

Digital Pen and Forms Management

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.

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**

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.

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 example:

- 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.

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.

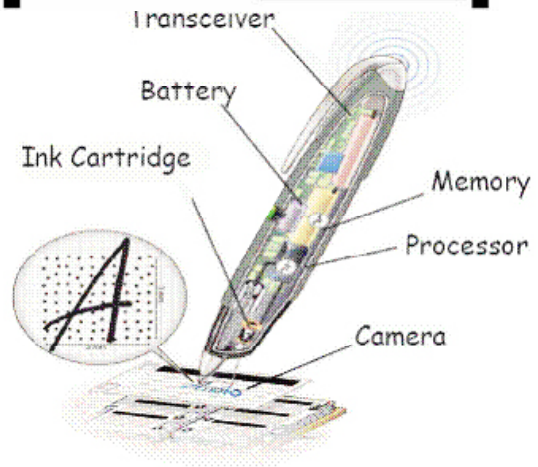
The pen sends a request to either a server or a local hot-synch agent with its unique identifier and the mathematical pattern it recognized from the paper. The agent responds with an IP address for the destination of the payload. The digital ink is then transferred to the application for processing over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

Paper to Electronic Form Solution Process

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

The image shows a digital form titled "CREDIT PRESENTATION (FOR REQUEST FOR ADVISE & COUNSEL)". The form includes several sections with input fields and checkboxes:

- Client Information:** Fields for First Name, MI, and Last Name.
- APPROVED UNIT (BRANCH):** A dropdown menu.
- CREDIT UNIT:** A dropdown menu.
- Business Description:** A text input field.
- Water Connection:** A text input field.
- COBT, I.G. (I) PROPOSED I.G. (I):** A text input field.
- PRICE:** A text input field.
- REASON:** A list of checkboxes including CHURN, INCREASE, INITIAL, UPDATE, USE, BOARD REPORT, and OTHER.
- EXCLUDED INFORMATION AND COMPLIANCE:** A section with checkboxes for TRADE, BODIES, and others.
- READY REQUESTED BY AND REASON:** A text input field.
- TYPE OF CREDIT:** A section with checkboxes for ACCOUNT OUTSTANDING and PROHIBITED UNIT.
- PROVIDERS AND WRITE OFFS:** A section with fields for FACILITY, PROVIDERS, and WRITE_OFFS.
- SECURITY:** A text input field.
- Handwriting Signature:** A field for a signature.



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”
- 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 image illustrates the process of digitizing a handwritten form. On the left, a paper form from 'SIERRA CREEK Building Inspections' is shown with handwritten entries. A blue arrow points to the right, where the same form is shown as a digital data capture. The digital form has yellow boxes highlighting the captured data regions, such as the inspector's name, date, time, and address. The form includes fields for 'Inspector Last Name', 'Date of Inspection', 'Time', 'Permit Required', 'Class Room', 'App. or Street Number', 'Address', 'Valid Registration for the Permit', 'Phone No. (Area Code)', 'City/State', 'Zip Code', 'Inspection Schedule', 'Status', 'Type of Inspection', 'Type of Occupancy', and a list of 'The Following Items are Violations' with checkboxes for each item. A floor plan diagram is also visible on the 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.

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 XP/Vista workstation, or

- Bluetooth to cell phones clients including latest generation of Windows Mobile devices.

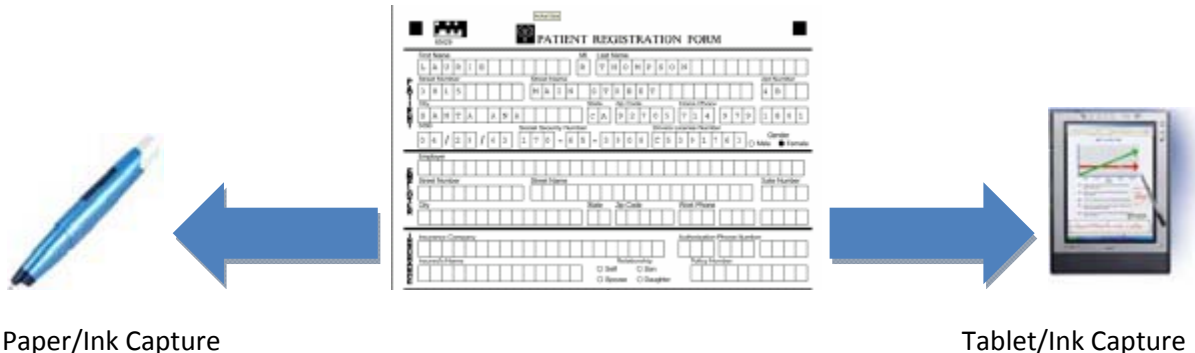
This flexibility allows ink routing and processing to be centralized on secure server infrastructures accessed over encrypted wire line or wireless channels. Application service handlers are defined based on Anoto pattern id to ensure the correct business rules get applied for each transaction received. 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 Vista-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.

Form Deployment & 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 table:

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

Pen Model

Data collection process unchanged ✓
Paper records exist ✓
Minimal maintenance and TCO ✓
No immediate user feedback ✗

Tablet Model

Real time integration capabilities ✓
Eliminates paper form ✓
Higher \$\$\$ investment and TCO ✗
Environmental and ergonomic issues ✗

Not only can your company's handwritten business forms be automatically transformed into digital files, they can be securely made available for processing and distribution - all in just seconds. In short, Anoto technology optimizes the basic yet essential process of managing handwritten business forms.

Anoto Provides the Technology

Anoto is the pioneering leader of digital pen & paper technology. Our de-facto standard technology lets users automatically capture and process handwritten text and illustrations in business forms. This is done by rapidly and reliably converting all handwritten information into digital format. Streamlining the capture and processing of handwritten information makes the paper-based process more efficient.

Work as Usual



Users benefit from the natural, simple and intuitive nature of using pen and paper. The big difference from a normal ballpoint pen is what digital pen and paper lets you do with handwritten information. Namely, whatever text and images a digital pen puts on the paper is converted into digital data. In short, employees gain the speed and power of digital technology while keeping all the familiarity and convenience of using ordinary pen and paper.

Just as important, there's no need to change basic operational processes or working routines. And no need for complex systems for converting and managing handwritten documents.

- User-friendly: pen and paper means gathering information with natural simplicity
- No need to change work routines or existing forms processes
- Natural face-to-face interaction without intrusive computers
- Intuitive: limited or no training of staff is needed
- Enables digital capture of both text and illustrations
- Ensures traceability: digital copies of all information for customer or own records

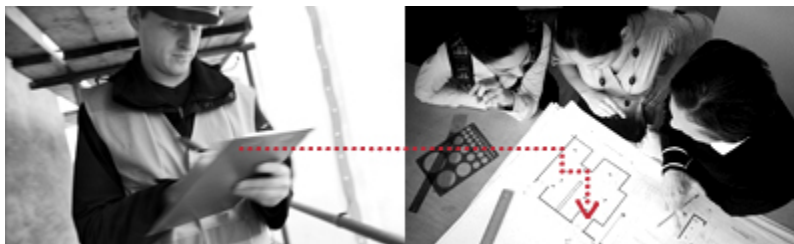
Boost Efficiencies



Imagine notes made by a nurse on rounds being securely sent to the hospital-wide medical records system. Specifications of a client's handwritten order going directly to your customer service team. Approved delivery confirmations from a regional logistics firm sent to your billing system instantly. This is how Anoto technology speeds up business process and cycles: it provides a faster, more efficient way to capture and process handwritten information in business forms.

- Capture information automatically as you write with no loss of productivity
- Cut lead time from days to minutes or seconds
- Get data validated while still on the job to ensure quality and service
- Increase your service: instant feedback to customers and business partners
- Easy traceability: all information automatically combined with stamps to identify time, pen user, and the exact form used

Stay Mobile



Anywhere, anytime mobility is benefiting many businesses today. Indeed, mobile communications devices help professionals lead their business worlds while on the go. However, working with PDAs or carrying cumbersome laptops around is not very convenient. Nor is using them to transfer data gathered in the field.

Data transfer in seconds. No passwords. No local network access needed. That's easy mobility. This is exactly what digital pen & paper technology offers mobile business professionals. They automatically capture information, then rapidly and securely send that information to back-office systems.

- No need for cumbersome laptops and complicated PDAs in the field
- Size of pen: convenient and lightweight to use
- Natural face-to-face interaction without intrusive computers

- Stay longer in the field: stores several days of information and has a long-lasting battery
- More durable than PDAs and laptop

Gain Cost Effectiveness



In today's highly-competitive, fast-paced world time frames are shorter than ever. The focus is on faster, more accurate, more efficient processes — and getting better results. Meanwhile, using pen and paper is still the most common way of gathering important information in business, so managing information in handwritten forms is a basic yet essential task for any business. As this work has been done manually, the process has been slow and tied up valuable resources.

Let our digital pen & paper technology manage the work instead. It makes information available quickly and automatically. This boosts operational efficiencies and frees resources, thus improving cash flow and increasing customer service levels.

- Eliminating or automating processing steps means significant cost savings
- Secure, high quality information capture and processing: removes costly correction routines and reduces risks for errors
- Data processed as it happens, no costly peak hours
- Low investment cost, fast implementation, easy scalability and flexibility
- Easily integrated with databases