The Biometric Consortium Conference
September 11th - 13th, 2007 Baltimore Convention Center, Baltimore, MD, U.S.A.

Walt Disney World's Biometric System providing "Usability Magic"

Diplomacy

Disclaimer

Disclosure

Usability of Biometric Systems

May 23, 2007

http://www.noblis.org/BiometricIdentificationClusterGroup.asp

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INSERT TICKET
HERE

Insert
Fingers
3
Enter
Pick-up Ticket
Insert
Fingers
2
2
Insert Ticket Here
1

What are our key operational issues?

"Auto-enrollment" - enrollment must occur like verification; no time for multiple presentations

Maximum device intuitiveness; no opportunity for training or instruction (potential language barriers)

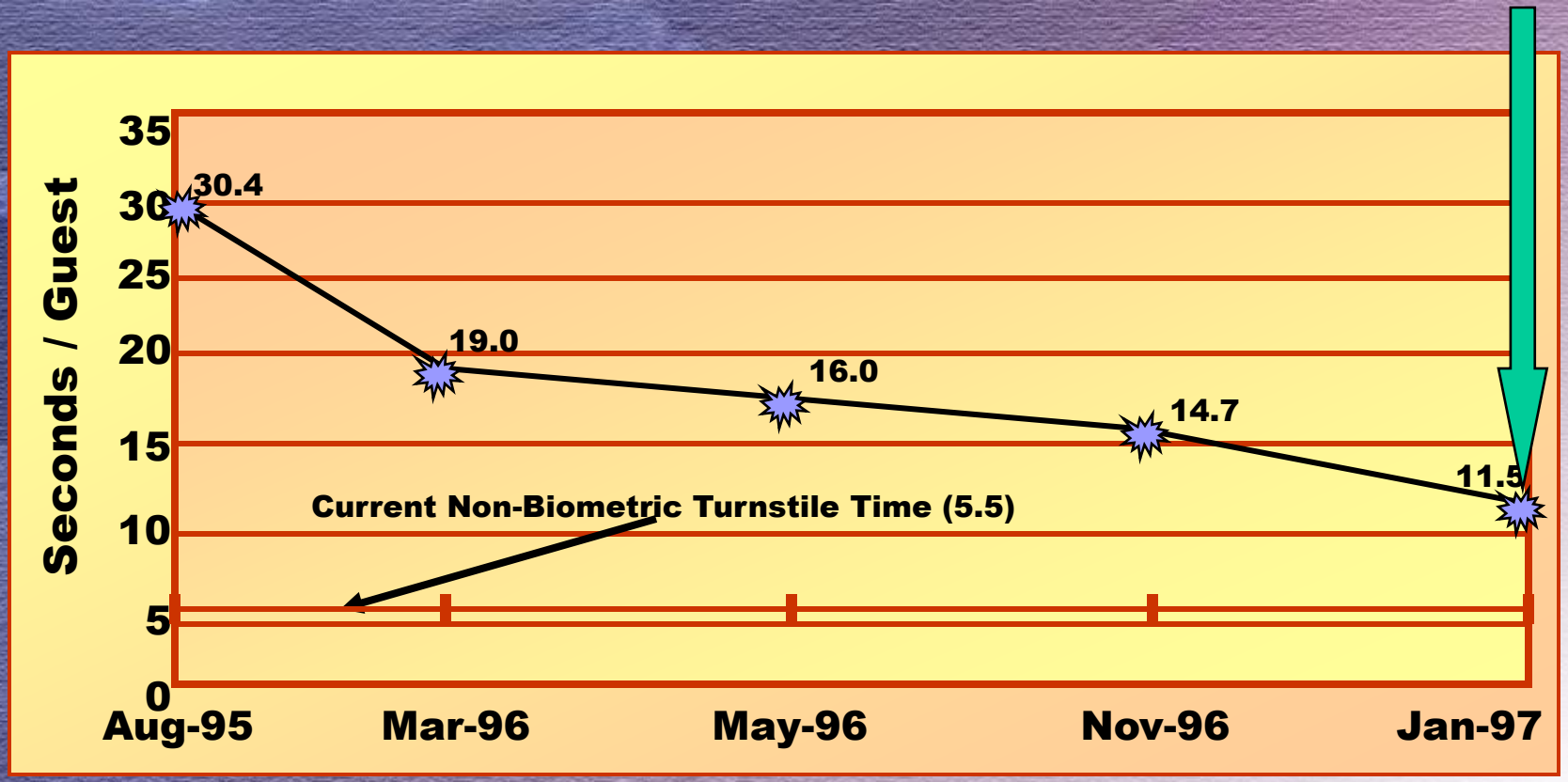
We define throughput as the average transaction time for all transactions from insertion of ticket to time of next insertion, including failures to acquire, repeat attempts, etc.

Device technology must be acceptable to the user population

We felt we had set "the bar" for ourselves internally...

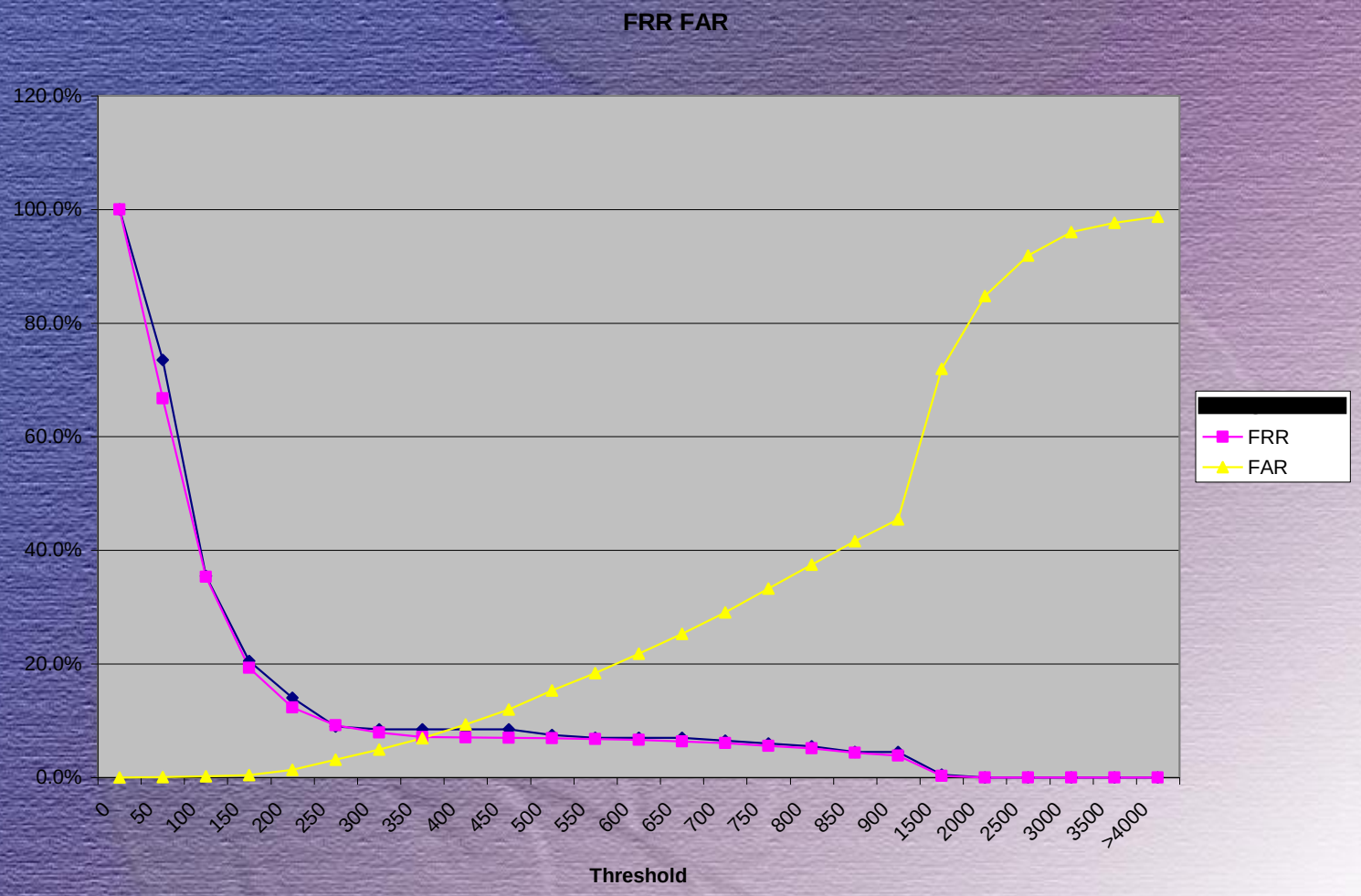
Throughput improvements:

Around 9.0 seconds is where we had hoped to get to…



Early Throughput Time History

WDW Hand Geometry System with trained Users: EER ≈ 9%



Testing in 2000

Our testing provided us with incomplete results due to a lack of comprehensive interface standards at the time;

However, we did find out what we needed to know…

We still thought that finger-scanning technology offered the fastest potential transaction possibilities

User throughput

System	Transaction Time (Seconds)			Time includes entry of PIN?
	Mean	Median	Minimum	
Face	15	14	10	Excluded
Fingerprint-Optical	9	8	2	Excluded
Fingerprint-Chip	19	15	9	Excluded
Hand	10	8	4	Included
Iris	12	10	4	Included
Vein	18	16	11	Included
Voice	12	11	10	Excluded

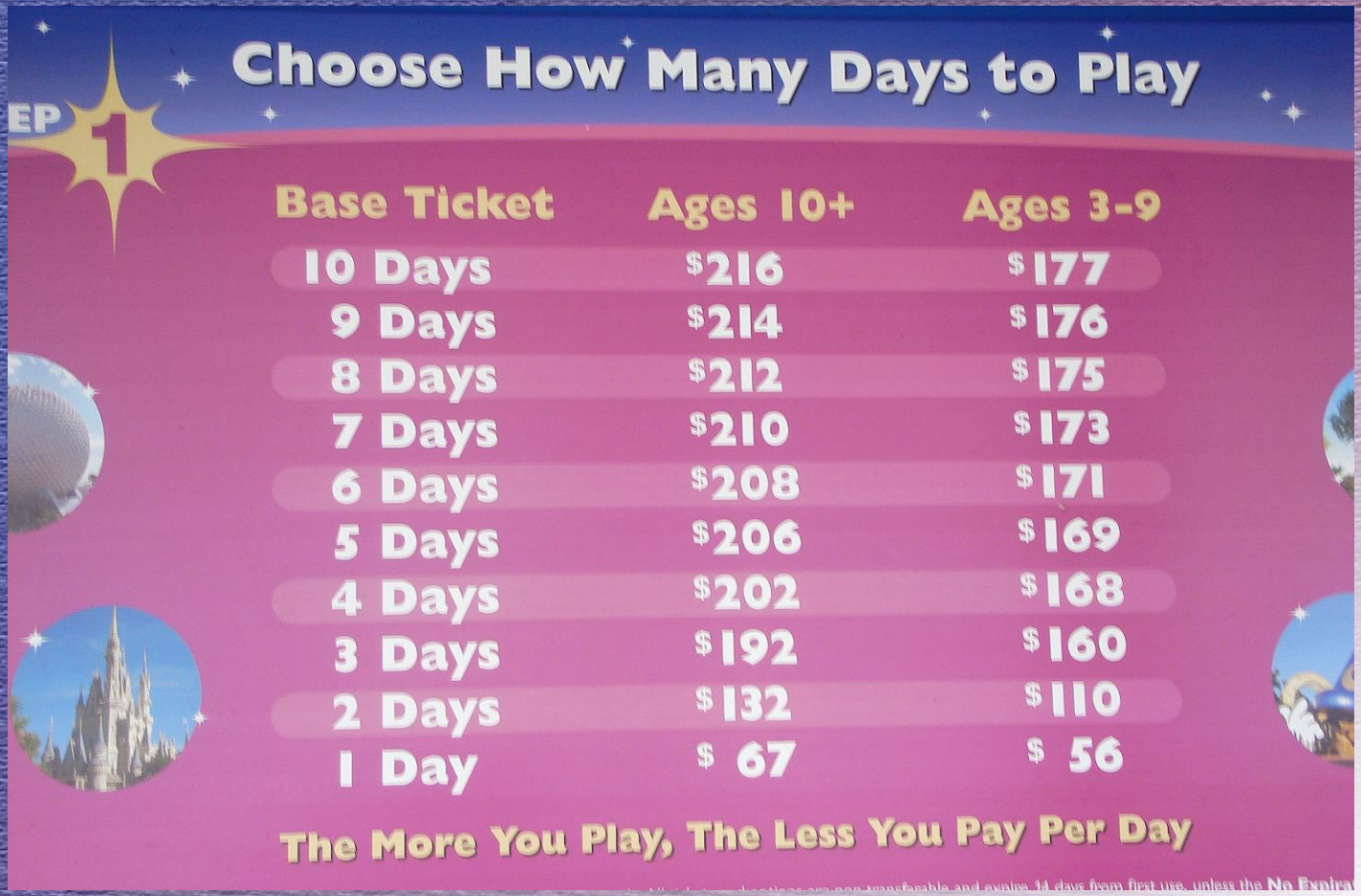
User transaction times

Ref: Tony Mansfield, Et Al., "Biometric Product Testing", Version 1.0 March 19, 2001, Center for Mathematics and Scientific Computing (CMSC) of the National Physical Laboratory, U.K.

And this publication confirmed our instincts…

What have we done?

"Magic Your Way!"



EP 1

Choose How Many Days to Play

Base Ticket	Ages 10+	Ages 3-9
10 Days	$216	$177
9 Days	$214	$176
8 Days	$212	$175
7 Days	$210	$173
6 Days	$208	$171
5 Days	$206	$169
4 Days	$202	$168
3 Days	$192	$160
2 Days	$132	$110
1 Day	$ 67	$ 56

The More You Play, The Less You Pay Per Day

“Magic Your Way!”

The environment is the same; however now….

We require biometric verification of ALL guests age 10 or older.

This population still includes elderly, foreigners, adolescents, disabled (and we still allow “opting-out”).

Our guests must still be able to present their biometric feature while wearing sunglasses, hats, suntan lotion, and jewelry. In addition, they are still carrying children, tote bags, food, strollers, etc.

Our guests are still often sweating, tired, anxious, and confused.

Comments on Doddington's Zoo:

…The animals in the zoo are mainly relevant to system performance in terms of accuracy. I propose that there are other animals that are relevant mainly to throughput:

Allow me to introduce the Biometric Circus McGurkus: (apologies to Dr. Seuss)

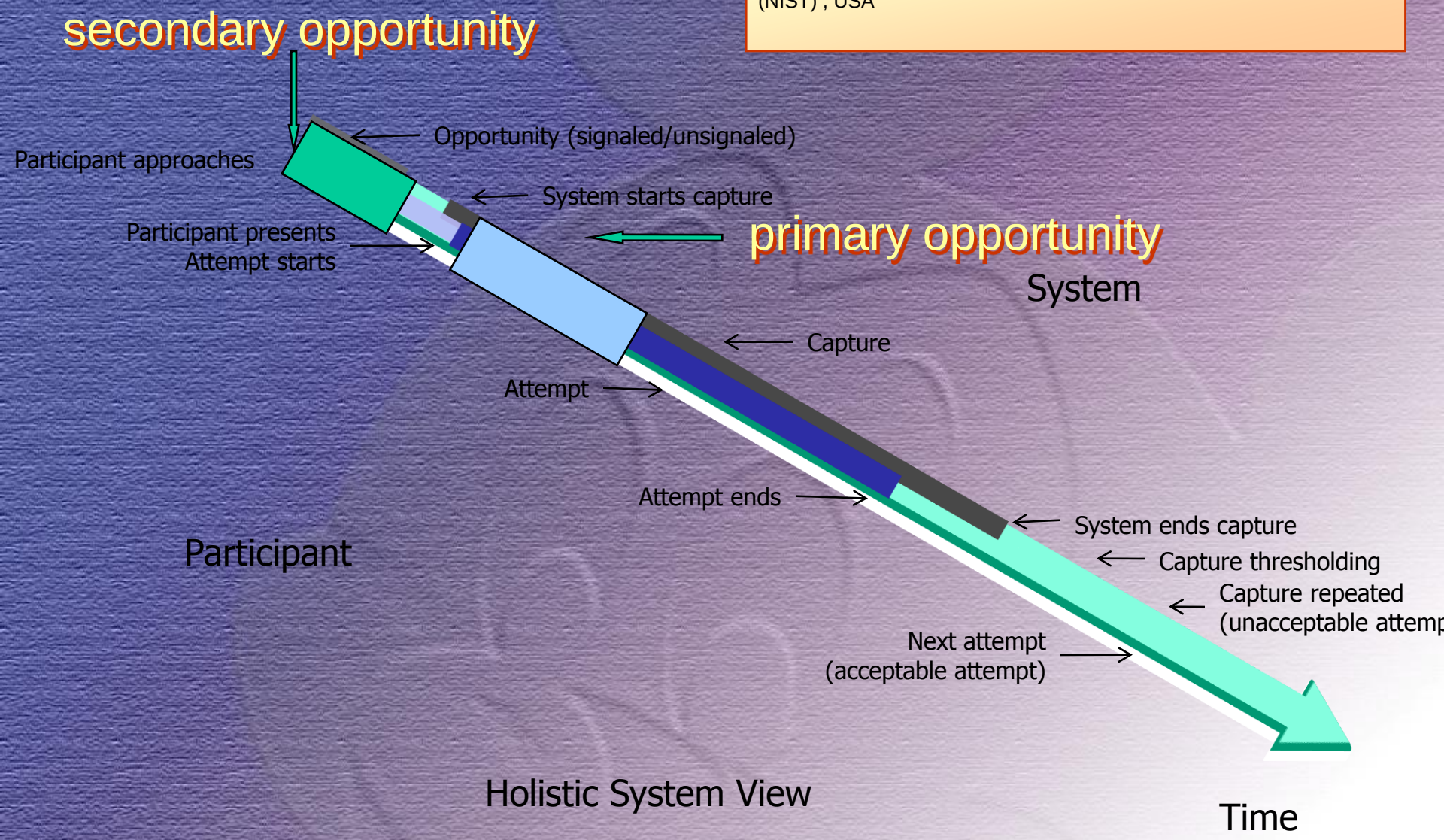
- **The Flummox – This is the animal that Darwin might eventually take care, but that hasn't happened yet, so you will have to deal with them. This is also known as the "throughput killer" or "95th percentile person"**

- **The Juggling Jot – This is the animal with their off-spring in a pouch, food and water reserves in some adapted appendage, and quite often showing signs of excitement and stress leading to repeated presentation attempts**

- **The Wink-hooded Hoodwink - This is the crafty, sneaky animal with the self-proclaimed, superior intellect that is going to test the system by switching fingers, simultaneously proclaiming innocence and ignorance**

The user as an interactive component

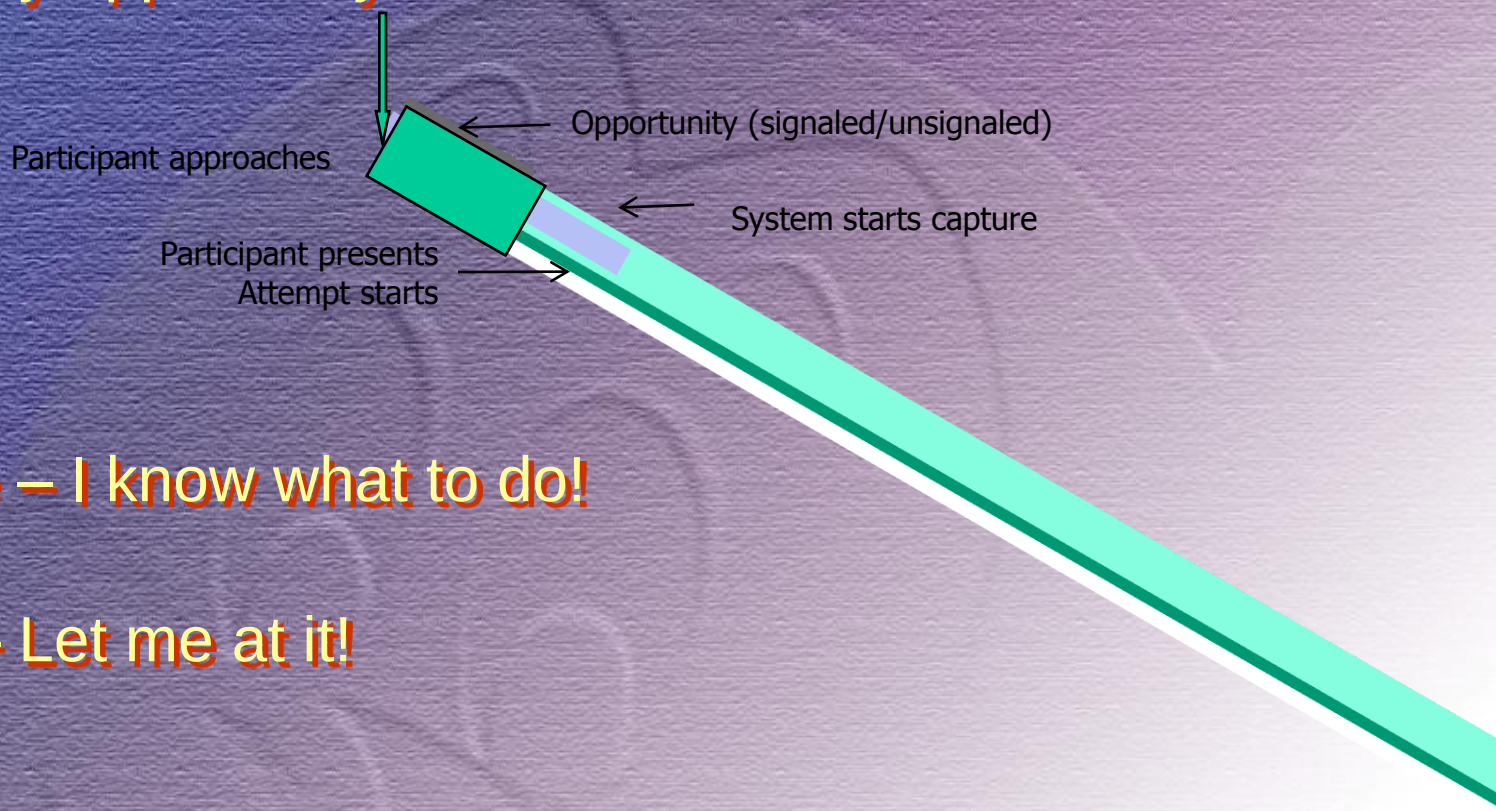
Ref: Mary Theofanos, “Usability of Biometric Systems”, May 23, 2007, National Institute of Standards and Technology (NIST) , USA



The user as an interactive component

Ref: Mary Theofanos, “Usability of Biometric Systems”, May 23, 2007, National Institute of Standards and Technology (NIST) , USA

secondary opportunity



Affordance – I know what to do!

Invitance – Let me at it!

So, we held the vendor responsible for all of the technical development of the sensor package itself, and we took ownership of the sensor enclosure and ergonomic interface elements:

- Enclosure mock-ups would be created for visual acceptability
- Ergonomic interface mock-ups would be created and tested to compare effectiveness
- Testing requirements would be established and milestones would be set in the schedule that allowed for “go/no-go” checkpoints

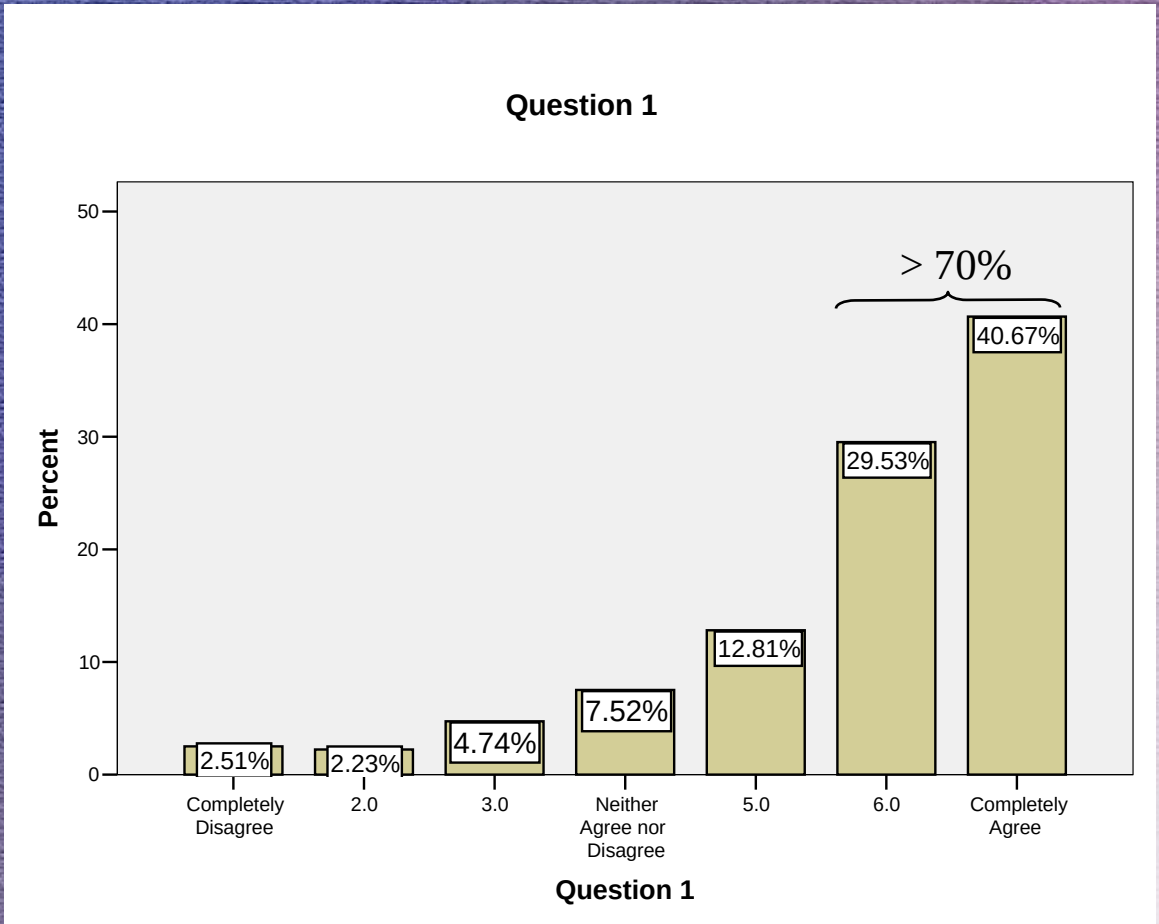
So, let’s take a look at some examples of the intensity of the efforts that were involved…

In May of 2005, the vendor delivered ten (10) alpha prototypes that were retrofitted into commercially available optical TIR scanners

We used these to conduct a Phase I - Technology test, as well as to study the human factors of what people would do when instructions were minimal

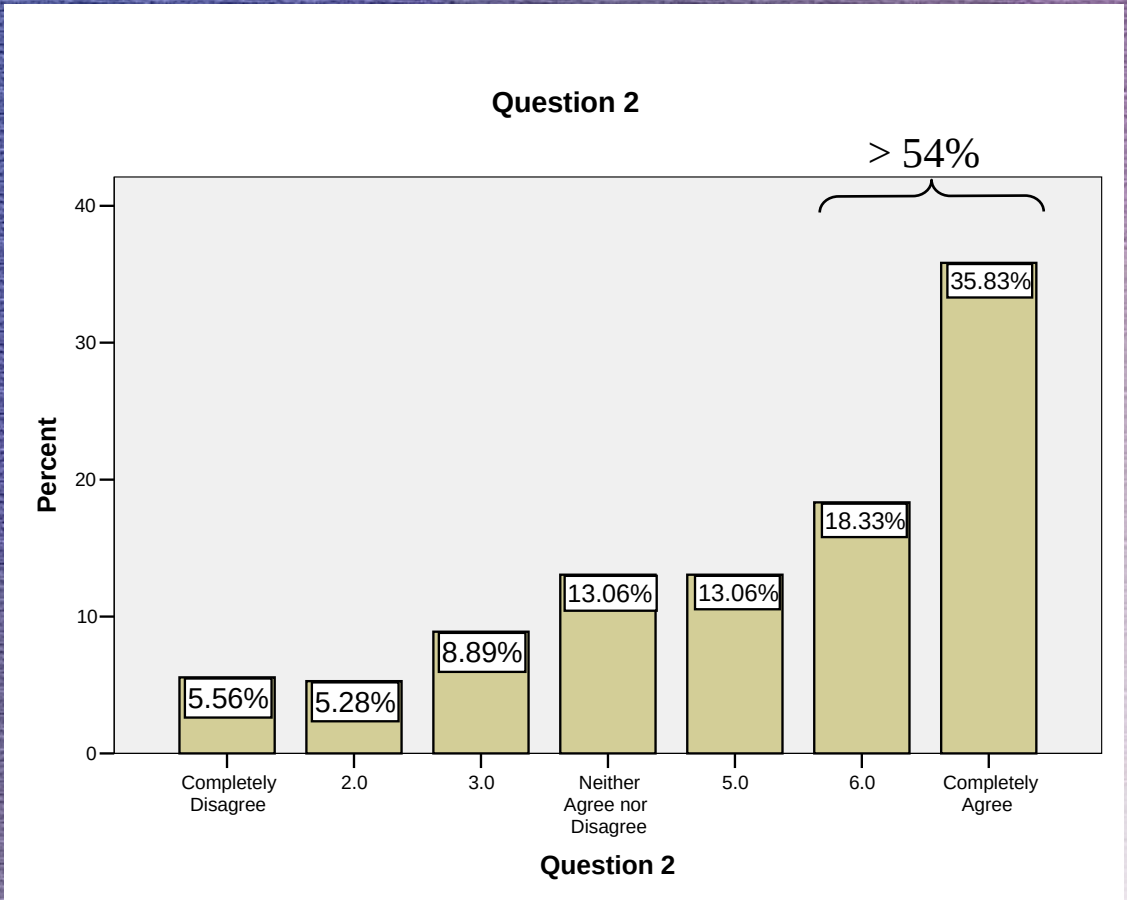
We also surveyed our test users, with some interesting findings:

Q1: <u>It would be easy to to figure out how to use this device without any instruction.</u>



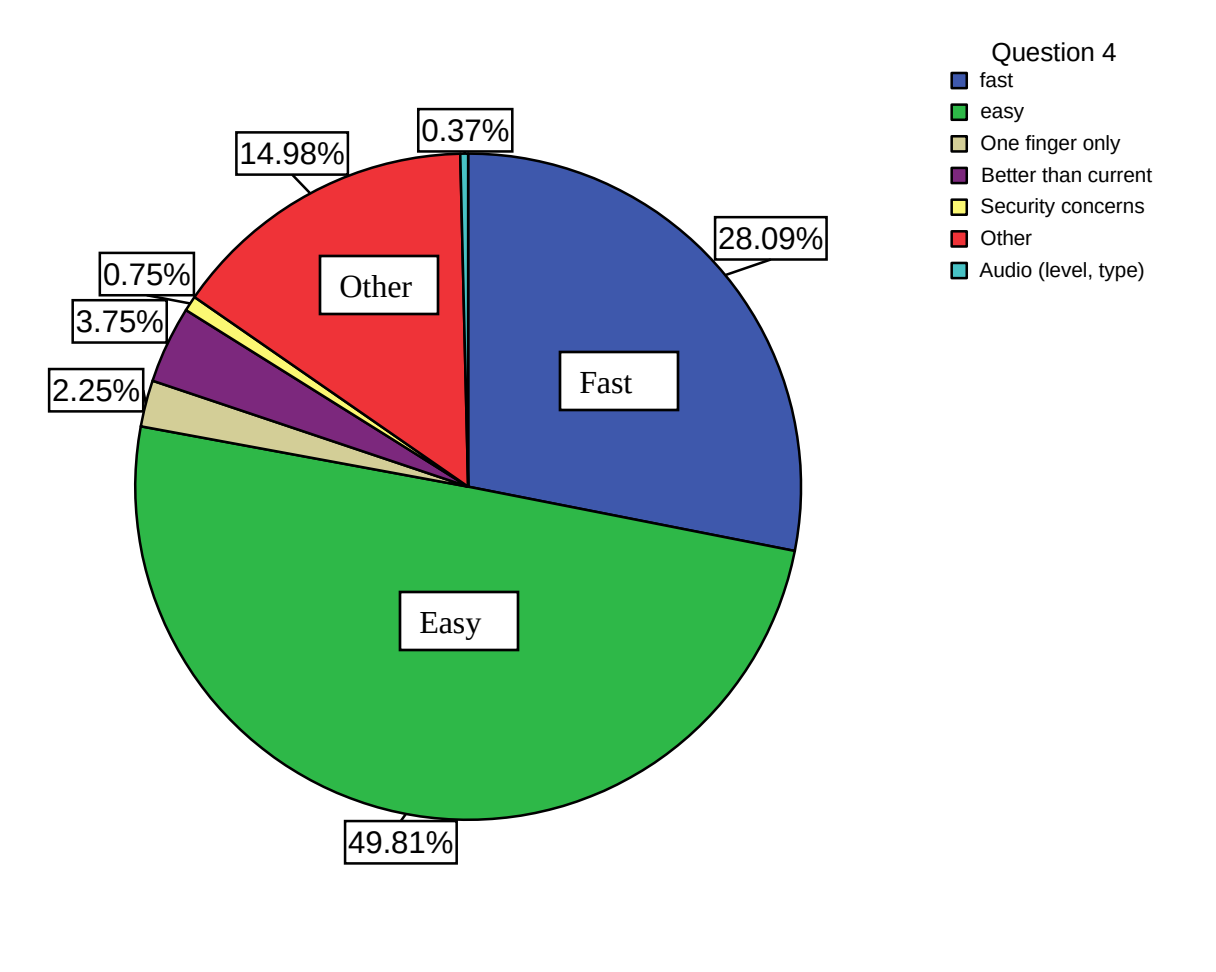
We also surveyed our test users, with some interesting findings:

Q2: I would not be concerned about privacy issues when using this device.



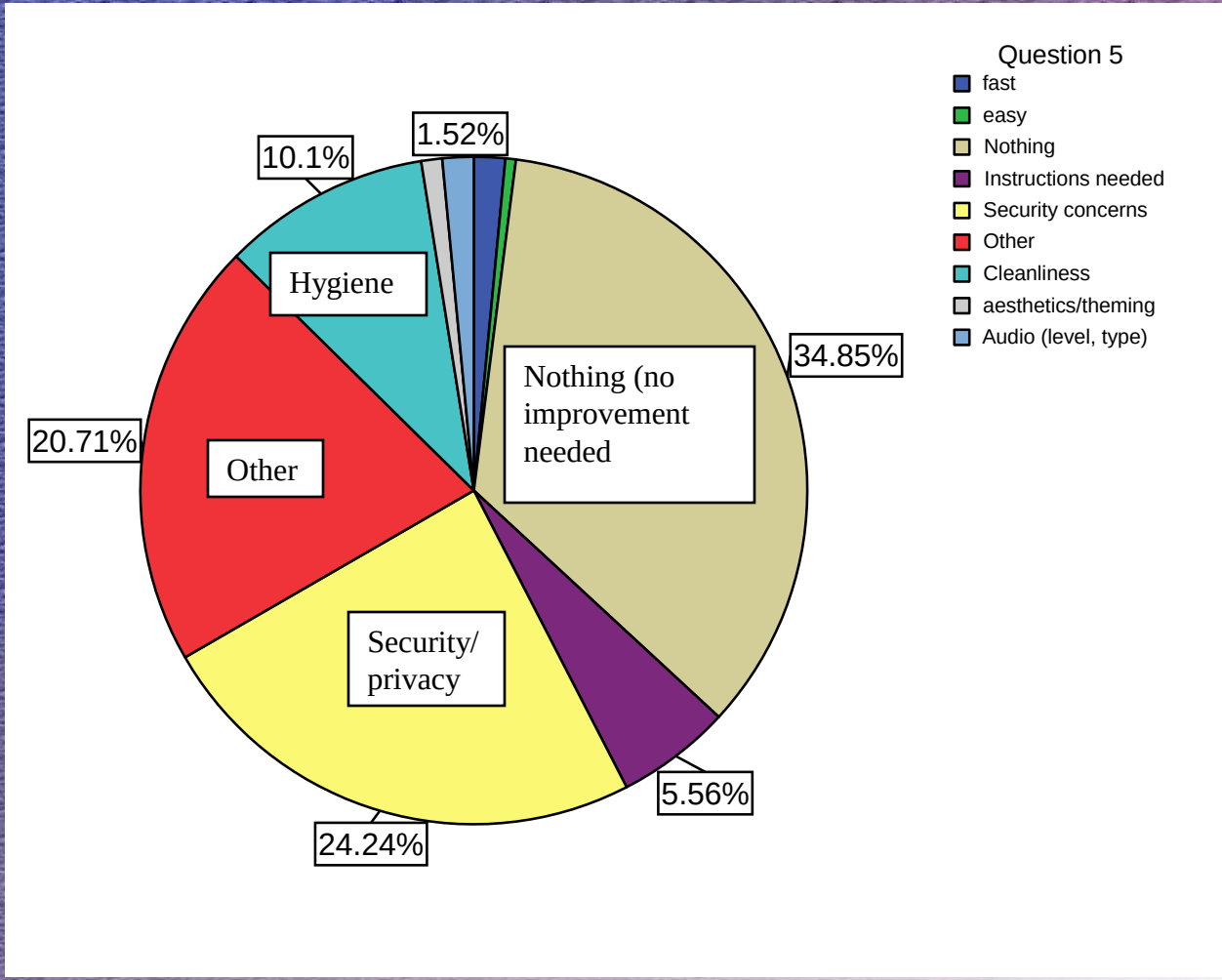
We also surveyed our test users, with some interesting findings:

Q4:What did you like about this device?

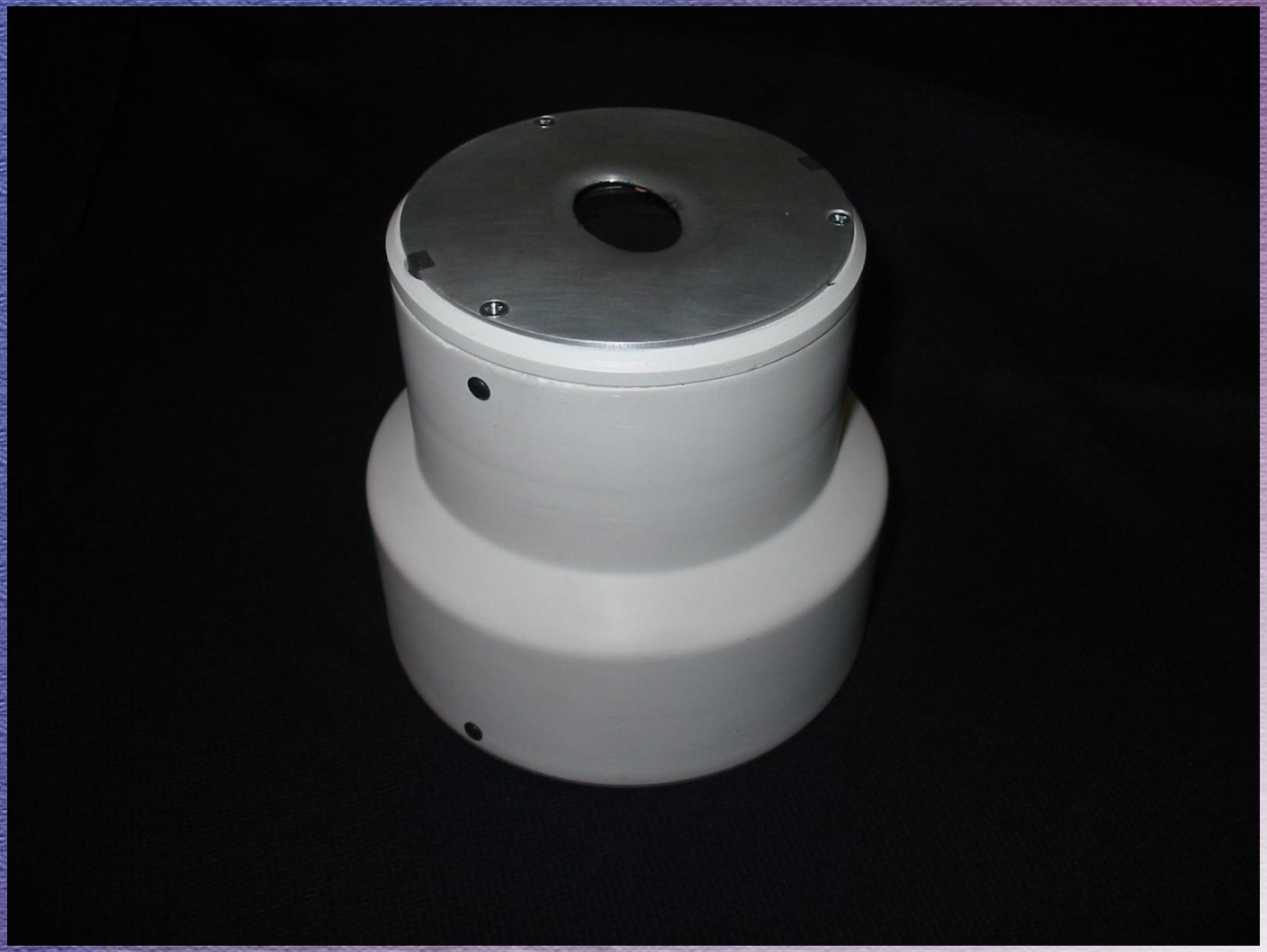


We also surveyed our test users, with some interesting findings:

Q5:What did you not like about this device?

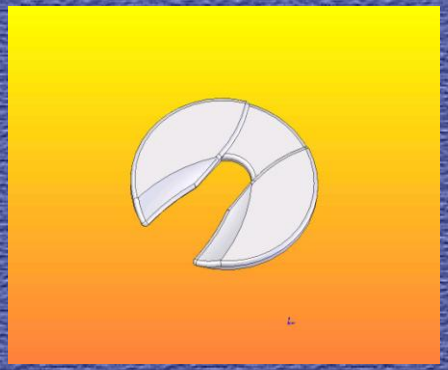
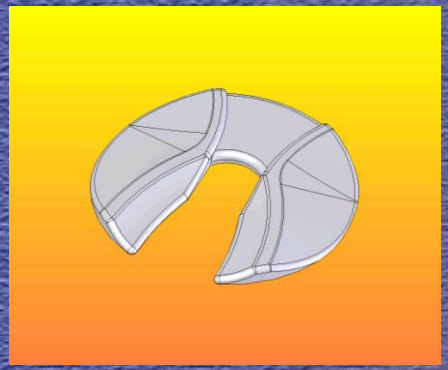
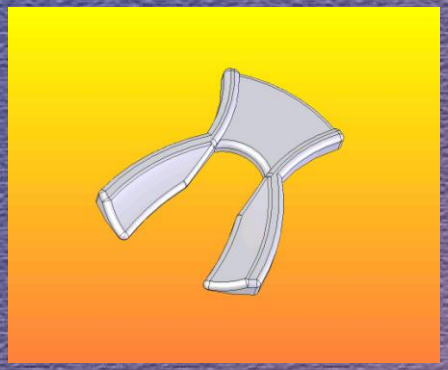
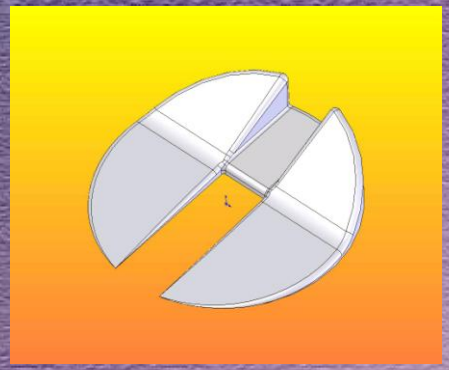
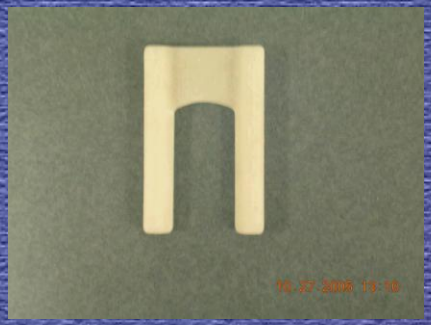
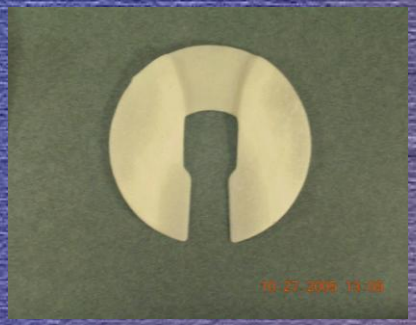


In Sept. of 2005, we received the first beta test unit
(it was nicknamed OCAM: One CAMera)



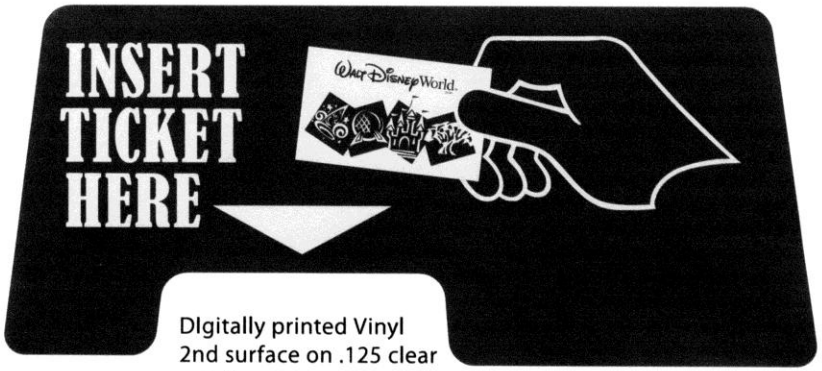
and it supposedly came with full sunlight capabilities…

Early enclosure mock-ups made from foam-core to match what we might end up with for an package…

Early ergonomic interface mock-ups that led to the final design…

DIgitally printed Vinyl
2nd surface on .125 clear
acrylic



DIgitally printed Vinyl
2nd surface on .125 clear
acrylic

INSERT
TICKET
HERE

INSERT
TICKET
HERE

INSERT
TICKET
HERE

We did some “quiet”, early testing in Nov. 2005 with guests and a mocked-up enclosure and some ergonomic interface mock-ups to see if we could learn enough about what worked and what didn’t…

Even during the brief OCCAM Beta Test, we were able to simply gesture and have untrained users successfully get authorized at a much faster pace…

OCCAM Beta Test results from Nov.16-18, 2005

- Presentations by >800 guests (one turnstile, 3 partial days)
- Various sunlight intensities, one hour of nighttime use
- Tested 4 types of user interface surface:
  - The Post
  - The Tall
  - The X
  - None
- Tested 3 levels of Yaw at 0, 15, and 30 degrees
- Tested 3 levels of pitch at 0, 5, and 10 degrees

•Categorizing sources of finger-scanning rejection

•We divided rejections into 7 categories of placement errors, where it was discernable :

- •Fingertip presented
- •Finger not flat
- •Side of finger presented
- •Finger motion during capture
- •Early lift-off of finger during capture
- •Finger rotated over 15 degrees from axis
- •Finger too far forward

•10 degree forward pitch appeared to be best angle for reducing finger placement problems

•Degree of Yaw seemed to make no difference (15 degreses was decided upon to

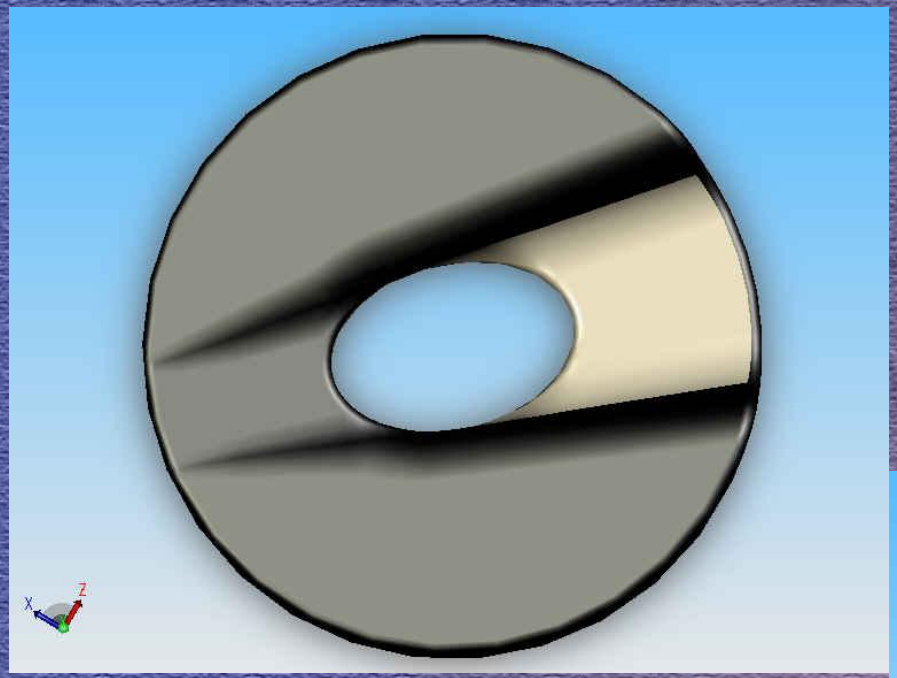
OCCAM Beta Test II results from Dec. 14, 2005

- Presentations by >550 guests (one turnstile, 1 partial day)
- Tested top 2 types of user interface surface (one modified; to be called hockey puck):
  - Ramp @ 0 degrees Yaw (total placement error = 4.9%)
  - Ramp @ 25 degrees Yaw (total placement error = 5.86%)
  - Hockey Puck @ 25 degrees Yaw

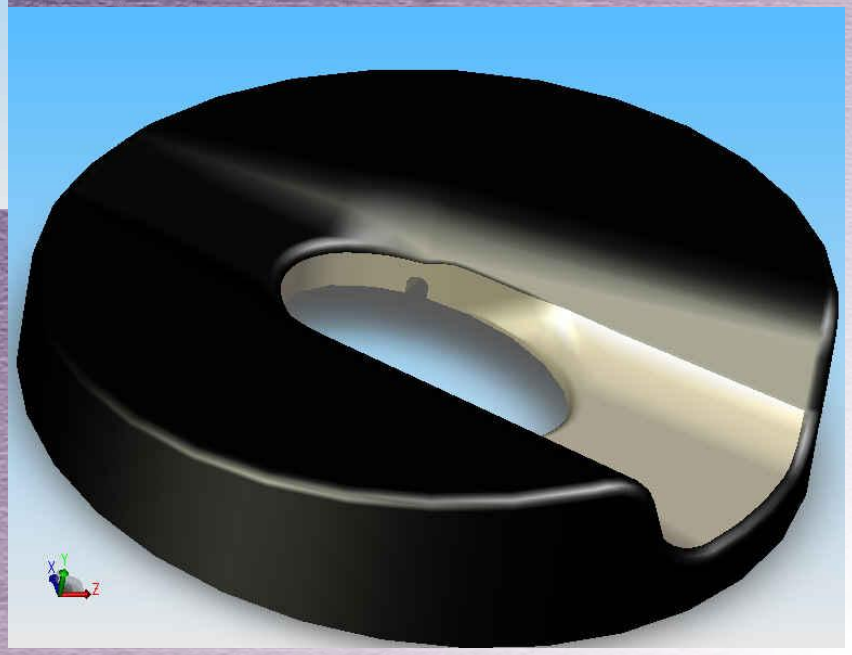
  (total placement error = 4.59%)

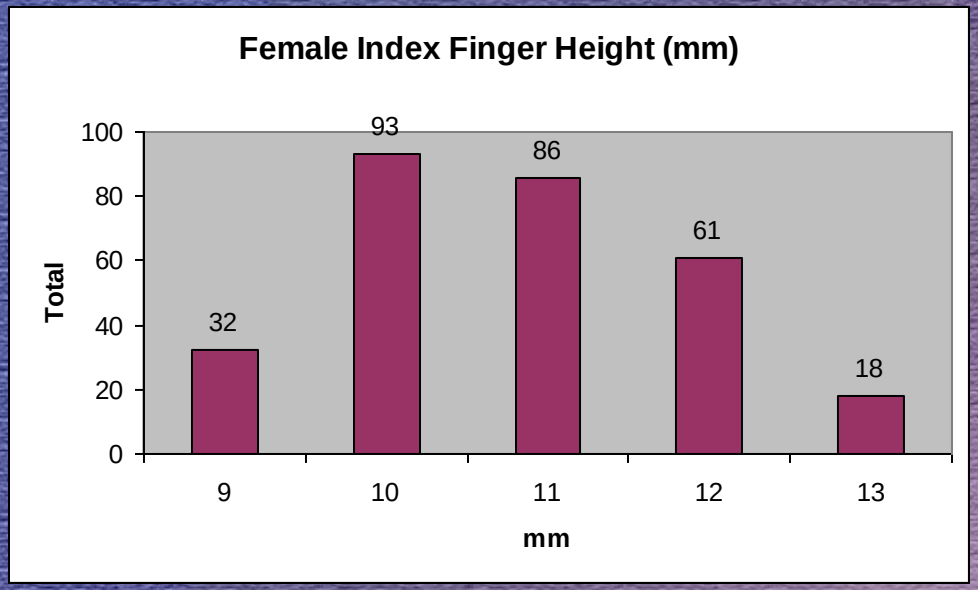
We had a winner!

So we ended up with an ergonomic design that looked something like this…

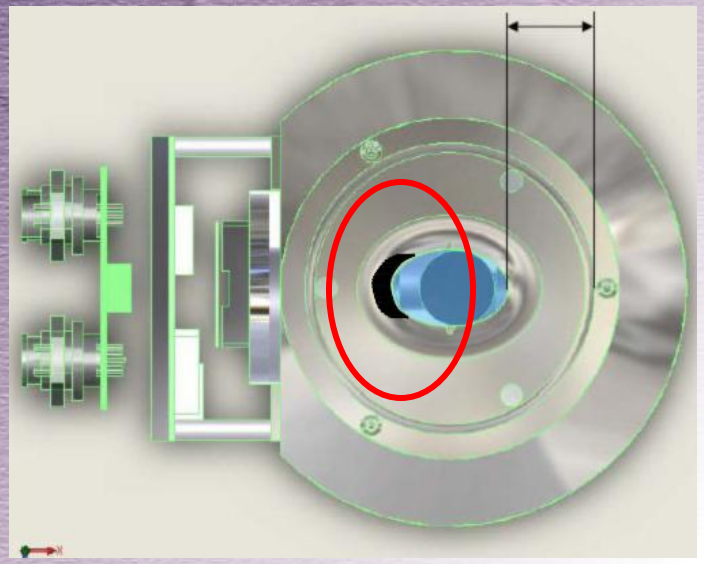


Novel enough to file for a patent…





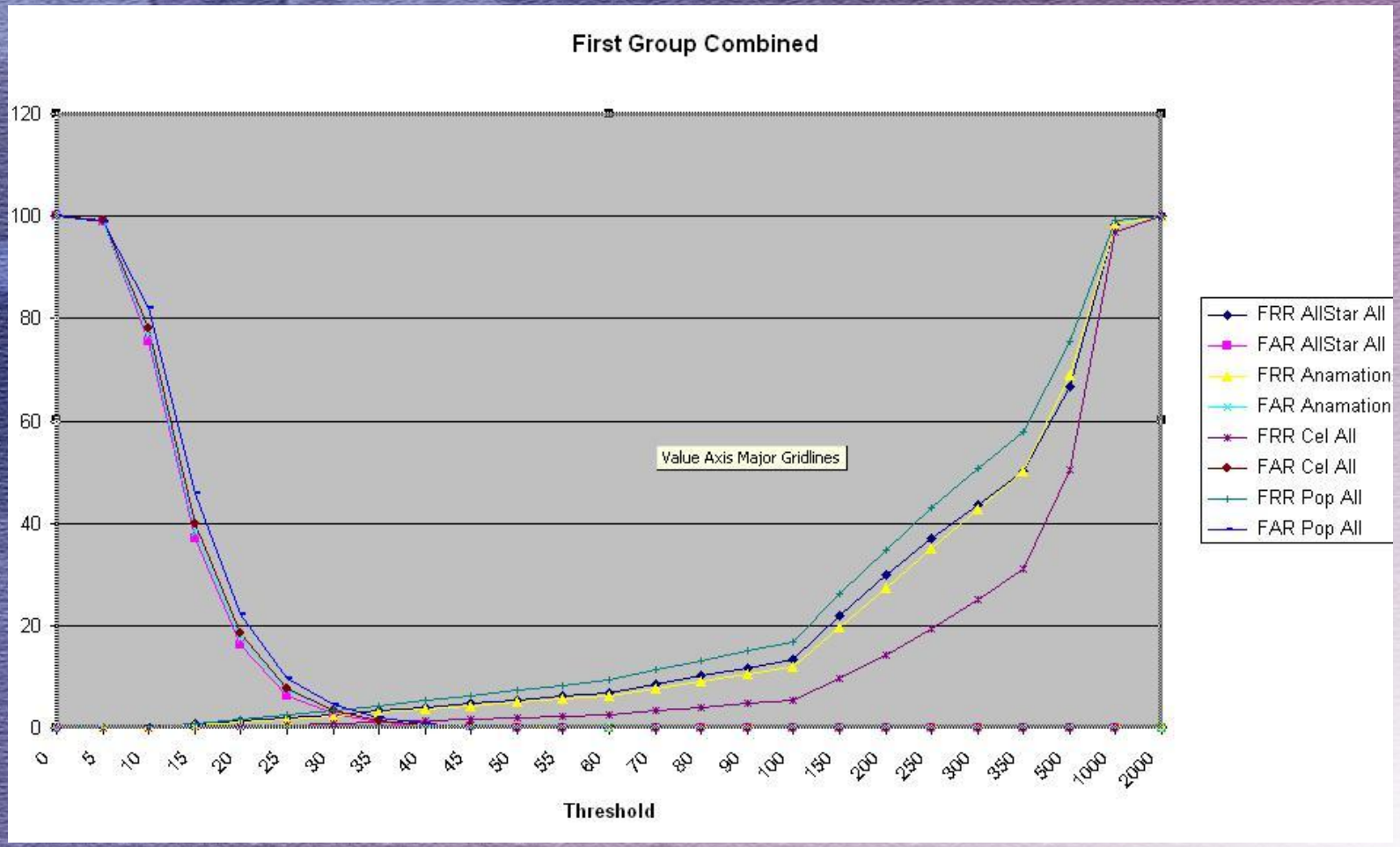
- **Current distance from platen surface to surface of metal = 2.2 mm (0.0863”)**
  - **Suggest small arc be added to prevent finger from sliding too far forward.**
  - **Suggest arc be ~ 2.8 mm high.**



- **Top of arc would be 5.0 mm from platen surface.**
  - **Arc would come up to edge of platen.**

01.29.2006

Preliminary data from internal Beta tests with untrained staff as users: ERR < 3%



1
INSERT
TICKET
HERE
©LindaMac2006

2
PLACE
FINGER
FLAT
©LindaMac2006

So what was the end result of the project?

- Still a one-to-one verification

- Verification is still anonymous; we do not know the identity of the passholder at the turnstile

- Our enrollment is still transparent - single feature presentation with truly minimal operator intervention or feedback

- We are now operating at approx. 11.5 seconds average per transaction, which was our goal…and our accuracy is is in the 5-6% FAR range with a total rejection rate of 11-12% and well below 1.0% FTA

Don’t ask me – ask them…

TOP 25 AMUSEMENT/THEME PARKS WORLDWIDE (2006)

Rank 2006	Park & Location	Attendance
1	MAGIC KINGDOM at Walt Disney World, Lake Buena Vista, Florida, USA	16,640,000
2	DISNEYLAND, Anaheim, California, USA	14,730,000
3	TOKYO DISNEYLAND, Tokyo, Japan	12,900,000
4	TOKYO DISNEY SEA, Tokyo, Japan	12,100,000
5	DISNEYLAND PARIS, Marne-La-Vallee, France	10,600,000
6	EPCOT at Walt Disney World, Lake Buena Vista, Florida, USA	10,460,000
7	DISNEY-MGM STUDIOS THEME PARK at Walt Disney World, Lake Buena Vista, FL, USA	9,100,000
8	DISNEY'S ANIMAL KINGDOM at Walt Disney World, Lake Buena Vista, Florida, USA	8,910,000
9	UNIVERSAL STUDIOS JAPAN, Osaka, Japan	8,500,000
10	EVERLAND, Kyonggi-Do, South Korea	7,500,000
11+	UNIVERSAL STUDIOS at Universal Orlando, Florida	6,000,000
11+	BLACKPOOL PLEASURE BEACH, England	6,000,000
13	DISNEY'S CALIFORNIA ADVENTURE, Anaheim, California, USA	5,950,000
14	SEAWORLD FLORIDA, Orlando, Florida, USA	5,740,000
15	LOTTE WORLD, Seoul, South Korea	5,500,000
16	YOKOHAMA HAKKEIJIMA SEA PARADISE, Yokohama, Japan	5,400,000
17	ISLANDS OF ADVENTURE at Universal Orlando, Orlando, Florida, USA	5,300,000
18	HONG KONG DISNEYLAND, Hong Kong, SAR, China	5,200,000
19	UNIVERSAL STUDIOS HOLLYWOOD, Universal City, California, USA	4,700,000
20	TIVOLI GARDENS, Copenhagen, Denmark	4,396,000
21	OCEAN PARK, Hong Kong, China	4,380,000
22	BUSCH GARDENS TAMPA BAY, Tampa Bay, Florida, USA	4,360,000
23	SEAWORLD CALIFORNIA, San Diego, California, USA	4,260,000
24	EUROPA-PARK, Rust, Germany	3,950,000
25	NAGASHIMA SPA LAND, Kuwana, Japan	3,910,000

Note: + indicates a tie
Source: TEA and Economics Research Associates (ERA)

TOP 15 U.S. WATER PARKS (2006)

Rank 2006	Rank 2005	Park Name and Location	Attendance	Change	Comments
1	1	Disney World-Typhoon Lagoon, Orlando, FL	2,050,000	6.6%	Hotter summer (up five degrees from prior years) kept interest in waterparks high. Strong season also fueled by Orlando tourism growth and on the heels of the highly successful 50th anniversary celebration at WDW
2	2	Disney World-Blizzard Beach, Orlando, FL	1,880,000	5.4%	Hotter summer (up five degrees from prior years) kept interest in waterparks high
3	3	Wet 'n Wild - Orlando, FL	1,340,000	flat	Strong performance at area theme parks, especially Disney, held down gains
4	4	Schlitterbahn-New Braunfels, TX	880,000	-4.7%	Weather issues, new competition from sister park in Galveston pushed numbers lower until end of summer when normalcy returned
5	5	Water Country USA-Williamsburg, VA	670,000	1.6%	Stable weather and precipitation kept numbers similar. New Great Wolf waterpark hotel added focus to Williamsburg as water destination
6	6	Raging Waters-San Dimas, CA	650,000	flat	Hot dry weather, up four degrees on average, kept attendance strong
7	7	Adventure Island, Tampa, FL	609,000	1.5%	Consistent weather and up slightly along with Busch Gardens Tampa
8	8	Noah's Ark-Wisconsin Dells, WI	590,000	2.4%	Very good summer for Wisconsin Dells as a destination kept Noah's Ark Strong and improved
9	-	Schlitterbahn-Galveston,TX	500,000	n.a.	New indoor/outdoor facility does very well in first year serving Galveston tourists and Houston market area. Welcome to first year on list
10*	11	Six Flags-White Water-Marietta, GA	464,000	1.8%	Precipitation half previous year and warmer temperatures helped park buck
10*	10	Wet 'n Wild Emerald Point - Greensboro, N.C.	464,000	-5.1%	Precipitation up by 70% slowed attendance reversed attendance gain of last year corporate declines
12	9	Six Flags-Hurricane Harbor-Arlington, TX	448,000	-10.3%	Hotter summer and a part of the overall Six Flags slump in 2006
13	13	Hyland Hills Water World-Denver, CO	443,000	12%	Steady weather but everything was running on all cylinders - strong season
14	-	Dollywood's Splash Country, Pigeon Forge, TN	410,000	8.5%	Record season for Splash Country and Dollywood. Warm temperatures during the peak season. Addition of Firetower Falls slides had a good marketing impact on tweens. Additions over the past three years continued the attendance growth
15	14	Soak City Cedar Point, Sandusky, OH	390,000	3.1%	Declines at Cedar Point caused in part by continued economic conditions in Detroit and Cleveland affected water park too

Note: + indicates a tie
Source: TEA and Economics Research Associates (ERA)

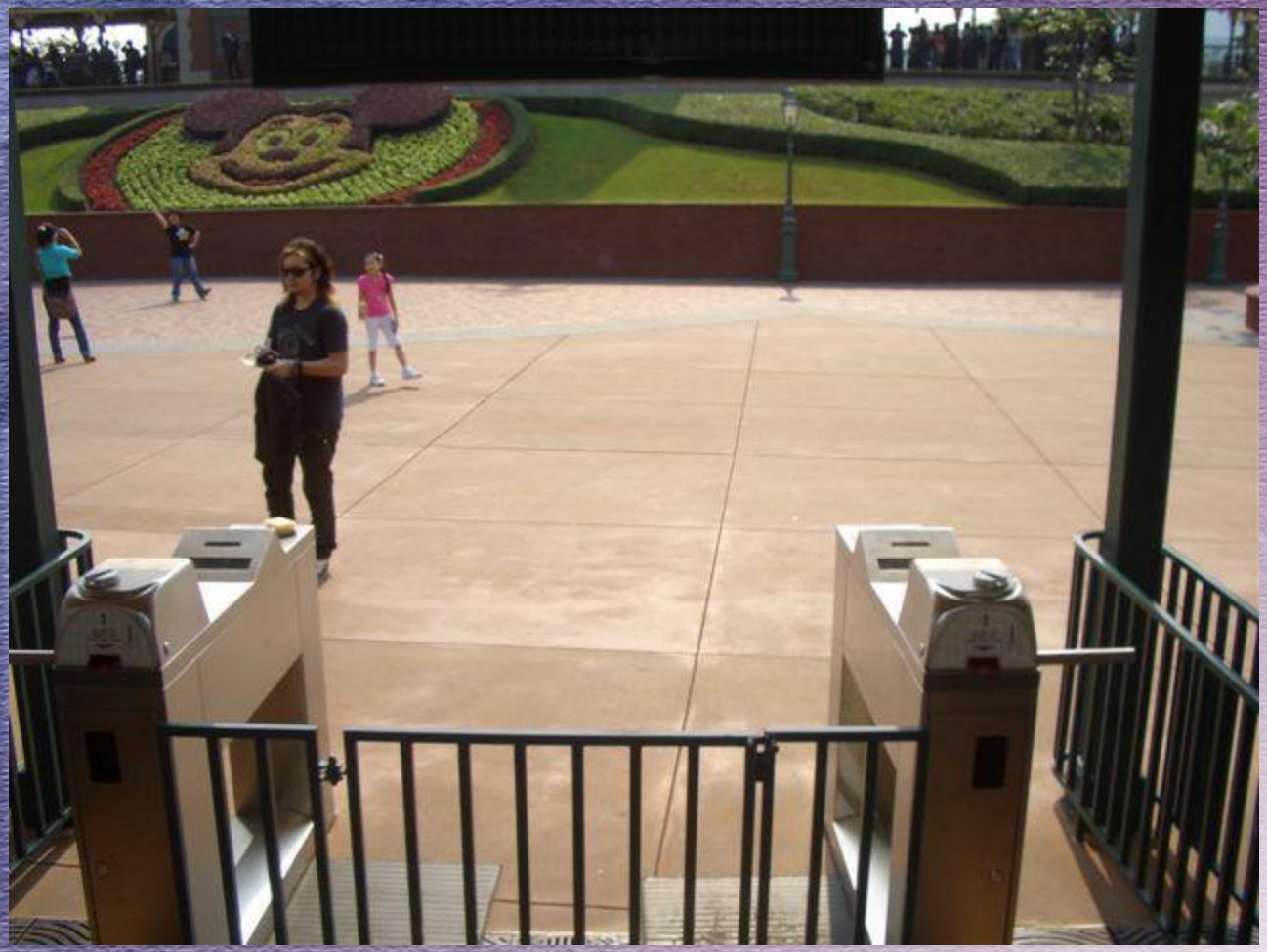
49,000,000 x 70% =

34,000,000

In our 1st full year of new sensor operation we’ve processed over twice the number of people than were processed in the previous 10 years of operations!

<each sensor has had well over 200,000 touches so far…>

What have we done since implementation?



Put them in at Hong Kong Disneyland!
But what's wrong with this picture?

In conclusion:

Our lessons learned:

There is still no magic bullet device for all applications, but we did build a better “mousetrap”

Implementing an enterprise-sized biometric system upgrade with a proprietary data interface is both costly and painful to accomplish

A change in biometric technology does not solve all your problems, it exchanges them for other problems

Questions?