

Your virtual card delivered

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Giftango Current Problem

- Scanning gift cards on mobile devices is problematic for POS conventional scanners
- Manual entry of the gift cards degrades merchant line-speed
- Lack of technology leadership and direction

Giftango GAP

<u>Technical</u>

- Ability to read barcode from mobile devices
- Mobile device differences creates various challenges:
 - File size, noise, glare, refresh rate
 - illumination, contrast, skew, shadow, distortion
 - Browser enabled

Organizational

- Companies willing to buy/invest new scanners?
- Line-speed; not willing to type
- Technology adoption

<u>Personal</u>

- Trust having merchant handle their phone
- Web-accessibility costs
 - Management of inbox / deletion of text message

Giftango Consumer Requirements

- R1 Must support the Smartphone's with following features:
 - Web browser/URL enabled
 - Hyperlink enabled within text messaging
- R2 Must be able to display a barcode with minimum screen resolution and size (iPhone)
 - LCD screen 3.5" with an aspect ratio of 480 by 320
 - 163 pixels per inch (PPI)
- R3 -The consumer will hold the phone; Contactless:
 - Read the gift-card ID off the phone without touching the device -at least 2cm to 10cm away
 - The phone may not be stationary; therefore, motion tolerance is required.
- R4 No additional cost for web-enabled text messaging
- R5 Manage the storage the gift card easily
- R6 Transfer of information needs to be secure.

Giftango Merchant Requirements

- R7 Line Speed same as swiping a physical card or scanning paper
- R8 Must be able encode ID of the gift card, which is passed to the gift card processor.
- R9 Must be combatable with existing POS interfaces:
 - Serial Communication
 - Keyboard Wedge
 - USB
- R10 -Scanner must backward capability
- R11 Must be able to read the barcode under varying light conditions.
- R12 Minimum Cost
 - Scanner
 - Licensing fee for producing barcode
 - Licensing fee for reading and decoding barcode
 - Contactless reader

Technical Evaluation Criteria

Requirement weights supplied by client

- Must have = 2
- Nice to have = 1
- Technology Capability
 - Fully meets = 2
 - Partially meets = 1
 - Does not meet or N/A = 0
- Technology Diffusion
 - Mature & adopted technology = 3
 - Early adopted with issue(s) = 2
 - Innovative stage = 1

Technical Evaluation Formula

- r = requirements 1 through 12
- W= Weight
- C=Capability
- D=Diffusion
- t=Technologies

$$\sum_{r=1}^{12} \mathbf{W}_{\mathbf{r}} \mathbf{C}_{\mathbf{r}} \mathbf{D}_{\mathbf{r}} \quad \forall \mathbf{t}$$

Spreadsheet Implementation SUMPRODUCT(\$C\$50:\$N\$50,C51:N51)

Technical Evaluation

			Consumer							Merhcant					
		Requirement	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	
	Canidat	weight e Techolgies	2	1	2	1	1	2	2	2	2	2	2	1	Total
		Transmissive													
	Р		6	6		6							3		30
	h o	Reflective	6	6		6							3		30
	n	TransFlective	6	6		6							3		30
	е	Elec. Paper	1	1					2				2		11
	в	Code128						2						6	10
	a r	PDF417						6						6	18
	c	Aztec						6						6	18
	d	DataMatrix						6						6	18
	e	QR						6						6	18
		Pen									6	6			24
	R e	Laser									6	6			24
	a d	CCD 1D									6	6			24
	e r	CCD Image			6				6		6	6		3	51
	s	CMOS 1D									6	6			
		CMOS Image			4				4		6	6		3	43
	F	NFC			2	2		2	4				2		22
V	D Legend: 2-Must Have; 1-Nice to Have (Weight) 2-Meets ; 1- Partially Meets; 0-Does not Meet/N/A; 3-Mature; 2-Early/Issues; 1-Innovator (Requirement)														

Organizational and Personal Evaluation

- Giftango has control on what barcode to use
- Industry has adopted the barcodes; however, industry is moving toward 2D barcode technology because of content capacity and security
- Starbucks is piloting gift cards using QR technology
- LCD transflective technology widely diffused with phone manufacturers
- Barcode technology widely diffused with POS manufacturers
- NFC technology introduction being pushed by multiple organizations: NFC forum, GSMA, and largest MNO

Conclusion

- The solution is indifferent to transmissive, reflective, or transflective; however, transflective are more favorable
- The solution favors 2D barcode; however, QR better is considered the leader
- The solution favors CCD Image Camera
- NFC is an emerging technology being heavily pursued; therefore, requires careful attention
- R5 manage storage of gift card is out of scope mobile wallet
- R8 found to be duplicate and included in other requirements

Recommendation

Don't worry about the phone Use QR and CCD Image Camera Keep an eye on NFC

Research Limitation

- Based only on literature review, except insights from Giftango
- Journal papers are limited and not current had to rely on reputable web sites
- Very little research on the actual problem; therefore meta analysis was required
- Evaluation weights are limited and specific to Giftango

Further Research

- There are many emerging display technologies and only future market conditions will decide on the ultimate innovations
- This is also the case with near field communications

Appendix – GAP Analysis



Giftango Needs

<u>Technical</u>

- Emulate the physical gift card
- Universal reading of barcodes
- Secure communication

Organizational

- Merchant Line speed
- POS Zero or minimal investment
- Giftango One barcode for email & mobile phone <u>Personal</u>
- Managing the virtual gift
- Consumer holds the phone for reading of barcode

Giftango Capabilities

<u>Technical</u>

- Virtual card via email or mobile device
- POS reads and process using paper barcode
- Display 128 (linear) Barcode & numbers

Organizational

- Integrated and established business relationships
 - gift card processors
 - merchants POS systems
 - shopping carts and payment gateways
- Reduce cost of physical gift cards
- On-demand gift card generation
- Details about consumer behaviors

<u>Personal</u>

- Convenience of purchase and use
- Availability on phone or email
- Automatic notification when viewed by the recipient

Appendix – Candidate Technologies



Giftango Product Technologies

Mobile Phone Display

Barcode

- Symbology
- Reader
- RFID/NFC

Broad Display Classifications

1.LCD

- 1. Emissive or Transmissive
- 2. Reflective
- 3. Transflective
- 2. Electronic Paper

Emissive or Transmissive

Disadvantages of the emissive display

- Constant power for backlighting
- Needs constant refreshing 60 times per second to avoid image degradation of flicker
- Organic light emitting diode (OLED) and the electrophoretic displays (EPD) require constant power to avoid screen flicker

Reflective

Advantages of reflective display

- No backlight, but it must be constantly refreshed
- A bistable type of reflective display does not require refreshing.

Disadvantage of reflective display

Poor image quality at ambient light levels

Transflective

Advantages of Transflective display

- Engineered to overcome backlight's high power consumption, and the shortcomings of the reflective
- **Disadvantage of reflective display**
- Poor image quality at ambient light levels

Electronic Paper

Advantages of e-paper display:

- Low power consumption
- Flexible
- Stable image
- Reflects ambient light well
- Can be scanned by all types of POS scanners

Emerging Display Technologies

Some desired features

- Convergent display experience
- Paper-like readability in almost any ambient condition
- Consuming significantly little power
- Industry-standard interface compatibility and manufacturability
- Fast response speed
- High refresh rates

Popular smartphones' display features

Smart Phone	Company	Global User	U.S Market	Desktop	Operating	Display	Screen
		Base	Position	Environment	System	Technology	Resolution
Android	Google	1 million	increasing	Win	Linus	LCD	320*480
				Mac			pixels
				Linux			@ 187 PPI
Blackberry	RIM	28.5 million	decreasing	Win	Blackberry	LCD	480*360
				Linux			pixels
iPhone	Apple	45 million	increasing	Mac	iPhone OS	LCD	480*320
							pixels @ 163
							PPI
Symbian	Various with	61 million	needs	Win	Sysmbian OS	LCD	480*320
	Nokia owning		catching up				pixel
	majority						

Sources: http://creativealgorithms.com

Barcode

Barcode

- Code 128
- PDF417
- Aztec
- DataMatrix
- QR

Readers

- Pen
- Laser
- CCD (single array sensors)
- CCD Image (multi array Sensors)
- CMOS Image (multi array Sensors)

1D - Symbology

1D is the most common

- vertical black bars that separated by white spaces with varying widths and checksums
- UPC code uses 10 symbols represent numeric numbers
- Code 128 uses 106 symbols to represent 128 ASCII characters
- Used of Identifier and DB lookup

2D-Symbology

- 2D gaining in popularity
 - Applications that require more than just an identifier
 - Used to encode a person's signature or other security credentials
 - Requires sophisticated readers to decode the information
 - Stacked or Matrix schemes

Barcode – Industry Leaders

	Barcode	Encodin g	Feature s	Barcode Standard	Supporting Organization s	
Code 128	barcode1	1D Linear	128 ASCII or Numeric Variable Check Digit	ISO/EIC 15416 ANSI AIM	Retail Transportation IATA BCBP GS1	
PDF417		2D Stacked	128 ASCII Numeric Binary Variable High capacity	ISO/EIC 15438 ANSI AIM	IATA BCBP DoD MIL Std 129P AMVA	Sources: http://en.wikipedia.org/wiki/Barcode, http://www.idautomation.com/barcode/aztec.html;
Aztec		2D Matrix	128 ASCII Numeric Binary High capacity	ISO/EIC 15438 ANSI AIM	IATA BCBP	http://www.barcodephp.com/2d/aztec/overview.php http://www.inlitereeserach.com/homepage/support/b_standards.htm International Air Transport Association (IATA); "Simplifying the Business Bar Coded Boarding Pass Implementation Guide": 4 th Ed.
DataMatrix		2D Matrix	128 ASCII Numeric Binary High capacity	ISO/EIC 16022 ANSI AIM	IATA BCBP GS1 German Post AIAG NASA EIA	June 2009, Montreal-Geneva
QR		2D Matrix	128 ASCII Numeric Binary Kanji High capacity	ISO/EIC 18004 ANSI AIM	IATA BCBP GS1 Widely Used in Japan	

Types of Readers

- Pen Linear
- Laser 1D linear
- CCD
 - 1D linear
 - 2D Image Area Camera
- CMOS
 - 1D linear
 - 2D Image Area Camera



- Requires the unit to be in contact of barcode 45 degree angle
- Light source such as laser or LED is emitted onto barcode
- Reflected light is captured by the pen's photodetector and decodes the code
- Aperture sets the minimum requirements for the barcode
- Cost ranges from \$60 \$140



- Employs an optical system to generate a laser beam and a lens for focusing
- Rate of about 50 times per second
- Linear symbologies are optimized to read by a laser scanner
- Reflected light is captured by the pen's photodetector and decodes the code
- Fast, reliable and read from distances
- Cost ranges from \$150 \$250

CCD - 1D

- Employ an single array of light sensors
- Maximum speed is approximately 50 scans per second
- Measures the emitted light, not the reflected light
- Not able to read half-tones or color
- Not as accurate as a laser
- Cost ranges from \$100 \$200

CCD - 2D

- Employ an multi array of light sensors
- Area imager illuminates the barcode using LED using video camera
- Lens projects the image and decoded
- Assure the resolution is of the bar code image meets resolution of the source
- Cost ranges from \$300 \$400



- Alternative to laser and CDD uses waffers
- Comes in 1D and 2D limited in performance
- Affected by blurring
- Requires a steadier state to read a barcode
- Requires adequate light conditions
- Minimum and maximum focus distances
- Not as widely used
- Cost ranges from \$300 \$400

Barcode and Readers

	Pen	Laser	CCD (1D)	CCD Image (2D)	CMOS (1D)	CMOS (2D)
UPC/EAN	Yes	Yes	Yes	Yes	Yes	Yes
PDF417	No	Yes w/	Yes w/	Yes	Yes w/	Yes
		special	special		special	
		feature	feature		feature	
Aztec	No	No	No	Yes	No	Yes
DataMatrix	No	No	No	Yes	No	Yes
QR	No	No	No	Yes	No	Yes

• Sources: <u>http://en.wikipedia.org/wiki/Barcode_reader</u>

http://www.socketcom.com/pdf/techbrief/ScanningPerformanceComparison.pdf

What is NFC

- Near Field Communication is short-range wireless connectivity technology standard designed for intuitive, simple and safe communication between electronic devices
 - Contactless transactions
 - Payments (tickets, etc)
 - Data transfer

Sources: http://www.nfc-forum.org/resources/faqs/

Purposes of NFC

- Enables mobiles be used as information access tool through "tags"
- Streamline communications and purchases
- Fast and easy services with security
- Make Short-range contactless communication available to global customers

Sources: <u>http://www.nfc-forum.org/resources/faqs/</u> www.forum.nokia.com/Technology_Topics/Mobile_Technologies/Near_Field_Communication/

Drivers of NFC

Commercial drivers

- Reduced cost of electronic issuance
- Increased revenue from interactive services
- NFC-enabled devices drive consumption of rich media content
- Consumer preference for NFC-enabled services

Drivers of NFC

- NFC Forum: formed to advance the NFC technology by setting specifications, promoting the technology, and ensuring device and service interoperability
 - Sponsor members: MasterCard, Microsoft, NEC, Nokia, NTT DoCoMo, NXP semi, Panasonic, Samsung, Sony, Visa, and more

Sources: http://www.nfc-forum.org/news/pr/view?item_key=d3b85812ad82501122a8fd459cdf1eccc83107c8

Drivers of NFC

- Motley Forum: to create financial services ecosystem and promote mobile banking
 - Members (50+): leading banks, vendor, payment processors, mobile network operators.
 - Board members: Duetsche Bank, UBS, HSBC, BBVA, eLacaixa, Nordea, Rabobank, DnB NOR, and Nokia

Sources: http://www.nfc-forum.org/news/pr/view?item_key=d3b85812ad82501122a8fd459cdf1eccc83107c8

NFC and Giftango's Consideration

- Frost & Sullivan: 1/3 of all mobile phones will have NFC within 3 years
- Strategic Analytics: By 2011 Mobile phone contactless will execute \$36 billion worldwide consumer spending
- NFC is based on existing contactless

RFID/NFC

	Communication Range	Line Speed Compliance	Integrated into Smartphone	Security	Mobile Payment	SIM-Card Link	Reader Availability
Active	10cm & up	Yes	No	No	Limited	No	Yes
Passive & Semi	10cm & up	Yes	No	No	Limited	No	Yes
NFC	2-10cm	Yes	Yes	Yes	Yes	Yes	Min

- Sources:http://java.sun.com/developer/technicalArticles/javame/nfc/
- www.differencebetween.net/technology/difference-between-rfid-and-nfc/

Requirements to Technologies

Consumer										Merhcant						
Canida	ate Techolgies	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12			
D	Transmissive	Y	Y					Y								
s	Reflective	Y	Y					Y								
Р а	TransFlective	Y	Y					Y								
У	Elec. Paper	Y	Y					Y								
в	UPC/EAN		У					У	У				У			
a	PDF417		У				У	У	У				У			
c	Aztec		У				У	У	У				У			
d	DataMatrix		У				У	У	У				У			
υ	QR		У				У	У	У			У	У			
	Pen							У		У		L	У			
R e	Laser			У				У		У		Y	У			
d	CCD			У				У		У		Y	У			
r	CCD Image			У				У		У	У	Y	L			
	CMOS Image			У				У		У	У	Y	L			
N	Active	Y	Y	Y		L	Y	Y	Y	Y			Y			
C	Passive	Y	Y	Y		L	Y	Y	Y	Y			Y			
Leg	end: "Y" Suppo	ort Dire	clty; "L"	Limite	d or Ind	irect Su	oport; B	Blank Sp	ace doe	s not; ",	/" no re	seach fo	ound			

Appendix - References



References

- "The history of LCDs" by Kawamoto, H (2002). IEEE, No.
 4, pp. 460-500. found at http://ieee.org/portals/cms_docs_iportals.
- No Author, The History of RFID, RFID Journal, 2005, <u>http://www.rfidjournal.com/article/view/1338/1</u>, accessed November 10, 2009
- Set Colaner, NFC & RFID: What They Mean to You, PC Today, Cover stories, May 2009, Vol. 7, Issues 5 <u>http://www.pctoday.com/editorial/article.asp?article=articles%2F2009%2Ft0705%2F20t05%2F20t05.asp</u>, accessed November 20, 2009
- No Author, Mobile NFC Services White paper, GSMA, January 2007
- [David Pringle, Operators to Define Requirement for NFC Handsets, June 30, 2008,
- http://gsmworld.com/newsroom/press-releases/2008/1121.htm#nav-6, accessed November 23, 2009
- Jan Ondrus, Yves Pigneur, Cross-industry Preferences for Development of Mobile Payments in Switzerland, Electronic Markets, 2007, Vol. 17
- Motorola, "laser Scanning or Digital Imaging: Which Bar Code Scanning Technology is Right for Your Application", White Paper,

http://www.motorola.com/staticfiles/Business/Products/Bar%20Code%20Scanning/Bar%20Code%20Scanner s/Fixed%20Mount%20Scanners/MiniScan%2012xx/_Documents/Static%20Files/Laser_Scan_Digital_Image WP.pdf, Date Accessed 11/16/2009

- "Barcode Reader"; <u>http://en.wikipedia.org/wiki/Barcode_reader</u>, Date Accessed 10/15/2009
- "Barcode"; <u>http://en.wikipedia.org/wiki/Barcode</u>, Date Accessed 10/15/2009
- "Introduction to barcode How a bar code reader works";
 <u>http://www.taltech.com/TALtech_web/resources/intro_to_bc/bcpwork.htm</u>, Date Accessed 11/24/09

References (cont)

- "Aztec Code Wikipedia, the free encyclopedia"; <u>http://en.wikipedia.org/wiki/Aztec_Code</u>; date accessed 11/24/2009
- Wakaumi, H. Nagasawa, C.; "A ternary barcode detection system with a pattern-adaptable dual threshold"; Sensors and Actuators A, 130-131 (2006), pp 176-183
- Borges, P.V.K.; Mayer, J.; Izquierdo, E.;" PERFORMANCE ANALYSIS OF TEXT HALFTONE MODULATION", Vol 3, Sept. 16 2007-Oct. 19 2007 Page(s):III - 285 - III - 288
- Malvido, A., Perez-Gonsalez, F., Cousino, A.; "a Novel Model for the Print-and-Capture Channel in 2D Bar Code", Multimedia Content Representation, Classification and Security, International Workshop, MRCS 2006, Istanbul, Turkey, September 11-13, 2006, Proceedings pp 627-634
- Datalogic Technical Engineer, Incident #78869, 11/11/2009
- Adams. R., "Bar Code 1 A Web Of Information About Bar Code Bar Code FAQ Answers", <u>http://www.adams1.com/faq.html</u>, Date of Access 11/16/2009, Last Date Modified 11/16/2009
- Adams, R.," 2-Dimensional Bar Code Page", <u>http://www.adams1.com/stack.html</u>, Date of Access 11/16/2009, Last Date Modified 11/16/2009
- Adams, R.;"BarCode1 Bar Code Readers Page"; <u>http://www.adams1.com/readers.html</u>; Date Accessed 11/15/2009
- "CCD Barcode Scanners, Readers & Linear Imagers IDAutomation"; <u>http://www.idautomation.com/ccdreaders/</u>; Date Accessed 11/25/2009
- "ZBA Z-380 CCD BAR CODE READER RS232 1/F D89 CONN P/S 9V shoping at Planet Online"; http://www.planetonline.com/Tech Specs/Computers Scanners Barcode Readers/ZBA Z 3080 CCD BAR READER RS232 I F DB9 CONN P S 9V 9094009R 10825338.htm; Date Access 11/15/2009

"Reading Bar Code"; http://www.barcodemax.com/reading_bar_codes.htm; Date Accessed 11/25/2009

References (cont)

 Nokia Developer Forum, "Display Bar Codes on Mobile Phone", <u>http://discussion.forum.nokia.com/forum/showthread.php?t=8167</u>, Date of Access 11/16/2009, Last Date Modified 10/08/2009

- Gao, J. Z., Prakash, L., and Jagatesan, R.; "Understanding 2D-Bar Code Technology and Applications in M-Commerce – Design and Implementation of A 2D Barcode Solution"; 31st Annual International Computer Software and Applications Conference, 2007
- "Knowledge base Barcode Standards read ANSI AIM standards 1D 2D barcodes from poor quality"; <u>http://www.inlitereeserach.com/homepage/support/b_standards.html</u>; Date accessed 11/20/09
- Gao, J. Z., Prakash, L., and Jagatesan, R.; "Understanding 2D-Bar Code Technology and Applications in M-Commerce – Design and Implementation of A 2D Barcode Solution"; 31st Annual International Computer Software and Applications Conference, 2007
- Pavlidis, T., Swartz, J., and Wang, Y. P; "Information Encoding with Two-Dimensional Bar Codes"; IEEE, June 1992, pp 18-28
- Pavlidis, T.; "A new Paper/Computer Interface: Two-Dimensional Symbologies"; IEEE, 2000, pp145-151
- Pavlidis, T., Swartz, J., and Wang, Y. P; "Fundamentals of Bar Code Information Theory"; IEEE
- Aztec Barcode Symbol Tutorial & FAQ; <u>http://www.idautomation.com/barcode/aztec.html</u>; Date of Access 11/13/09
- Barcode Generator for PHP Aztec Barcode Overview; <u>http://www.barcodephp.com/2d/aztec/overview.php</u>, Date access 11/23/09

References (cont)

- International Air Transport Association (IATA); "Simplifying the Business Bar Coded Boarding Pass Implementation Guide"; 4th Ed, June 2009, Montreal-Geneva
- [dover] Dover, J.;"The evolution of the PDF417 communications medium"; Logistic Information Management, Vol. 8 No. 2, pp 34-37
- Bar Code Technology: Matrix 2D Symbolgies; <u>http://www.aimglobal.org/technologies/barcode/2d_symbologies_matrix.asp;</u> Date Accessed 11/24/2009
- "Starbucks introduces barcode payments with its new iPhone app"; <u>http://econsultancy.com/blog/4667-starbucks-iphone-apps</u>; date access 11/24/09
- Mallat, N., Rossi, M., Tuunainen, V. K., Oorni, A.; "The impact of Use Situation and Mobility on the Acceptance of Mobile Ticketing Services"; IEEE, Proceedings of the 39th Hawaii International Conference on System Sciences, 2006, pp1-10
- Socket Communications; "Comparing Scanning Performance: Laser vs. Linear CMOS technologies", <u>http://www.socketcom.com/pdf/techbrief/ScanningPerformanceComparison.pdf</u>, Date Access 11/24/2009
- Litwiller, D.; "Photonics_Spectra_CCDvsCMOS_Litwiller", www.dalsa.com/public/corp/Photonics_Spectra_CCDvsCMOS_Litwiller.pdf; Date Accessed 11/14/2009