A Smart usage of Active RF Id Technology for Metro Transportation

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Abstract:

Metro is the transportation medium where people are travelling faster on compared to other medium, though it matches our daily life accordingly, we even face a problem regarding purchase of tickets before entering the metro and the ticket for sure to be stamped is also a constraint to travel in metro train. For the convenience of customers, there are three choices for ticket purchase. The RFID tokens are valid only for a single journey on the day of purchase and the value depends on the distance travelled. Fares are calculated based on the origin and destination stations using a fare chart. Travel cards are available for longer durations and are most convenient for frequent commuters. A deposit is to be made to buy a new card which is refundable on the return of the card any time before its expiry if the card is not physically damaged. Tourist cards can be used for unlimited travel on the over short periods of time. There are two kinds of tourist cards valid for one and three days respectively.

1 Introduction:

The Smart cards can also be recharged through the internet using net banking, debit and credit cards. After completing the top up process, the commuters will have to physically validate their recharge by using the Ticket Reader Cum Add Value Machine. In all these methods we need to swipe the card and then enter the metro, when we are in urge, the time taken to swipe a card also matters a lot, which may lead to miss the train or cause some accidents. So we got a solution to overcome these factors, people who enters the metro are provided with the card (RF id) with their face as identity as done in the first method. The passenger utilizes the card for his travelling but he has no headache of swiping or tracing the card for his entry/exit. The card will be automatically scanned by the scanners in the metro cabin where it updates the database of the user (card id) once the metro departs from the station. As long the user travels it will be automatically accounted to the user's database. The updating algorithm even cross-references the database for every departure for previous entries if it matches then updates the database for the passenger else marks that he already departed in the previous station. At last while leaving the station submit the card pay the bill

by cash/credit card/debit card. For frequent users prepaid card can also be made available. This paper gives a solution to problems faced on purchasing tickets for travelling in metro, in an easier and faster way which coordinates our fast moving time. The passenger of a metro train can be tension free, so as to buy tickets and

then get it stamped and swipe it, which is time consuming, when a person is in urge. So this project makes it easy, all we have to do here is just purchase a RFID card with face as recognition agent in it. This card will be automatically be scanned by scanners in the metro cabins, update the database with all necessary information.

2 Technology involved:
The following are the requirements.

1. Cards with RF Id (unique).
2. Card scanner
3. Security protocol.
4. Database with Updating algorithm.
5. Implementation of RFID.

2.1 Cards with Radio Frequency ID [1]

Radio frequency identification (RFID) is a rapidly growing technology that has the potential to make great economic impacts on many industries. While RFID is a relatively old technology, more recent advancements in chip manufacturing technology are making RFID practical for new applications and settings, particularly consumer item level tagging. These advancements have the potential to revolutionize supply-chain management, inventory control, and logistics.

As of the Fig 2.1. At its most basic, RFID systems consist of small transponders, or *tags*, attached to physical objects. RFID tags may soon become the most pervasive microchip in history. When wirelessly interrogated by RFID transceivers, or *readers*, tags respond with some identifying information that may be associated with arbitrary data records. Thus, RFID systems are one type of automatic identification system, similar to optical bar codes.

There are many kinds of RFID systems used in different applications and settings. These systems have different power sources, operating frequencies, and functionalities. The properties and regulatory restrictions of a particular RFID system will determine its manufacturing costs, physical specifications, and performance. Some of the most familiar RFID applications are item-level tagging with *electronic product codes*, proximity cards for physical access control, and contact-less payment systems. Many more applications will become economical in the coming years.

Early commercial examples of RFID applications include automatic tracking of train cars, shipping containers, and automobiles. Railroad cars were originally labeled with optical bar code labels for tracking. These labels began to deteriorate and be obscured by dirt, causing reads to fail.

As a solution, railroad companies began to tag railcars with RFID devices. By 1994, these devices were mandatory and nearly every railcar in the United States was tagged.
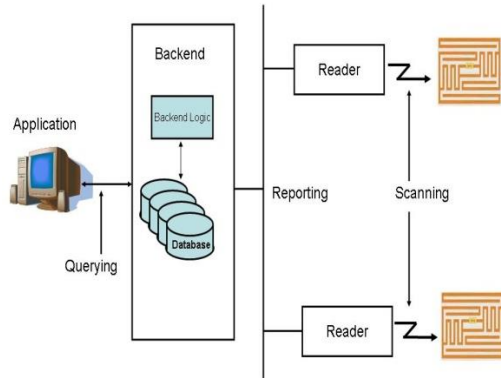

Fig 2.1 A Simplified Radio Frequency ID system used in the smart card

There are two types of RFID [1] [2]:

1. **Passive RFID**

Is where the RFID tag's power is derived from the Reader's electromagnetic or inductive field. The RFID tag has no battery and is typically low-cost, robust and can last "forever". The tag stores energy from the Reader's electromagnetic/inductive field and passes information back to the Reader by modulating the Reader's own radiated energy.

Three frequency groups are commonly used: LF (Low Frequency), HF (High Frequency) and UHF (Ultra High Frequency) (LF = 125/134 KHz, HF = 13.56MHz, UHF 850-950MHz). LF and HF systems typically use magnetic or inductive energy so the operating range is low and usually less than 1 meter. UHF systems use radiated electromagnetic (RF) energy and reflected modulation similar to "Radar". UHF RFID systems can have ranges up to 10 meters. LF, HF and UHF passive tags are low-cost, simple devices. Short range LF and HF Readers (range 10cm) can be low-cost also. Longer range UHF Readers (up to 10m) are more complex systems and are relatively expensive.

2. **Active RFID**

Is where the RFID tag has its own power source (typically a small battery). The tag is actually a transceiver and responds to received commands from the Reader and "actively" transmits data back. Active tags can use any ISM or licensed frequency band, the most common being 850-950MHz and 2.4GHz. The range is dependent on both the tag and Reader transmitter power and receiver sensitivity. Active tags typically spend long periods "asleep" to prolong battery life. Range can be 10's of meters to several kilometers.

Active tags can be relatively large and have a finite life (batteries need to be changed) and are significantly more expensive than passive tags. Active Tag Readers use a similar level of technology to the tags and can be relatively inexpensive. Some tags can use "passive" circuitry to "wake up" and

then "actively" transmit data, this technique offers longer battery life.

We use passive RFID here:

Table 2.1 Comparison of the different frequencies with their properties [3].

Frequency	LF 125 ~ 135 kHz	HF 13.56 MHz	UHF 850 ~ 960 MHz
Read Range	0.5 ~ 2 m	< 1m	> 3m
Cost	Relatively expensive	Less expensive	Least expensive
Penetration of materials	Excellent		Poor
Affected by water?	No	To some extent	Yes
Power source	Passive (Inductive)	Passive (Inductive)	Passive (Propagation)
Data Rate	Slower		Faster
Reading Multiple tags	Poor	Good	Very Good
Applications	Car immobilisers, Animal identification, POS	"Pharma", Libraries Baggage tracking, Tickets Payments, Passports	Pallet/ Case tracking, Tolls Baggage tracking

As per the Table 2.1, we can compare the different frequencies according to their properties. So for our project we use UHF which has a range of about >3m i.e. it can track up to 10m. For UHF (850-960MHz) passive RFID systems, the reading range is dependent of the Readers transmitting power and receiver sensitivity and the physical environment. Low-frequencies penetrate materials and liquids better. Higher frequencies (particularly UHF) can be absorbed and blocked by liquids and reflected by hard materials.

2.2 Card Scanners

RFID readers (scanners) should be available both in the metro cabin as well as station, so that two tasks are done:

1. Scanners in the metro cabin- Scans for obtaining the passenger details including his boarding and departure time.
2. Scanners in the station- scan the card and obtain the updated database for payment process.

Features of the required scanner are as follows:

1. **High-performance RFID reader**: PXA270 at 624 MHz processor, 128Mb memory ideal for high volume, high density, high throughput applications, RF-challenging environments and on RF-challenging materials such as those with a high metal of liquid content; can accommodate growing needs to future-proof your investment.

2. **Rugged design**: IP53 sealing, die cast housing; maximizes uptime even in the toughest warehouse or production environments.

3. **Application flexibility and lower deployment costs**: 4-port and 8-port reader configurations; provides greater application flexibility and lets you cover more portals with fewer readers.

4. **Small footprint**: All cabling and input/output ports are on one side, resulting in a compact size that simplifies and reduces the cost of deployment and management.

Below is the Fig 2.2 , which is one of the example for the best available RF Id scanner.

Fig 2.2 RFID Scanner

2.4 Database with updating algorithm

1. The database will contain the person's details such as: Name, Place, Date of Birth, RFID number, Departure station, Alightment station, Time taken, Cost per each station and finally the total cost.
2. Updating algorithm will be of faster and efficient one with less ambiguity.
3. Updating should take place automatically.
4. Updating of a particular set will be as fast as the scanner scans the cards.
5. It is more secure, with no interaction provided to the unauthorized persons.

2.3 Security protocol

Face scanners are mandatory because, we cannot trust that whether or not the card belongs to the same person. So we introduce a face scanner at the payment center in order to verify the person possess his own card.

A facial recognition *device* is one that views an image or video of a person and compares it to one that is in the database. It does this by comparing structure, shape and proportions of the face; distance between the eyes, nose, mouth and jaw; upper outlines of the eye sockets; the sides of the mouth; location of the nose and eyes; and the area surrounding the check bones. Upon enrolment in a facial recognition program, several pictures are taken of the subject at different angles and with different facial expressions. At time of verification and identification the subject stands in front of the camera for a few seconds, and then the image is compared to those that have been previously recorded. To prevent a subject from using a picture or mask when being scanned in a facial recognition program, some security measures have been put into place. When the user is being scanned, they may be asked to *blink, smile or nod their head*. Another security feature would be the use of facial *thermograph* to record the heat in the face.

The main facial recognition methods are: feature analysis, neural network, and Eigen faces, automatic face processing. [5][6]

Some facial recognition software algorithms identify faces by extracting features from an image of a subject's face. Other *algorithms* normalize a gallery of face images and then compress the face data, only saving the data in the image that can be used for facial recognition.

A probe image is then compared with the face data. A fairly new method on the market is three-dimensional facial recognition. This method uses 3-D sensors to capture information about the shape of a face. This information is then used to identify distinctive features on the face, such as the contour of eye sockets, nose and chin. The advantages of 3-D facial recognition are that it is not affected by changes in lighting, and it can identify a face from a variety of angles, including profile view. The same can be seen as in the example Fig 2.3 (a).

Another new technique in facial recognition uses the visual details of the skin, as captured in standard digital or scanned images. This technique is called skin texture analysis, turns the unique lines, patterns, and spots apparent in a person's skin into a mathematical space. Preliminary tests have shown that using skin texture analysis in facial recognition can increase performance in identification by 20 to 25 percent. The benefits of facial recognition are that it is not intrusive, can be done from a distance even without the user being aware they are being scanned. (i.e.: bank or government office)[4]. What sets apart facial recognition from other biometric techniques is that it can be used for surveillance purposes; as in searching for wanted criminals, suspected terrorists, and missing children. Facial recognition can be done from far away so with no contact with the subject so they are unaware they are being scanned.

Facial recognition is most beneficial to use for facial authentication than for identification purposes, as it is too easy for someone to alter their face, features with a disguise or mask, etc. A typical example of the facial recognition can be seen in Fig 2.3(b) Environment is also a consideration as well as subject motion and focus on the camera. Hence it will be better if we use a 3D-scanner, in order to come over the problems faced through forgery. We can also use skin texture analysis in some serious situations too.
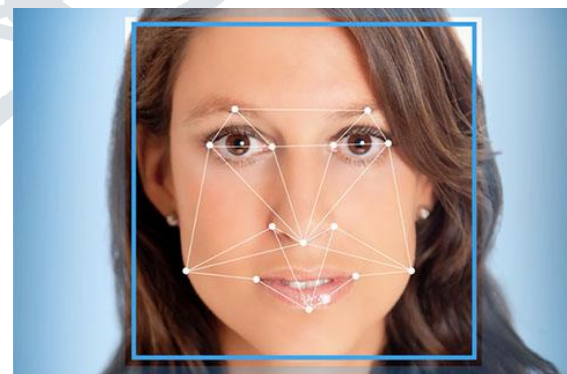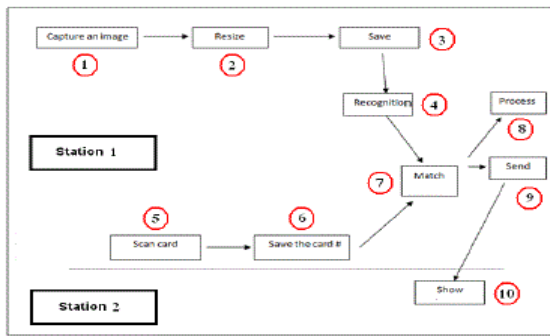

Fig 2.3(a) Image being scanned [5]

Fig 2.3[7] (b) Face recognition system station1 and station2

5.   [EZ-Pass] Electronic toll collection for toll roads and bridges: http://www.e-zpassiag.com
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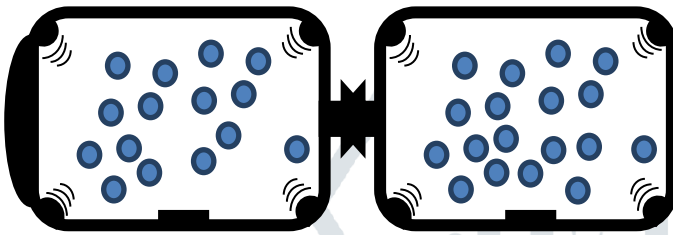
How to Implement:

Fig 2.3(c) Dramatical representation of the Metro where the implementation is carried out and how the process takes place.

2.4 Metro train with implementation of the RFID

1. The user enters the metro station and obtains his card by scanning his face.
2. The face image is resized.
3. Saved for the feature use.
4. The recognition process starts
5. The rfid no of card scanned.
6. And is saved for the feature use.
7. Now a match is found or not checked in the process step 8. With the datanupdated in the database for the recognition.
8. The user enters the cabin and the sensors are activated immediately after the metro starts departing.
9. Sensors placed at corners of the cabin scan all the rfid available in the cabin and updates it into the database using updating algorithm.
10. After the metro departs from the every station the scanners once again scans all the rfid's and cross-references the database. If found earlier then it marks as non-departed customer else departed customer. While leaving the station customer rfid will be scanned and his transaction is carried out by Credit/Debit card, net banking.

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