

White Paper

Pen & Paper Solutions – Innovation with Ink

January 2006

Many businesses are still mandated by process and/or legal necessity to capture information through paper forms. Software vendors and system integrators offer electronic methods of copying paper content into business systems. Typically, these information capture methods utilize either expensive centralized scanning to graphic and optical catalogues and/or labor intensive manual data entry client/server, web-based or host systems. These solutions create a sizeable demand for automating the electronic capture, processing, storage and archiving of considerable quantities of paper forms that cross all lines of business. Some estimates put the cost of processing paper forms in the United States alone at roughly 360 B\$/year.*

Significant strides in character recognition software can now be leveraged to offer cost effective business solutions for capturing electronic ink from freehand input recorded on paper or tablets without the additional cost and burden of document scanning. The most common device for information capture worldwide continues to be the pen. The sophistication of modern character recognition software allows for the development of paper user interfaces (PUI) and electronic paper forms on tablets that can accept the written word as a viable data entry mechanism. These new approaches for harnessing and empowering the mobile worker will drive lower costs throughout the enterprise by minimizing data entry while improving productivity and responsiveness for customer facing professionals – in and out of the office.

The adoption of electronic ink capture from digital pen or tablet technology means companies can integrate handwriting capture capability from business forms with any front or back office information management business system. The benefits are immediate - savings through the streamlining of paper workflow without changing where or how people want to work, in or out of the office.

This paper is an executive briefing explaining the business benefits offered to organizations wanting to improve paper based data capture and manual workflows through the introduction of electronic ink and digital writing solutions.

* Association for Information and Image Management (AIIM) study; <http://www.iasinc.net/formsprocessing/index.asp>

Table of Contents

Introduction.....	3
Document Scope	3
Target Audience.....	3
Liberating the Mobile Office Worker	4
New Application Interface Paradigm.....	5
Digital Ink Technology Components.....	5
The Paper	5
The Pen	6
Data Communications.....	6
Paper to Electronic Form Solution Process	6
Page Design Model.....	6
Software Design Model	6
System Deployment Model.....	7
Paper vs. Tablet Interface	9
Pen vs. Tablet Comparison - Pros and Cons.....	9
Digital Ink’s Value Proposition to Customers	10
Concluding Remarks.....	11

Introduction

All organizations are struggling with paper form data capture inefficiencies. Many have invested in some form of document management based on image capture through scanning and are now looking at replacing these aging and costly systems with newer digital storage or content management systems. Many of the more powerful document management systems offer modern features such as collaboration, digital content support, workflow integration and archiving options - all accessible via a web browser. These enterprise systems are certainly expensive to implement and maintain, and unfortunately, none currently solve the challenges of data capture from paper source by offering conversion and contextual understanding of *written text*.

Electronic forms based on input captured directly from paper and/or tablet interfaces using pens as opposed to keyboard entry promises dramatic productivity gains for the mobile workforce and the multi-billion dollar forms processing industry. In fact, the rate of adoption of tablet and digital ink technologies may parallel that seen in the expanded use of Voice Extensible Markup Language¹ owing to similar scientific advances in handwriting character recognition software.² Supporting evidence can be found in statements (and actions) made by one of the world's most innovative software architects the chairman of Microsoft;

"Throughout this decade, [electronic] ink will become as popular as the graphic user interface became in Windows" - **Bill Gates, New York City, November 2002.**

Document Scope

This paper outlines the technology and business advantages of adopting digital pen-based workflows and attempts to cover the technology underpinnings of pen-based computing and the intersection between tablet and paper-based document capture at a high level.

The scope of this paper broadly outlines architecture descriptions for systems based on electronic ink information capture and illustrates how these solutions save money by increasing efficiencies and are readily integrated into corporate back office and enterprise information management systems.

Target Audience

This briefing document will be of interest to senior business executives and information systems managers charged with finding ways to reduce fixed and operating costs surrounding paper and data-management-workflow. Specific verticals this technology is especially applicable to include those business forms requiring customer ink signatures.

¹ See for example <http://www.w3.org/TR/voicexml20/>

² refer to: <http://documents.cfar.umd.edu/cgi-bin/getocrsoft.pl?key=Company&dir=ocrvend&action=list>

Liberating the Mobile Office Worker

Rethinking business opportunities requires recognition of obvious changes in work patterns. The information needed by a knowledge worker is best kept local and personal and is viewed as an important first step in the discovery, creation and promotion of content. What appears to be constraining the widespread adoption and leveraging of this shift in mobile work patterns are quite simply the challenges associated with mobile application development, namely:

- Security and integration costs for data synchronization with enterprise systems;
- Technology volatility in devices, operating systems, network options;
- Challenges in deploying and subsequently supporting large mobile workforces;
- Human usability factors

The use of cryptography for securing data while in-transit and for stationary data on mobile systems provides a means of addressing security issues raised by organizations. Small footprint databases (Oracle, Sybase, Microsoft ...) simplify “out-of-coverage” data access while XML technologies in conjunction with higher bandwidth GPRS/GSM wireless networks address some of the technical challenges of interfacing and managing data exchange between the “back-office” and the mobile occasionally connected user.

Considerations for Human Usability

Despite the advances suggested above, the ROI challenge surrounding wireless application development still remains, with a large portion of the financial burden and cost associated with the design of the user interface form-factor. This is because usability of an application requires adopting a target platform that not only deals with the technology constraints of the application (i.e., data persistence, CPU and memory, OS functionality, device robustness, security, air interface support, etc...), but some would argue more importantly emulation of familiar “look and feel” of desktop-functionality:

- Drop-down list-boxes, scrolling requirements, font size, colour, image restrictions
- Support for plug-ins, external viewers i.e., browsers, Word, PDF, audio, etc ...
- Keyboard vs. pen data entry

This has a far reaching impact on “how” an application can be designed and built to run on a resource-constrained device. This in turn translates to high development costs and a significant degree of guessing as to the longevity of vendor support for the selected target device.³ This volatility introduces significant financial risk to any business/technology decision regarding the combined hardware-software-network target platform selection.

The adoption of a mobile user interface is therefore highly dependent on a software abstraction layer capable of mitigating these risks. Without this level of abstraction, applications will never live up to the promise of write once run anywhere – a necessary condition to meet stringent IT budgets driven by a measurable ROI.

Apart from on-line e-mail and (teenage) chat, the emergence of the killer application for small devices has been forever coming and thus greatly exaggerated.

³ Consider the no. of versions of Palm and Microsoft OS software for handhelds no longer supported.

New Application Interface Paradigm

Pen based electronic data capture (Digital Ink) is a disruptive technology capable of addressing many of the objections raised above⁴. Digital Ink has the potential of winning mindset with mobile knowledge workers and budget conscience CIO's whose information requirements, while ultimately being tied to a desktop and server application, can be mobilized in a way that allows for familiar presentation, data capture and accelerated integration into business systems in a seamless manner. Additionally, the existence (or lack) of the wireless network is not a prerequisite for acceptance of the model whose overwhelming attractiveness is that paper remains the most widely acceptable end-user interface as it directly mimics existing business workflow patterns and activities. Paper requirements within a business maintain its existing role and appeal and the user adapts to a slightly refined entry tool that has great familiarity – *the pen*.

Digital Ink technology allows business data be captured, converted, verified and then stored directly into existing systems using open standards like XML, SQL and HTTP.

Digital Ink Technology Components

Anoto

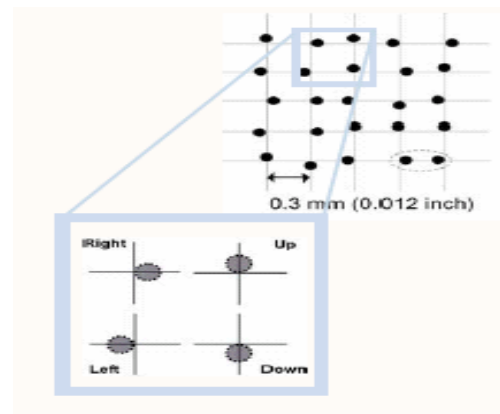
Anoto is a Swedish company that has developed a patented printing-related technology based on sophisticated mathematics capable of identifying and recording pen ink strokes. Over the course of the past several years a number of innovative companies have become Anoto partners for the purposes of building applications that can leverage concepts surrounding paper interfaces as a natural medium for capturing human pen strokes.

The Paper

A mathematical algorithm in the form of a grid of dots is attached to pages of a business form. Standard human data capture regions are then added to make the paper digitally active. A page can also contain control objects that are interpreted by the pen that are used for initiating specific actions. For examples;

- New Form
- New Page
- Completed/Transmit

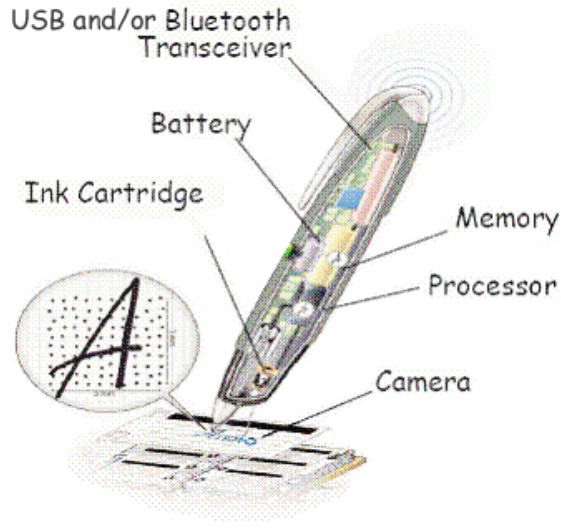
Any paper format (letter, legal, notepad, etc...) can be printed with the mathematical pattern, which appears as a faint watermark of non-obtrusive dots. Anoto licenses their pattern space to commercial partners for building paper-based applications.⁵



⁴ The electronic tablet and stylus is a paper –pen interface equivalent.

⁵ See <http://partner.anoto.com/partner/view.htm?ID=1323>

The Pen



Shown is an example of a digital pen and grid pattern. The pen, which writes with normal ink, registers the following:

- Location (x, y)
- Pressure (P) and speed of writing (v)
- Time of use (t)
- Inclinations and rotations

It does this by means of a sophisticated battery driven camera that continually scans the paper as ink is applied. All pen strokes are recorded and stored in memory for later transmission.

Data Communications

Communications can be managed in one of several ways but is dependent on the specific pen used by the application. Pens can store upwards of 40 A4-size pages of handwritten information in memory and operate under a wide variety of industrial conditions.

The pen sends a request to either a server or a local hot-synch agent with its unique identifier and the mathematical pattern it recognized from the paper. The agent responds with an IP address for the destination of the payload. The digital ink is then transferred to the application for processing over standard Internet protocols http(s).

Paper to Electronic Form Solution Process

A Digital Ink solution comprises a three (3) part process:

Page Design Model

- Existing business paper forms are analyzed from a perspective of data flows, context and type definitions. Pages are built as graphical resource files defining the paper interface look and feel.
- Anoto patterns are attached to the graphic as an underlying watermark prior to final form printing.

Software Design Model

- The page design is imported and capture regions supporting business rules (yellow boxes) are written to handle data conversion of form inputs. Specific regions are captured “as is” e.g., *Signatures*
- Export paths supporting data workflow routing, approval and integration points are programmatically defined.

System Deployment Model

- The application is deployed as a locally accessible client software module either on Windows workstations, tablets or directly on cell phones. An optional server can be used to support on-line form delivery and workflow routing.
- Pens and paper forms fulfillment is completed and are issued to end-users.
- Users perform their normal business function writing the business details of paper form transactions as necessary.

Character Recognition & Transformation

The digital pen captures and records all the ink it releases as it moves. Controls on the paper allow the user to indicate a starting point and a logical ending point during the data capture process. For example, the transmit control for a wireless digital pen would recognize a stroke through a _{Send} control on the paper form to initiate transmission to its bluetooth partner device.

Shown in the figures below is a representative Digital Ink data capture and conversion results for a sample business template paper form.

The accuracy of conversion is almost always better than 95% but is a function of several factors including:

- Sophistication of the underlying recognition engine
- Clarity and style of the handwriting
- Type of data being converted (numbers vs. characters vs. mixed vs. bitmapped)

It is important to note that because digital pens record the ink released as a set of discrete points as it moves,⁶ the intrinsic ability to perform character conversion using sophisticated algorithms is far superior to traditional static optical character recognition systems. This ensures a high degree of data capture with minimal error correction review.

⁶ Digital ink is recorded as a set of x, y, z, t, P and velocity coordinates for each camera scan (~100/s)

Business System Integration and Streamlined Workflow

One of the most exciting advantages offered by this technology is that not only is the paper record preserved for filing as per normal business workflow, but the actual paper image is captured through the pen's camera technology with results exactly mirroring the benefits optical scanning offers today. Consider the savings in time, errors and thus costs between manual, scanning and digital ink based workflows normally associated with the data capture application identified below.

- Q/A & Safety Inspection Forms
- Assessments
- Data Collection and Reporting
- New Account Opening
- Credit Applications
- Signature Capture
- Insurance Forms
- Weigh Label / Manifest
- Driver's Log
- Meter Readings



The ability to capture pen strokes directly into XML data elements for conversion and immediate validation by client and/or server-side business rules, literally as the ink is drying, provides for real-time business decision making enabling better customer service.

Signature capture, a critically important element of paper-based contract management and fiscal compliance reporting is completely supported, as is all freeform text annotations and drawings including margin notes. These field elements are associated with graphic bitmaps.

Databases and Document Management

Ink uploads are performed in one of two ways, namely:

- USB docking stations attached to a Microsoft Windows 2000/XP workstation, or
- Bluetooth to cell phones clients including latest generation of RIM BlackBerry devices.

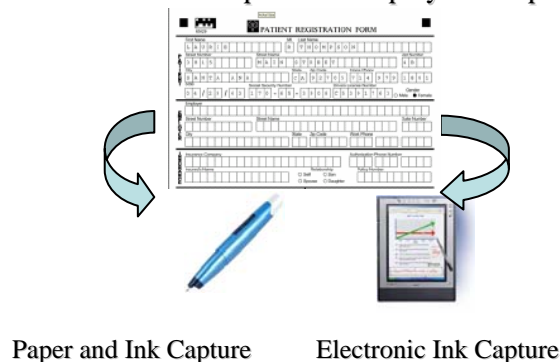
This flexibility allows ink routing and processing to be centralized on secure server-infrastructures accessed over encrypted wire line or wireless channels. Application service handlers are defined based on Anoto pattern id to ensure the correct business rules get applied for each transaction received. For example, routing of captured images can be fed directly into Enterprise Document Management Systems and handwritten information converted to ASCII data can be immediately forwarded to any relational database, Oracle, DB2, SQLServer, *etc* ... for ensuring business decisions are acted upon in the earliest possible timeframe.

Paper vs. Tablet Interface

This white paper has so far discussed the concepts behind the Anoto technology and digital data capture from paper and ink. However, many of the business advantages posed by the capture of handwriting from paper can also be realized with current XP-tablet technologies. This arises from the fact that handwriting recognition software libraries responsible for reading the Digital Ink from an Anoto supported pen, are also capable of analyzing input from the electronic stylus from the XP-tablet screens.

Gartner has identified Tablet PC's as technology with a high benefit rating for specific industries. They recommend the use of this technology in product applications that are paper form based which can legally eliminate paper records. The largest benefit claimed is there is no need to re-train front line staff on managing customer engagements that reduces the data capture effort, reduces the errors in transcription and does this in a substantially shortened timeframe and at lower cost.⁷

Form Development & Deployment Options



Pen vs. Tablet Comparison - Pros and Cons

Business decisions leading to a preference to adopt either a tablet data capture solution or an Anoto digital paper solution are generally driven by the considerations below and summarized in the accompanying table⁸:

- the number of data collection devices,
- requirements surrounding paper receipts for document filing, and
- complexity and operating environment.

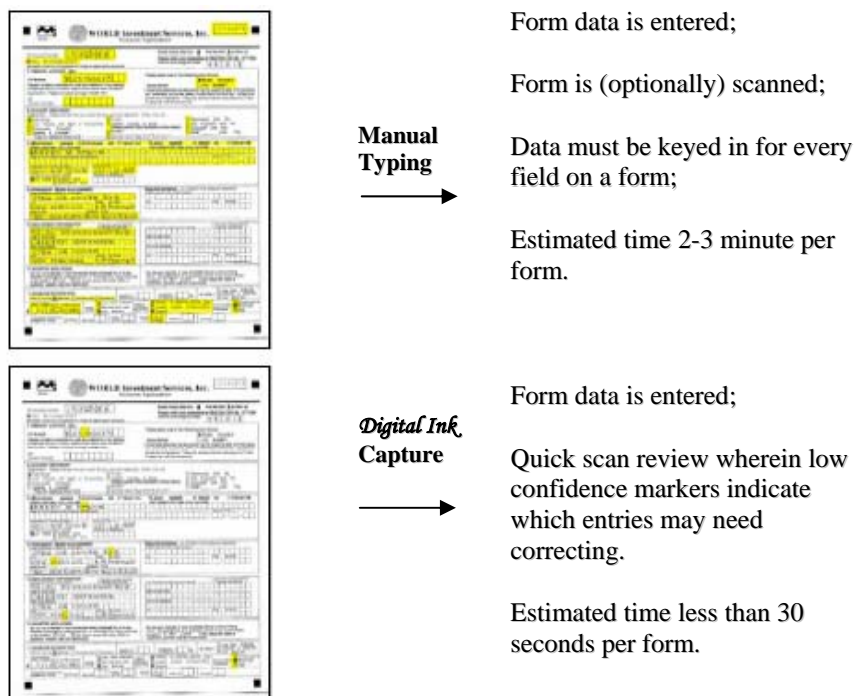
Pen Model		Tablet Model	
Data collection process unchanged	√	Real time integration capabilities	√
Paper records exists	√	Eliminates paper form	√
Minimal maintenance and TCO	√	Higher \$\$\$ investment and TCO	✗
No immediate user feedback	✗	Environmental and ergonomic issues	✗

⁷ Gartner Research Report – G00124924, Nov, 2004.

⁸ Note: INKStreams unique handwriting recognition software runs on either pen & tablet allowing companies to choose a mix based on requirements and budget.

Digital Ink's Value Proposition to Customers

There has been accelerated growth in the acceptance of both tablet and Anoto based technology and related products during the last several years.⁹ The primary business driver for the rate of adoption of pen-based computing is an organizations ability to remove inefficiencies in the data entry process. This is illustrated in the diagram below.



The number of paper forms a company deals with currently and the number of employees required to input this data directly drives calculated ROI.

As revealed above, implementing a digital workflow solution with data capture at source, allows for an overall acceleration of business decision making as the information can be collected, analyzed and acted upon in far less time than current manual intensive keyboard entry. Other tangible business benefits as touched on in this paper can also be realized;

- Opportunities for Back Office systems integration with enterprise Content Management Systems (CMS) and/or Relational Database Management Systems (RDBMS) for trimming costs associated with paper form handling.
- Increasing the ROI of implementing BlackBerry Enterprise Servers by utilizing bandwidth for delivering business data other than email from the field in seconds.
- Capture of time-stamped ink strokes as they are written to address fraud on paper.

⁹Refer to <http://www.anoto.com/>

Concluding Remarks

The growth in mobile computing and wireless networks has affected the way people *want* to access information while away from their desks and stationary computers. Voice recognition software advances has led to the emergence of voice-based computer systems for handling cellular and land-based telephone access to systems. This paradigm shift away from traditional user access modes and system's interaction is providing new and exciting business opportunities for leveraging disruptive technologies based on other non-keyboard-based user interfaces.

The most common device for information capture worldwide is the pen and the parallel sophistication of modern character recognition software allows for the development of user interfaces based on paper and electronic tablets which can accept the written word as a viable data entry mechanism. By changing only a pen, organizations big and small can change everything in the way they manage cumbersome and expensive workflow processes.

Electronic ink capture is an innovative way to improve competitive position and unlike many other frustrating mobile technologies, digital writing requires no change to *how* and *where* people can transact business.



Pen & Paper Go Anywhere

About INKStreams Corp.

INKStreams is a licensed Anoto Canadian services provider offering digital writing solutions on this powerful, mobile and user friendly technology. Our three plus years of expertise in paper user interface design and unmatched portfolio of digital pen-handwriting recognition software, managed and hosted document management services, and wireless deployment capabilities, allows forward thinking organizations an easy way to experience the many Business Benefits derived from implementing handwritten data capture using digital [electronic] ink. For more information visit <http://www.inkstreams.com>

About Anoto Group AB

Anoto is a Swedish hi-tech company with unique solutions for transmission of handwritten text from paper to digital media and scanning of printed text. All products are based on digital camera technology and image processing in real time. The Anoto Group today offers a comprehensive solution entailing paper, pen and server technologies, allowing us to connect all types of writing paper with the digital world. <http://www.anoto.com>