APPLICATIONS OF RFID TECHNOLOGY

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Introduction

RFID technology has been around for quite a long time, however, due to issues like cost has not achieved mass-market appeal. This paper examines the differences and advantages of RFID technology over other forms of identification, and how these differences make RFID the best choice in particular applications.

Firstly we need to examine the key features of RFID compared to some of the other forms of identification, notably human readable text, and machine-readable markings (e.g. barcodes.)

RFID Key features

- Not line of sight
  RFID tags do need to be visible to be read / written.

- Robust
  Because they don't need to be visible, they can be encased within rugged materials protecting them from the environment they are being used in. This means they can be used in harsh fluid and chemical environments and rough handling situations.

- Read speed
  Tags can be read from significant distances (especially the active variety) and can also be read very quickly. This is especially useful when the items needing to be identified are moving quickly for example on a conveyor.

- Reading multiple items
  A number of tagged items can be read at the same time within a RF field. This cannot be done as easily with "visual" identifiers.

- Security
  Because tags can be enclosed, they are much more difficult to tamper with. A number of tag types now also come programmed with a unique identifier (Serial Identification) which is guaranteed to be unique throughout the world.

- Programmability

   Many tags are read / write capable, rather than read only. This means that information can be written to the tag, perhaps to show that the item being tagged has gone through a particular process, or that it's condition or status has changed somehow. Or in some instances to store information about the tagged items e.g. the results of a test that it has undergone.

In most applications in which tags are used, it is a combination of the above technical features (as well as the price) that justifies their use. The applications described range from the obvious to some very unusual ones. In this paper an attempt has been made to keep these examples diverse, although space limits constrain the number we can discuss. Hopefully the variety will generate ideas and show how RFID technology can be used to gain specific operational benefits.

Applications within the Supply chain, (warehousing and logistics)

Historically products have been moved on Pallets, but over the last decade, the trend has been to use roll cages (especially in the retail sector), and is now moving to using plastic crates.

There are a number of issues with attaching RFID tags to roll cages. Roll cages are made from metal, which effects the RF field. This is a problem for a single roll cage, put is compounded because roll cages can also be stacked, in a similar way to supermarket shopping trolleys. Once these issues have been solved, and a tag attached, it can be used for a number of applications.

Information about the contents loaded onto the roll cage can be written onto the tag, e.g. quantity, weight, serial number, date / time etc. This allows the information to be easily checked after transit, without having access to an on-line database. This can be very useful to check if items have gone "missing" during transit.

At a warehouse, there is usually a large number of loading bays, where vehicles are loaded for particular delivery routes. Unfortunately, a common mistake is that a roll cage can easily be moved onto the incorrect loading bay and therefore the wrong vehicle. By the time the error is discovered, it is usually too late to easily rectify especially in the case of fresh produce, which has a sell by date.

By using the tag on the roll cage and RFID readers on each of the loading bays, it is possible to identify roll cages, as they are loaded onto the vehicle. By using a buzzer or light, a warning can be given to the operator to indicate that the cage is being loaded incorrectly. At each of the delivery points that the vehicle stops at, another reader can be used to identify the cages that are supposed to be unloaded at that point. The advantage of using RFID tags in this way is that the reading and verification is done completely automatically, therefore the operator only has to worry about loading the vehicle, and does not need to use any equipment, leaving his hands free.

Roll cages themselves are expensive assets. By using the loading bay readers, you can also determine where roll cages have been delivered. This allows you to keep track of the roll cages, and know where they are "bottle necking". I.e. roll cages are used to deliver goods, however, since no goods come back, roll cages are either returned empty or left at the delivery point. During busy periods, e.g. Christmas, it's important to know where roll cages are so that they can be put back into the supply chain.

Roll cages also need to be maintained. In the past it has been very difficult to identify a roll cage, because they go through such rough handling labels and other visible identification becomes damaged quite quickly. By using the RFID tag serial number, you can uniquely identify the tag and therefore maintain a service history, as well as making sure the cage is serviced on a regular basis.

The above scenarios show that a single RFID tag can be used for numerous applications. This is important to understand because the cost justification becomes much more powerful, since for the price of a single tag, you can solve numerous problems.

The same principles can be applied to crates as well as roll cages, with the slight complication that crates can be loaded onto a vehicle in stacks of four. So if one is being loaded incorrectly, then it is not necessarily obvious to the user which one in the stack is incorrect.

Tracking of Fork Lift Trucks

By attaching a reader to a forklift truck, and employing tags in the floor, the truck can know the general area that it's in. If greater accuracy is required, this is achieved by simply putting more tags within the floor.

This leads to numerous benefits, for example, the truck can provide information about it's location to a warehouse management system (using a radio data terminal), which can the allocate work to the nearest truck. The truck route can also be monitored to make sure that the truck is taking the optimum route between two points. One customer also wants to use the location tags to monitor the speed of trucks, this relates to a health and safety issue with some truck drivers driving too quickly around the warehouse. Again, these are all examples of multiple applications using the same tag, therefore improving the cost justification.

Retail Applications

Every year thousands of shopping trolleys go missing from supermarkets. They usually end up in rivers, canals or peoples back gardens. Supermarkets are now even being charged by local councils for clearing them out of local waterways.

Similar problems apply to trolleys, as to roll cages. They are metal, and can also be stacked, and suffer from rough handling (see how people push a trolley into the Trolley Park, when they have finished there shopping and unloaded it.) Also given the nature of supermarkets (very open plan) it's very easy for shoplifters to load goods into a trolley and exit the supermarket without going through a payment till.

By tagging the trolleys and employing readers strategically throughout the store and in the car park, you can make sure a trolley entering the store can only exit after going through a payment point. Likewise, by placing readers on the exits to the car park, you can stop trolleys being taken off the premises.

Having knowledge of where trolleys are, and also to record maintenance history can provide asset-tracking benefits. By deploying readers throughout the aisles and then linking the trolley to a loyalty card, specific customers buying / walking patterns can be tracked around the store. By linking readers in the aisles to displays, customer specific marketing can be advertised as the trolley approaches and is read by the reader.

Once again, by having the reader infrastructure in place, other applications are then possible. One additional example is child security. Many supermarkets now also have Crèches in store, and are actively trying to be child friendly. By giving each child a tag in the form of a colorful badge or wrist strap, the child can be tracked around the store, and alarms sounded if the child exits the store.

Handmade chocolates

During the manufacture of these particular chocolates, they are moved around the factory, through different processes, on plastic trays. The problem is that the trays are not uniquely identified. Trays need to be washed regularly, and also need to be used within a few days of being used, otherwise risk contamination. Labels cannot be used on the trays, since they would have to survive the wash processes, and also must not carry contaminants around the factory. By using a tag embedded within the tray, during its manufacture, you can identify the tray without the problems associated with a label.

This allows the trays to be automatically tracked around the factory without human intervention by using unobtrusive readers located throughout. The tag can also hold information about when it was last washed, therefore only the "freshest" trays can be used in the chocolate manufacturing process. Any trays that have not been washed within a particular time period can also be identified easily. If contamination does occur, by using an audit trail of which tray was at what location over a given time period, the source of the contamination can be quickly identified.

Because visibility of work in progress is now improved, the need for stock checks is eliminated, avoiding costly man-time / over time and factory shutdown periods.

Spare parts for Surgery

When hip surgery is carried out, it involves a number of different parts, all of which are specifically tailored and designed for a particular operation. The parts are supplied in the form of a kit, and must only be used together. Because the parts have to go through a number of manufacturing and sterilizing processes, a label is not suitable. By employing a tag embedded in the part, it can be tracked through various processes, and then all the parts for the kit can be reconciled before being delivered to the hospital. The tag can remain in the part after it is fitted to the patient, so that if it fails at a later date, it can easily be identified.

Sports goods

Like a number of "high value label" manufacturers, sports goods suppliers are suffering from "Grey imports" from the far east taking significant market share. To alleviate this, embedded RFID tags can be used to uniquely identify the products. Also batch codes, manufacturing dates, and shipping details from the point of manufacture can also be stored in the tag.

When the goods arrive in the country of sale, they can be easily checked without having to remove the packaging, and then sample audits can take place at retail points to check that genuine articles are being sold, and also the route taken to reach the shop. Also if these items are returned, warranty and batch checks can be carried out. Sample store checks can also be used to make sure country specific pricing is employed, and that retailers do not buy goods cheaply in another country and sell where they are not supposed to. Rip off Britain?

Document Tracking

Often the original copies of legal or confidential documents need to be controlled. By employing a smart label tag, and a tag on the actual person, in the form of a card, readers around a building can track documents and reconcile them to the person in possession of them. In addition to this, the documents and the "owner" whereabouts can be monitored at all times. This also can be used as a security feature to ensure that only authorized personnel have access to specific documents.

Conclusion

This paper has illustrated that RF tags have a potentially vast scope of applications. The main barrier to implementation historically has been cost justification for a particular application. It is hoped that the broad functionality illustrated will allow implementers to use an RFID tag for numerous applications thereby increasing the benefits and improving the return on investment. This, together with continued advancements in RFID technology will enable it to become more acceptable to a wider user base.