Silent Sentinel's Loss and Theft Prevention System

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ABSTRACT

This paper offers a view into loss and theft protection that is ubiquitous and omnipresent. The solution for loss and theft prevention rests in the resourcefulness of the application of networked wireless technologies and tech-facing applications that work concurrently to track items of value or importance absent human intervention unless needed to disrupt a loss or theft. The system described alerts users when a loss is imminent so that the user can retrieve the tagged item before it is actually lost or left behind. This approach places the control for loss and theft prevention in the hands of users. The added benefit is that this approach promotes privacy by design as an essential element of project development. Privacy is the single greatest challenge in a 24-7 connected world. Solutions providing transparency to users and delivery of just-in-time communications to support user engagement at key points to effect a positive or avert a negative outcome is essential to maintain low dependency on remote computing solutions to problems.

Keywords: theft prevention, loss prevention, tracking, RFID.

1 INTRODUCTION

The research is intended to create loss and theft prevention applications that can track wireless RFID signals in real-time while in rich RFID signal environments. The application provides alerts to users based upon predetermined proximity rules so that warnings may be issued to users before a loss or theft occurring. The research focus is on reliable signal differentiation among RFID tags in situations where the number of tags would exceed the capacity of current methods used to read multiple RFID tags.

Major factors limiting the growth of companies in this space are poor battery life and restricted tracking functionality because of short distances for tracking. Further, the proper functioning of existing methods of loss and theft prevention requires that the user experience a loss before the technology can be engaged. Although recent enhancements in Bluetooth capabilities may improve battery life, the technology is still limited by requiring the user to be within close proximity of the lost or stolen device in order to locate it once it has been assessed.

2 RFID

The research will pursue answering questions regarding the application of 5G capacity joined with optimized algorithms to the exploration of methodologies for consistently discerning unique RFID tags associated with the innovation proposed to expand the number of RFID tags that can be managed using a tracking system based upon proximity.

The occurrence of interference due to tag signals is a common issue in RFID systems. Simultaneous transmission from multiple tags leads to the collision as the readers and the tags normally use the same channel. Collisions are classified as reader-to-reader, reader-to-tag, and tag-to-tag collisions.

The project will consider methods for addressing different types of RFID Collision:

Reader-Reader Collision, which occurs when neighboring readers simultaneously, interrogates another tag in the same frequency band. Reader-Reader collision may also occur when the tag is within the readable range of one reader and the interference range of the other reader; the signal from the latter reader may interfere with the return signal from the tag.

Reader-to-Tag Collision, which occurs when a tag receives multiple concurrent queries from different readers.

Tag-to-Tag Collision, which occurs when multiple signals simultaneously arrive at the reader this prevents the reliable detection of all tags within its interrogation zone. Because of the IoT, this problem will receive additional focus on the reliability of loss and theft prevention using RFID tag technology.

A further complication is the limits on the number of RFID tags that can be read simultaneously in an environment that may be saturated with the presence of not only an unbounded number of RFID tags but also other signals that make up the IoT.

The focus of this research is addressing the multiple challenges of RFID tags in tag and signal-rich environments.

RFID readers can receive signals from only one tag at a time. If two tags are sending signals at the same time the reader must distinguish one from another. There are anti-collision algorithms to help distinguish between RFID signals that support the collection of data for a single tag at a time. The process of reading multiple tags operates at a high rate and appears instantaneous.

The process of reading tags can be managed by an algorithm but there are limitations when the number of RFID tags reaches a saturation point where the reader is not able to efficiently discern the individual tags to be read and answer questions regarding RFID signals and other types of signals and the reliable functioning of the proposed technology.

The inquiry into RFID tag reader and tag differentiation will consider the non-trivial challenge of reading the signals for select tags while ignoring signals from other sources including other RFID tags to effect loss and theft prevention. It is understood that many tagged objects and multiple RFID tags may interfere with each other's communications. This reduces the reliability and efficiency of the RFID system. We propose the development of an anti-collision algorithm for communication between multiple tags and a reader. To address interference of RFID signals from multiple neighboring RFID tags, the proposed research will employ a number of techniques that will involve time-division (TD) technique, where tags in the proximity zone are assigned a specific time slot so that at every instance in time, a reader communicates with tags using the specific time slot. Coupling this with the speed of 5G we hope to raise the capacity of reader devices to query tags and assess the loss and theft posture of each item and report when conditions may indicate a pending loss. We will develop computer simulations to illustrate the performance of the proposed anti-collision technique for multiple RFID tags as part of the research undertaken.

The project, to the degree practicable, investigates the length of time, tags must spend in the proximity zone to be accurately identified under varying conditions, environmental factors, and competing signal scenarios where other tags exist on all sides. Further work will involve incrementally increasing RFID tag density and learning how additions impact quality and theft prevention as that is a major challenge for users of mobile and portable devices in an IoT signal-rich environment.

3 OBJECTIVE

This project will result in invaluable research on the viability of an innovative approach to loss and theft prevention that uses proximity initially in feet but to extend to inches and ultimately fractions of an inch based on wireless signal proximity. Proximity rules are used to trigger alerts to avert losses and thefts.[1] Further, the work will survey the application of security and authentication techniques to assure the end-to-end trustworthiness of the approach to loss and theft prevention. The project will investigate the size and scope that can be achieved when linking wireless devices intended to function as a loss and theft security fog network [2].

On any given day, more than 60 million people are searching for lost items. A laptop is stolen every 53 seconds; 70 million smartphones go missing each year. 52% of all device thefts happen in offices; 25% while users are attending conferences. And 85% of losses incurred by companies are the result of compromised data on lost devices. In 2010, a single corporate data breach cost on average $7.2 million. Over a lifetime consumers spend $5,591 replacing lost items. Businesses also face lost productivity, the loss of intellectual property, data breaches, and legal fees. It is reported that the cost of a single laptop, can be as much as $49,000 when calculating for downtime, support, and management time.

The number of portable devices that people carry with them is growing, and on average people lose 1 item annually. The time spent searching for lost items is 2.5 days annually and costs U.S. households a total of $2.7 billion a year. Millennials are twice as likely to forget something than baby boomers. The typical cost of replacing a lost item is $220, but the value of these items to consumers is the data they contain.

Using NFC devices for inventory management is a well-known application of the technology, but the ability to use it for the fine-grained, consumer application in real-time, immediate tracking of personal items is unanticipated. We believe that recent improvements in the capabilities of the technology combined with the ubiquity of high-quality sensors in cellular telephones can enable this tracking and provide consumers a capability that substantially reduces their mental stress while saving over 2.7 billion dollars in lost wallets, keys, and cellphones. The substantial promise behind the loss prevention capabilities underscores the importance, novelty, and significance of performing the integrative research to prototype and test this unanticipated application of the technology and the novel user interface it requires.[3]

Although several applications could be developed, the selection of loss and theft prevention is one challenge for users of mobile and portable items in an IoT signal-rich environment. People misplace and lose things they value and treasure. This is important to consumers given the fact that when a user leaves the location where the item was left, the opportunity to recover it diminishes substantially.

About 70% of the things lost have stored data that includes pictures, contacts, calendars, and other irreplaceable information. Consumers report that 18 percent of losses are thefts, and another 19% occur on public transportation. The other reasons for losses are forgetfulness or merely being too distracted to notice something was being left behind. Only 29% of people have had a lost wallet or purse returned to them by a stranger, and just 27% have had a lost phone returned by a stranger.

4 SOLUTION

The solution to reducing loss of items of value is by getting alerted before you move too far apart so as to not forget these items. Using a patented proximity-based approach to loss prevention an alert can be sent to the user/owner before they move too far from a lost item so that it can be retrieved.

The research objective is to develop and operationalize pre-loss or pre-theft prevention protocols, augmented through machine learning and user engagement that reduces incidents of lost or stolen portable devices or items. The research will support the exploration of intelligent systems that function on the principle of fully automated processes for routine delivery of services and functions which in this case prevent losses or thefts. Over time the machine learning will allow greater understanding of individual user needs and support more local control by users of all aspects of the loss and theft prevention service provided. Market verticals include healthcare delivery in managed medical settings and homes, transportation navigation systems to aid bipedal movement within connected cities, and greater command of mobile devices and wireless-enabled appliances found in homes, smart transportation. Application for loss and theft prevention exists in industrial, transportation, food processing, education, health care, and retail settings.

5 CONCLUSION

Loss and theft prevention applications are needed to reduce the cost of replacing and securing data, devices, and items of value. The proposed project does not treat the IoT as a threat but as an opportunity to leverage communications for the purpose of loss and theft prevention. This approach is disruptive to existing applications on the market and will present significant opportunities in demand-side settings where timing and delivery of goods and services can be done without excess inventorying of supplies or personnel.

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