4494319/)]
2. Judith K., Christine A., Ines W., Veronika H., Günther S. 2021 Tracking Devices for Pets: Health Risk Assessment for Exposure to Radiofrequency Electromagnetic Fields [Online]. Animals. 2021;9:2721. doi: 10.3390/ani11092721 [[Article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8465301/#B1-animals-11-02721)]
3. LoRa Alliance (no Date) What is LoRaWAN® Specification. Available from <https://lora-alliance.org/about-lorawan/> [Accessed 21 August 2023].