RFID

Overview

- What is RFID?
- How RFID Works
- Current Applications
- Future Applications
- Potential Research
- Discussion

What is RFID?

- Radio Frequency Identification
- The use of radio frequency tags to identify real objects.

What does it mean to identify something?

Identification

- Assign IDs to objects
- Link the ID to additional information about the object
- Link the ID to complementary info
- Find similar objects

Identification Examples

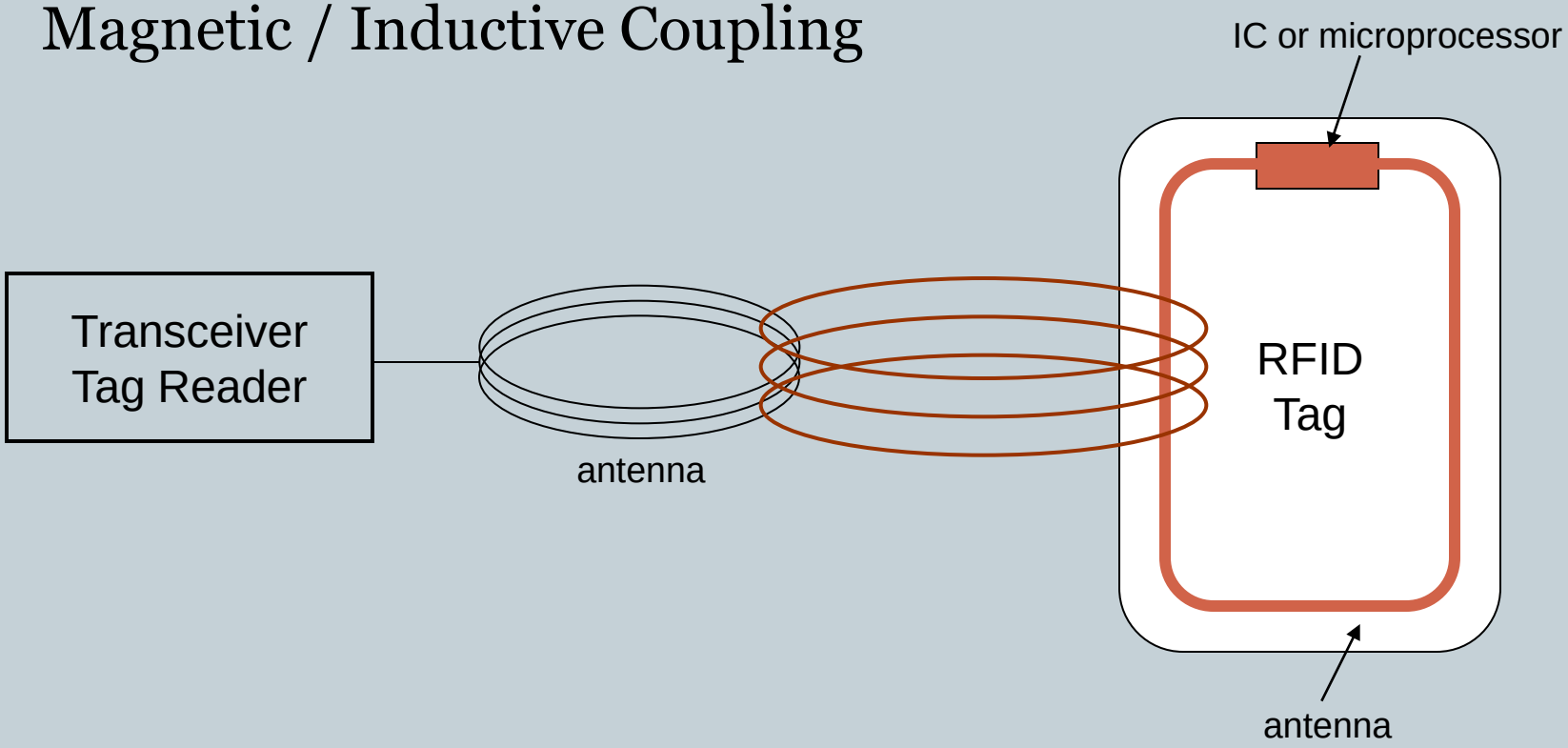
- Bar Codes
- License Plates
- Social Security Numbers
- Student ID
- Serial Numbers
- Car Keys
- Database Keys

How Does RFID Work?

- 3 Components
  - Transceiver – Tag Reader
  - Transponder – RFID tag
  - Antenna

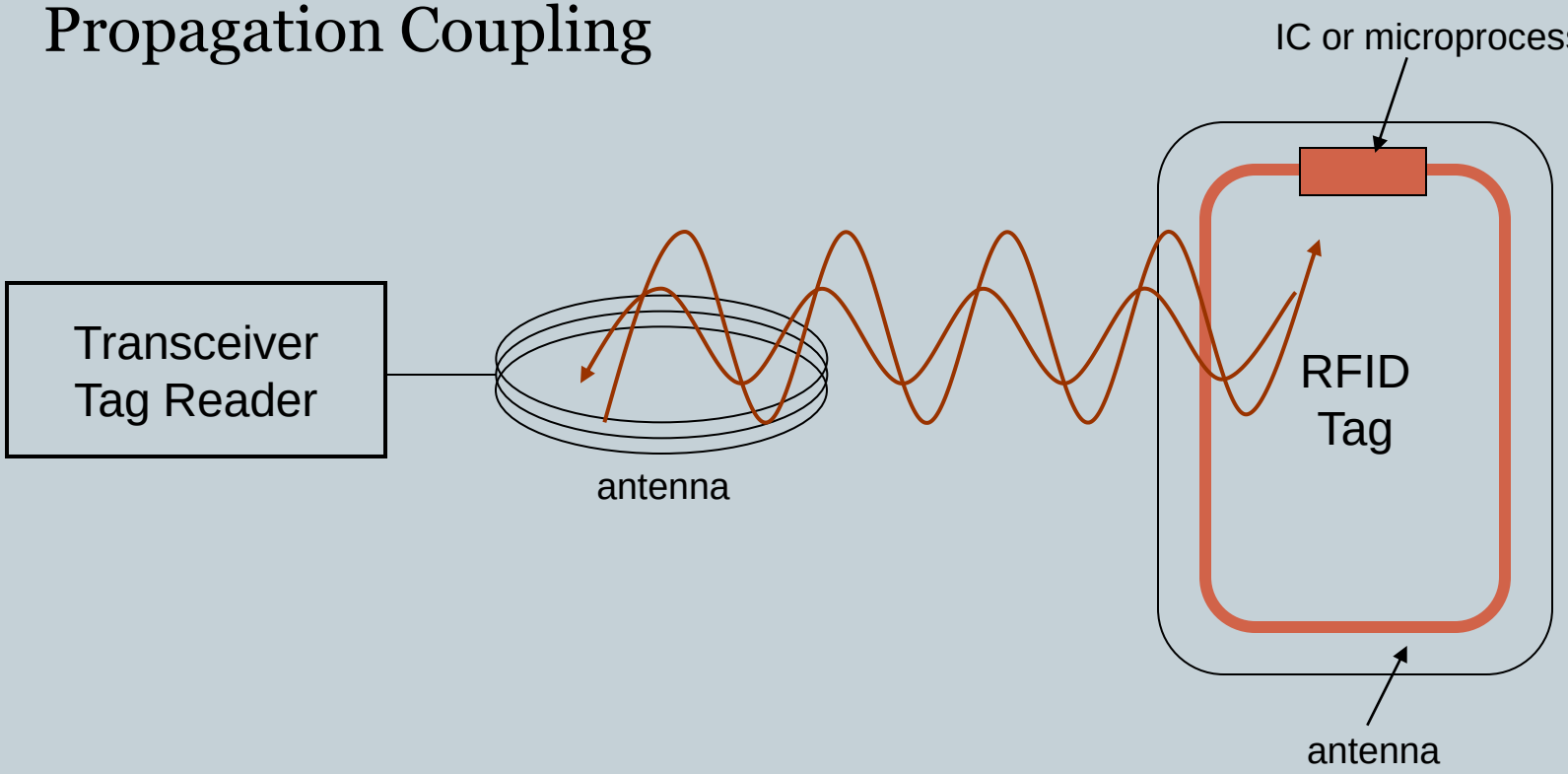
RFID Hardware

Magnetic / Inductive Coupling



RFID Hardware

Propagation Coupling



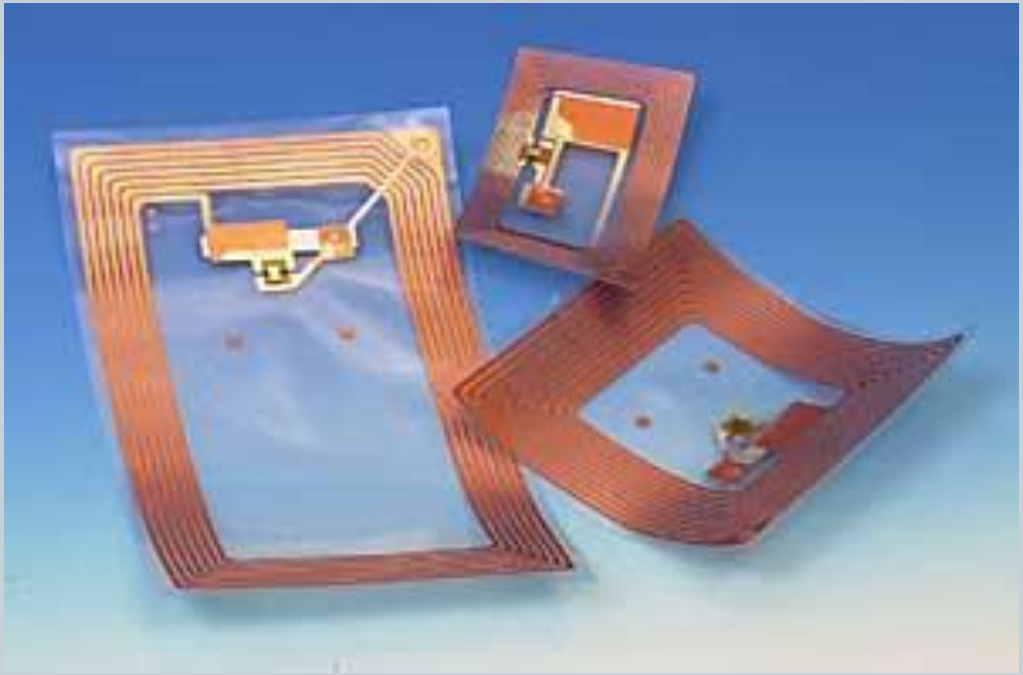
Types of Tags

- Passive Tags
  - No battery
  - Low cost
- Active Tags
  - On-board transceiver
  - Battery – must be replaced
  - Longer range
  - High cost

Types of Tags

- Read Only
  - factory programmed
  - usually chipless
- Read / Write
  - on-board memory
  - can save data
  - can change ID
  - higher cost

Real Tags



Real Tags

Real Tags

Multiple Tags?

- What happens when multiple tags are in range of the transceiver?
- All the tags will be excited at the same time.
- Makes it very difficult to distinguish between the tags.

Collision Avoidance

- Similar to network collision avoidance
- Probabilistic
  - Tags return at random times
- Deterministic
  - Reader searches for specific tags

Frequency Ranges

- Low – 100-500 kHz
  - short range, low data rate, cost, & power
- Intermediate – 10-16 MHz
  - medium range and data rate
- High – 850-950 MHz & 2.4-5.8GHz
  - large range, high cost, high data rate
  - needs line of sight

Frequency Ranges

- 8 total ranges around the world
- No standards … yet

Frequency Trade-Offs

- Power
- Cost
- Bandwidth
- Line of Sight

- Lifespan
- Range

Current Applications

- Livestock Tagging
- Wild Animal Tracking
- Electronic Article Surveillance (EAS)
- Automated Toll Collection
- Animal Husbandry
- Vehicle Anti-Theft

More Applications

- Passive / Secure Entry
- Airline Baggage Tracking
- Postal Package Tracking
- Time and Attendance

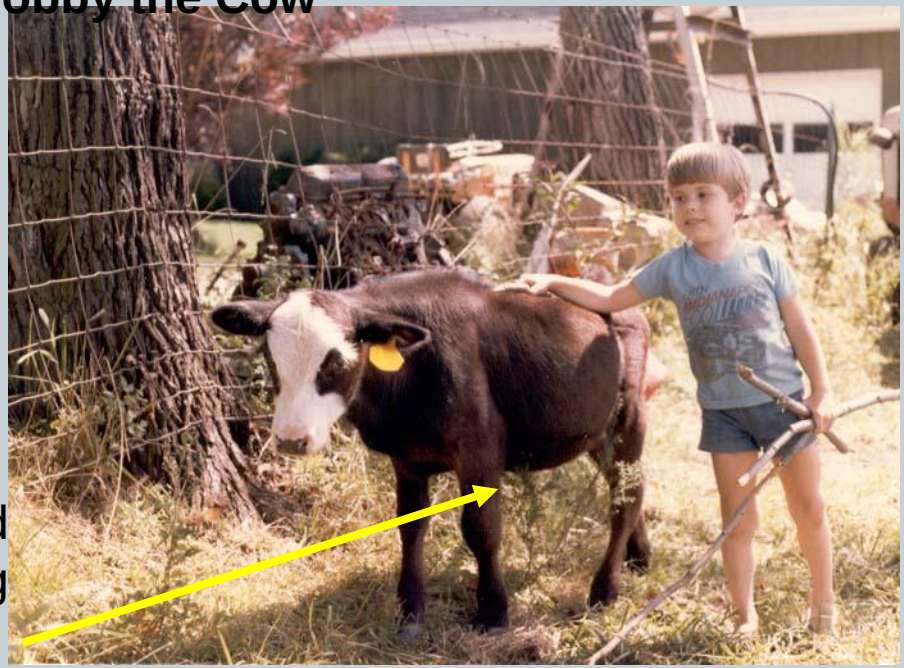
Who’s got an RFID tag with them right now?

Security

- RFID used to grant entry to secure areas
- Tracks time and movement of people
- Dynamically change access codes
- Provide automated entry

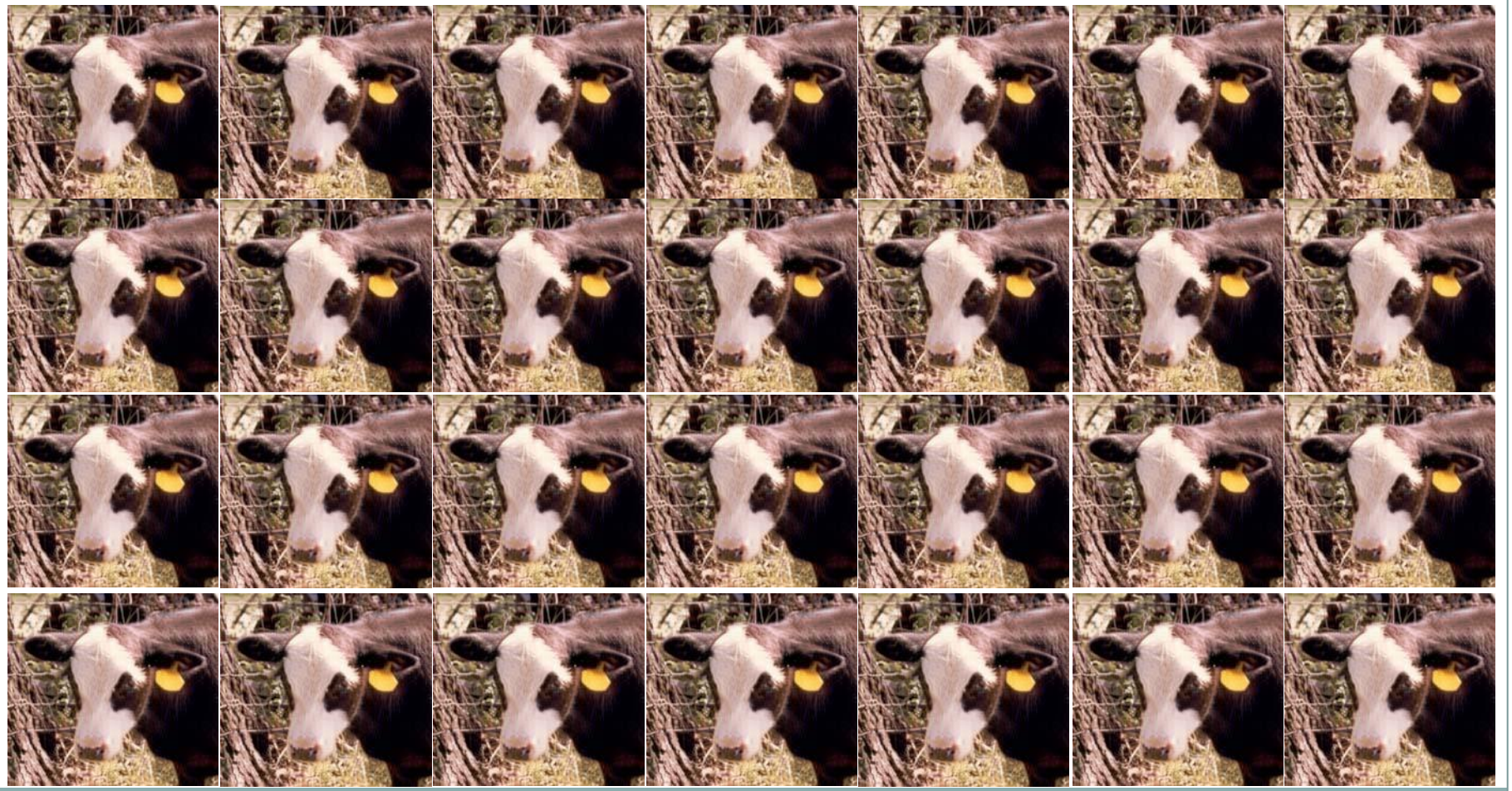
Livestock Tagging

Meet Bobby the Cow



Bobby has an old fashioned ear tag for identification.

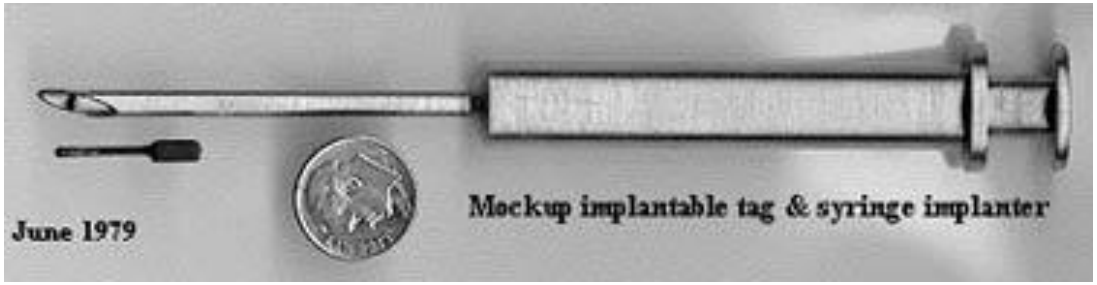
Bobby's Part of a Herd



Bobby Needs His Shots

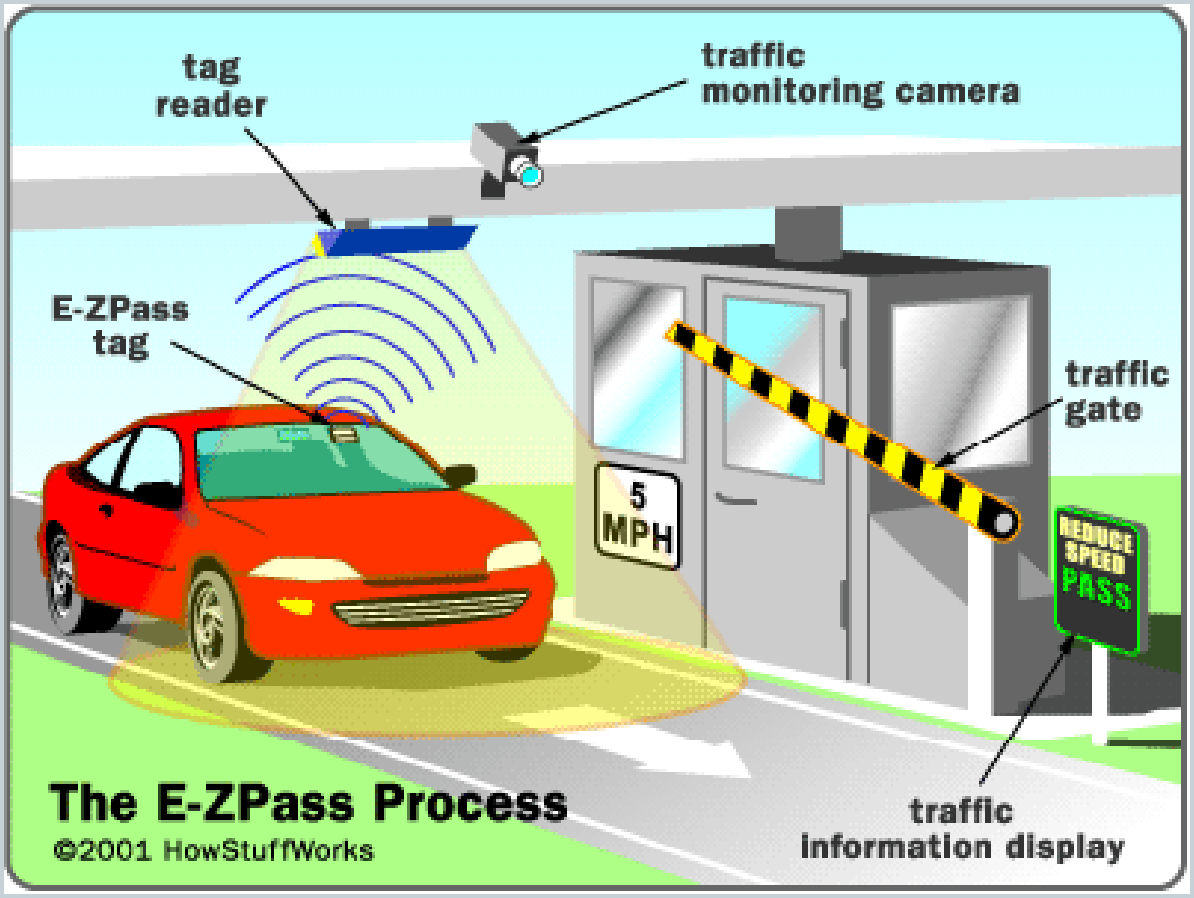
- All of Bobby's herd need their shots
- Each one needs to be recorded
- Why use RFID tags instead of the old-fashioned tags?
  - cows get dirty
  - herds can be large

Tracking Penguins

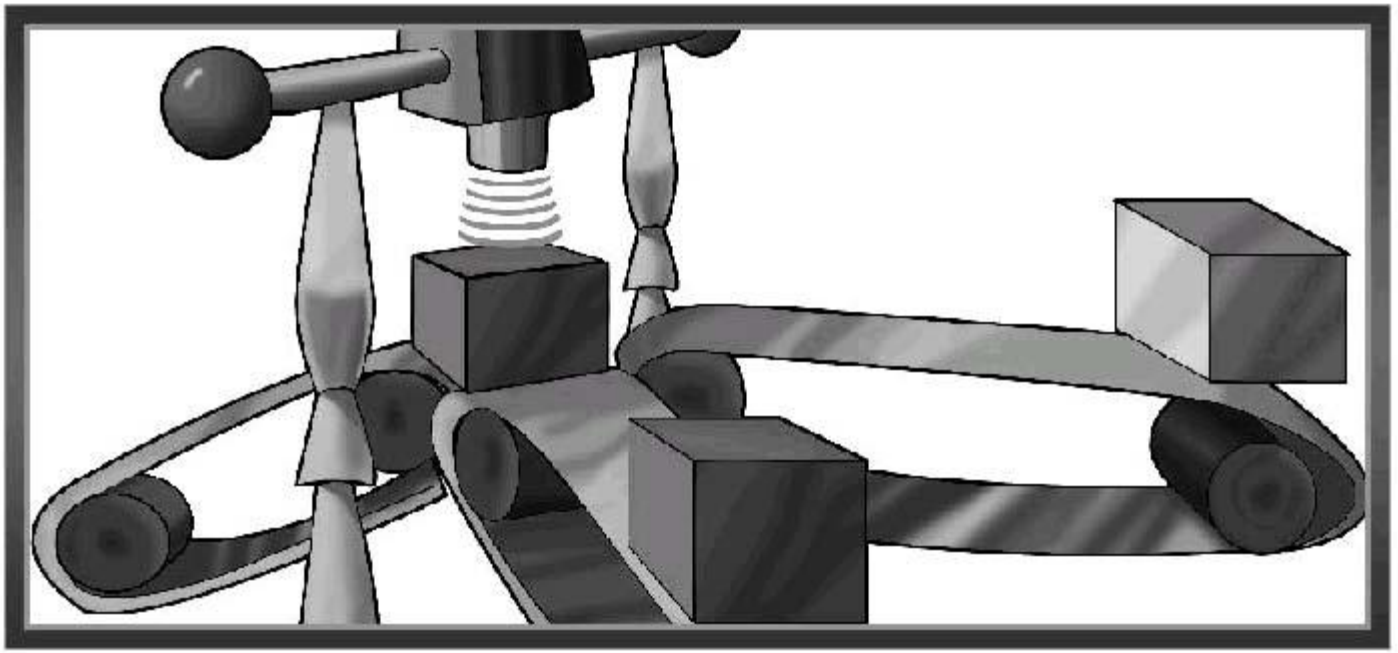


http://www.beitec.com/penguin.htm

Automated Toll Collection



Package Tracking



Picture courtesy Texas Instruments

Potential Applications

- Smart Grocery Store
- Smart Kitchen
- Smart Sitterson

Smart Grocery Store

- Every item in the store already has a bar code.
- Why not use an RFID tag?
- Speed up checkouts

Smart Grocery Store

- Several carts this full in early evening could seriously slow down the checkout process.
- How much do cashiers cost?

Smart Grocery Store

- Add an RFID tag to all items in the grocery.
- As the cart leaves the store, it passes through an RFID transceiver
- The cart is rung up in seconds.

RFID UPC

Artist conception courtesy Motorola

Smart Groceries Enhanced

- Track products through their entire lifetime.

Diagram courtesy How Stuff Works

Smart Fridge

- Recognizes what's been put in it
- Recognizes when things are removed
- Creates automatic shopping lists
- Notifies you when things are past their expiration

RFID Chef

- Uses RFID tags to recognize food in your kitchen
- Shows you the recipes that most closely match what is available
- RFID Chef Movie

Distributed Systems Group
ETH – Zurich, Switzerland

Smart Sitterson

- Tag locations throughout Sitterson
- User walks around with handheld and transceiver
- RFID tags point the handheld to a webpage with more information about their location or the object of interest

Other Future RFID Applications

- RFID in the Euro by 2005
  http://www.eetimes.com/story/OEG20011219S0016
- Xerox PARC Page Detection
  http://www2.parc.com/red/members/back/papers/UIST_RFID.pdf
- RFID in people?

RFID's Advantages

- Passive
  - wireless
- Store data on a tag
- Can be hidden
- Work in harsh environments
- Low cost?

RFID's Disadvantages

- Lack of standards!
- Short range
- Cost

Open Discussion

- What identification systems exist that could be enhanced with RFID?
- What new identification systems are only feasible using RFID?

References

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RFID

COW JEWELRY – OR – REVOLUTION

TRAVIS SPARKS

HTTP://WWW.CS.UNC.EDU/~SPARKST