Electronically Publishing The Art of Signatures

Bing Hu

Content

- Partly Funny Joke
- Background and History of the Signature
- Why Current E-Signature Publishing is Bad
- Requirements of E-Publishing Signatures
- Architecture and Design of My EP Signature Software
  - Freely Extensible and Dynamic Handwriting Publisher (FEDHP)
  - Live Demo
- 25 Features: Description, Examples, Short Methodology
- Conclusion

Partly Funny Joke

What is…

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What is…

… at the end of every email …

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What is…

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Signatures!

Background and History

1. Brief History of Handwritten Signatures
2. Transactional and Cultural Importance of Signatures
3. Taxonomy of Signatures

Does anyone know what this is?

Kushim: Signature on Clay (Uruk Period, c. 3200 BC)

For those whose Sumerian is rusty:

It reads "28,086 measures barley 37 months **Kushim**."

Crash Course Through Time

Sumerian: The First Signature (c. 3200 BC) - “*Seals, which were typically attached to small round cylinders about an inch in length, would be pressed onto wet clay to authenticate documents*”

What else was happening in 3000 BC?

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Construction of Stonehenge (c. 3100 BC)
In its first version, it consists of 56 wooden posts…

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Construction of Stonehenge (c. 3100 BC)
In its first version, it consists of 56 wooden posts…
Otherwise more commonly known as “Woodhenge” :-)

When did Handwritten Signatures?

3200 BC - Kushim / Sumerian Signature

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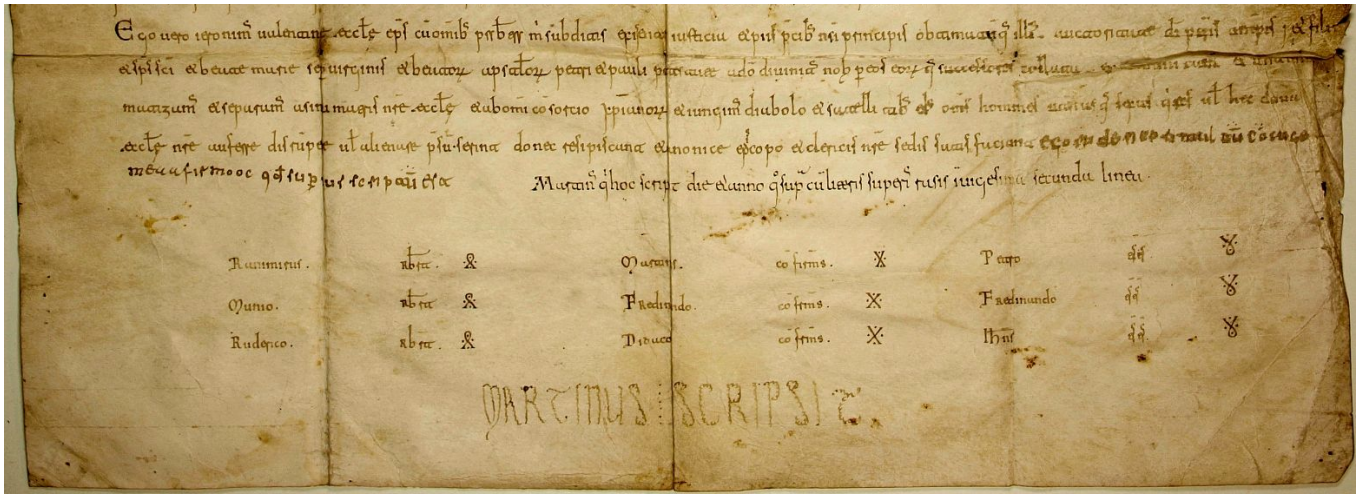
1069 - First Recorded Signature of a Famous Historical Figure

Rodrigo Díaz de Vivar (El Çid)



«ego ruderico, simul cum coniuge mea, afirmo oc quod superius scriptum est.»

"I Rodrigo, together with my wife, affirm that which is written above."

Crash Course Cont.

1600s - Widespread use of Signatures - “*In 1677, the Parliament of England mandated that certain contracts must be signed to be legally binding, further cementing the importance of signatures in legal documents.”*

1867 - Statute of Frauds - Required specific transactions to have a “note or memorandum in writing” that was “signed by the parties” in order to be legally valid

1869 - Acceptance of Digital Signatures Via Telegraph - Morse Code Signature

1900s - Signatures Via Fax Machine - Transmit images of documents with legally binding signatures over phone networks

2000 - E-SIGN Act - Recognizes the legal validity of electronic signatures and records in both foreign and interstate commerce.

Signatures as a Transaction

1. Signatures are a way to validate and verify a Transaction
    a. Business Documents
    b. Legal Documents
2. Signatures are a way to authenticate documents
3. With the acceptance of E-Sigs, authentication and verification are increasingly being completed electronically
4. Electronic signature authentication and verification has made everyone’s lives easier

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Are today's E-Sigs the same as Handwritten Signatures?

If E-Sigs are the same - Why Don’t We See This?

$800

~~$800~~ $500 SALE

If E-Sigs are the same - Why Don’t We See This?

$800

What if we use a fancy font?

~~$800~~ ~~$500~~ $300
SUPER SALE

Handwritten Signatures have Cultural Value

Handwritten Signatures have a personal touch, that current E-Sigs publishing fails to replicate…

Handwritten Signatures have Cultural Value

We’ve seen this…

Handwritten Signatures have Cultural Value

We’ve seen this…

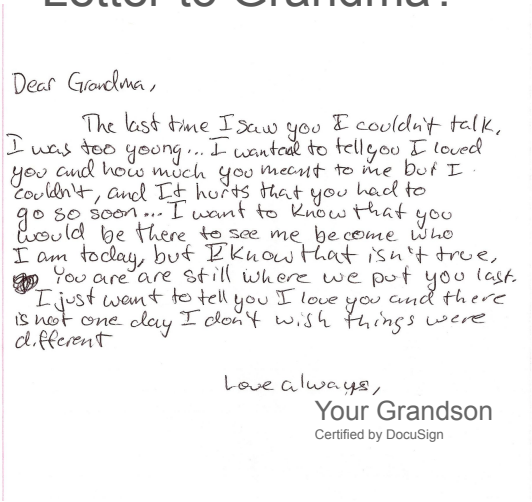
How about a Bday card?

Handwritten Signatures have Cultural Value

We've seen this…

How about a Bday card?

Letter to Grandma?



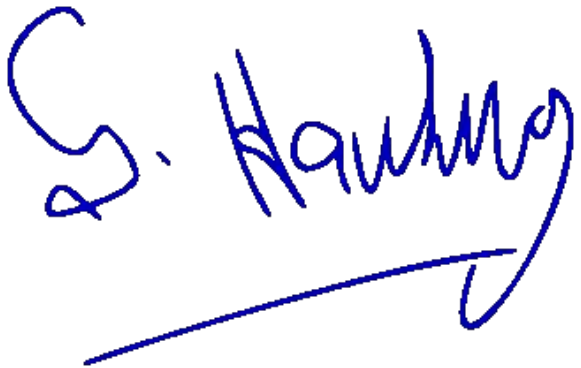
Underlying…

Handwritten Signatures Represent Individuals!

- Handwritten signatures provide agency that E-Sigs do not

Why Current E-Sig Publishing is Bad

- It’s Ugly
  - Pixelated or Boring
- It’s Static
  - Copy-paste png or default font
- Sure it is good for business - but it doesn’t represent dynacism of an individual or culture



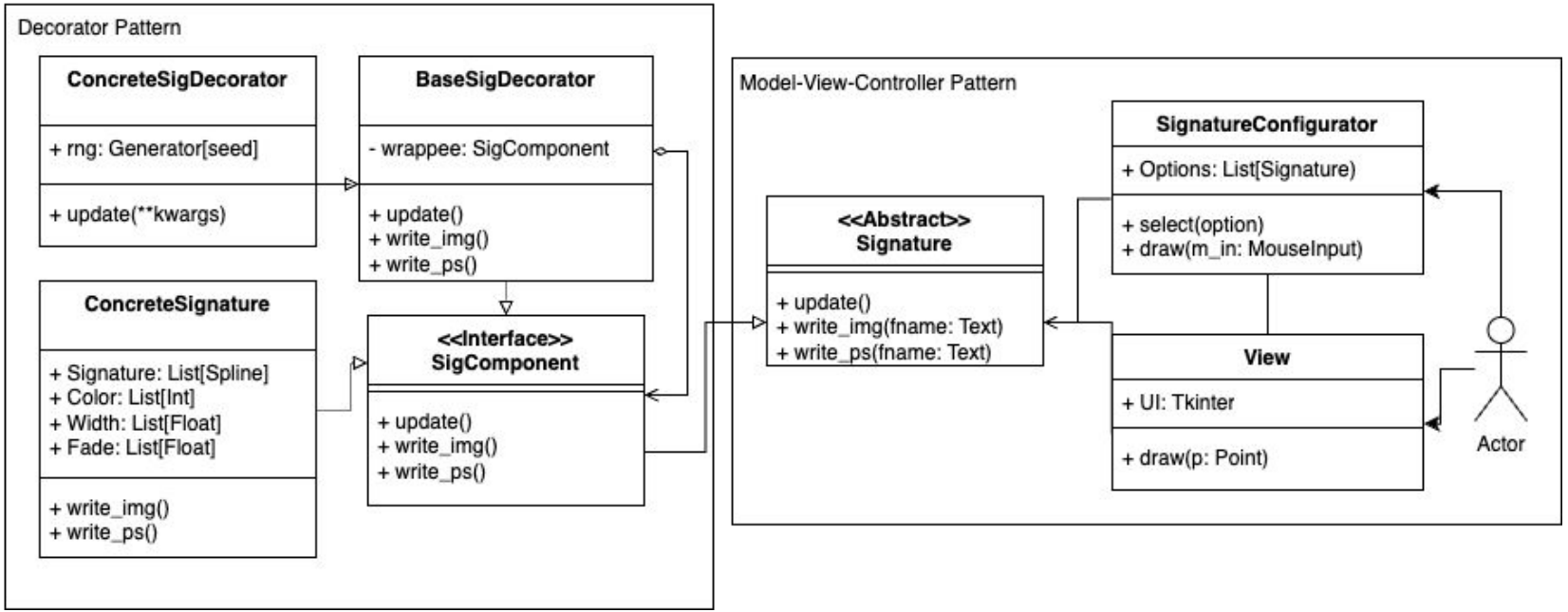
S. Hawking
Certified by DocuSign

Requirements For E-Publishing Signatures

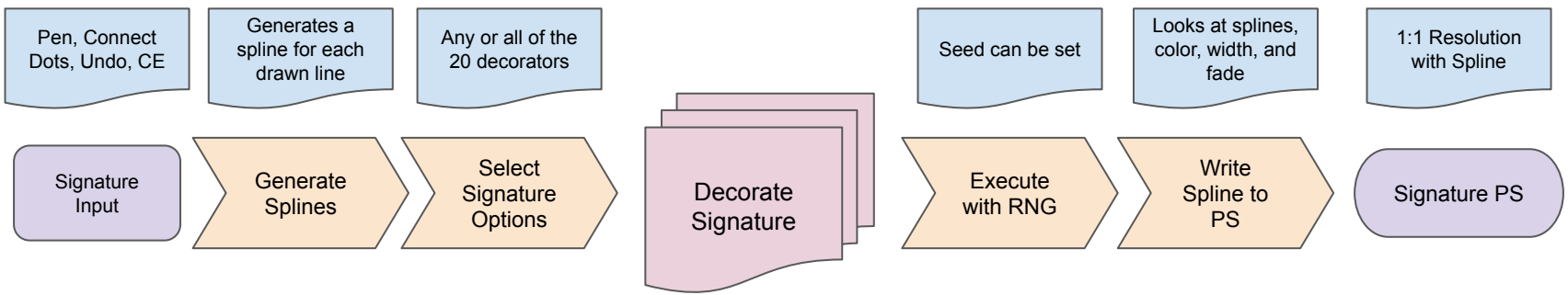
- It's Ugly - We need to make it infinitely scalable
- It's Static - We need to make it variable everytime we use it
- It doesn't represent individuals or culture
  - We need to make it simulate the qualities of handwriting
  - We need to consider how other cultures do signatures - i.e. Arabic, Asian
- E-Sigs are good for transactions
  - But modern security rely on document level encryption and locking
  - We need to make place the onus of validation, verification, and authentication on the E-Sig itself if possible
- E-Sig pngs or stamps are easy to interface with
  - We need to make our entire process equally easy to interface and utilize

Freely Extensible and Dynamic Handwriting Publisher (FEDHP)

High-Level Architecture

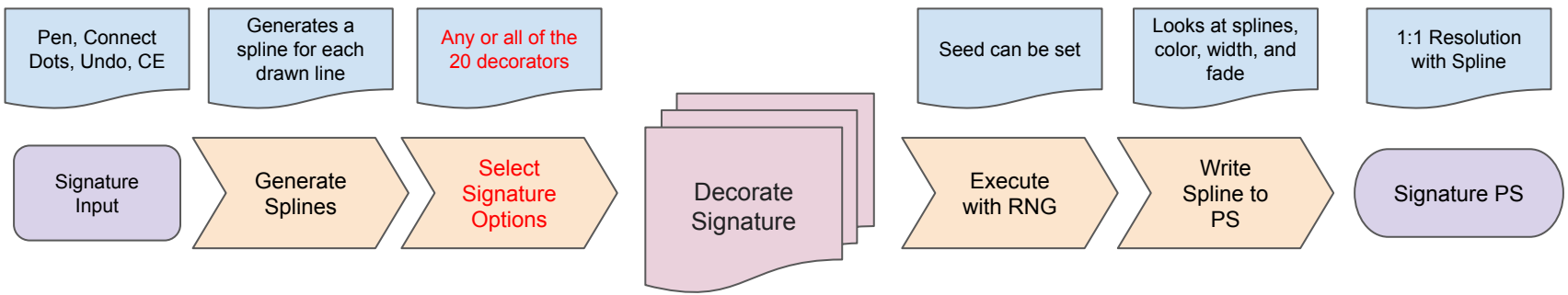


High-Level Workflow



Live Demo

High-Level Workflow



25 Implemented Features

- 5 UI Features
  - Pen - draw the line free-hand
  - Dot-pen - draw the line by clicking dots
  - Undo - remove last point or dot-segment
  - CE - clear everything
  - Finish - output and save before and after pngs and the final ps
- 20 Signature Decorators + Bonus

25 Features

- 5 UI Features
- 20 Signature Decorators + Bonus
  - Color, Width, Fade, RNG Seed
  - 3 Pressure - alters line width and fade
  - 2 Drifts - dynamic translations
  - 2 Stretches - static stretch
  - 4 Jiggles - adds random noise
  - 2 Smoothing - removes artifacts
  - 2 Stamp - stampify/sealify signature
  - Surprise!
  - Bonus

I will speak about each, cover each option with examples, and describe the methodology with 1 or 2 terms

Color, Width, Fade, RNG Seed

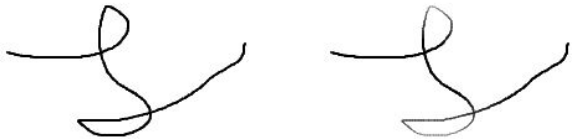
Methodology: PS Knowledge

Note: These are Screenshots of PS Output - That is why it is pixelated…
In reality all signatures are infinitely scalable.
RNG Seed is used to generate all noise for decorators.

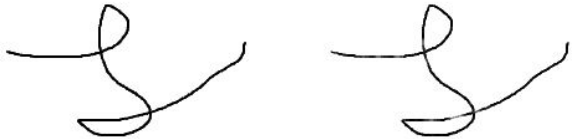
Pressure Decorators

As a person writes, the pressure on the pen changes, causing fluctuations in line width and fade.

- Y-Fade



- Velocity-Fade



- Start-End-Fade

Methodology: Stepwise Linear Scaling

Drifts

A signature may drift upwards or downwards or become more or less slanted as a person writes.

- Y-Drift

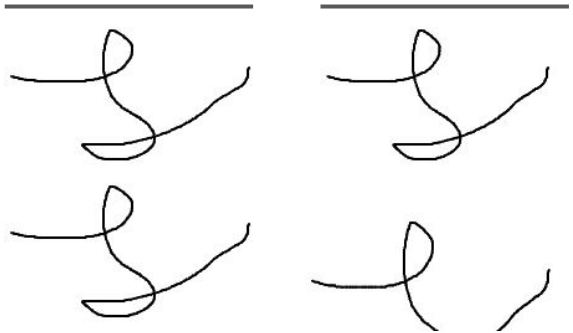
- X-Drift

Methodology: Linear Scaling

Stretches

A signature may take up more or less space horizontally or vertically.

- X-Stretch
- Y-Stretch



Methodology: Rescaling

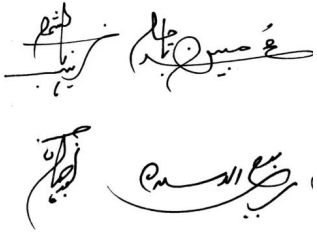
Jiggle

As a person is writing, Brownian Noise may be added that alters the writing.

- X-Jiggle

- Y-Jiggle

- Velocity-Jiggle
  - Jiggle in direction of velocity



- Dot-Jiggle
  - Only jiggle small lines
  - I.e. Dots, Arabic Markings

Methodology: Additive Smooth Noise after Double Integration

Smoothing

Artifacts can be introduced given imperfect input tools. Pen tool is hard to use with a mouse and there is limited precision with the Dot-pen tool (given a limited attention span). We introduce smoothing to remove artifacts:

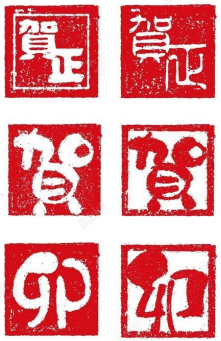
- Triple Interpolation with Kernel

- Short Line-Segment Removal

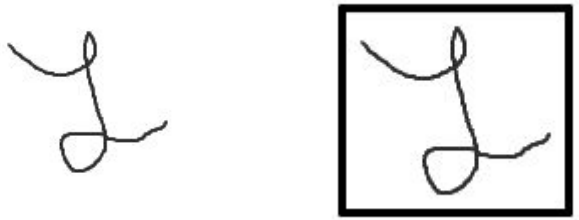
Methodology: Convolution and Thresholding

Stampifying

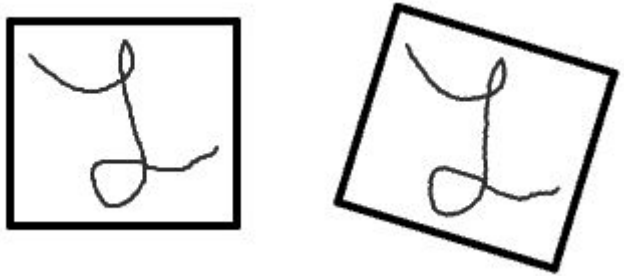
Many cultures also utilize stamps and seals as a signature or additional to a signature. Stamps and seals when used may rotate.



- Stampify



- Rotate

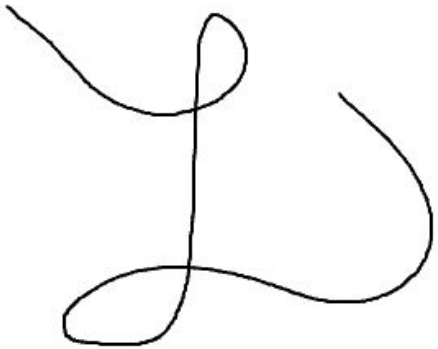


Methodology: Draw and 2d Rotation

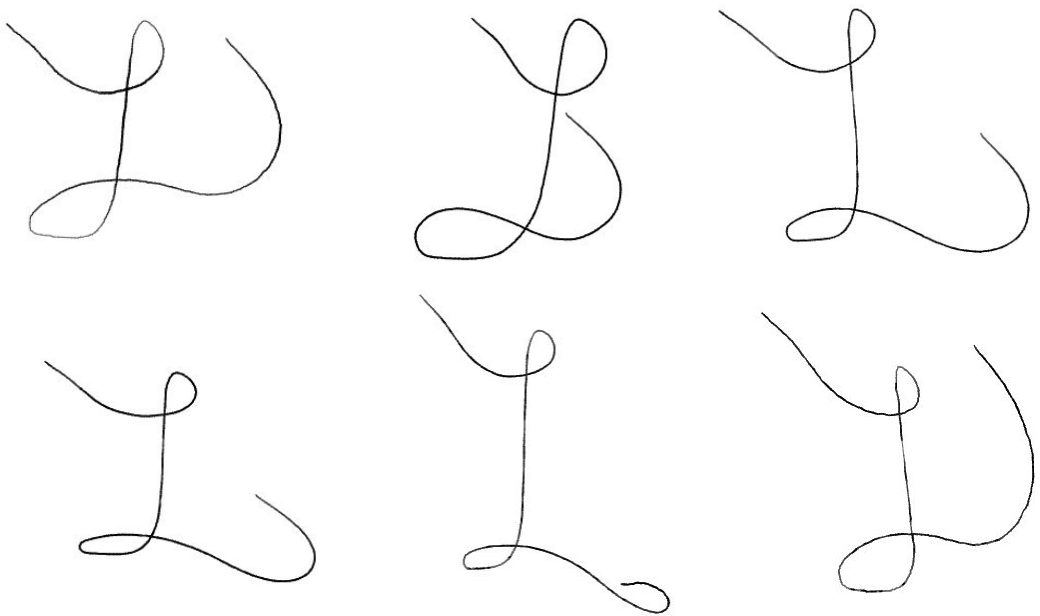
Surprise!

It’s hard to know when what is going to affect what. Surprise randomizes all decorators.

Original



Surprises!



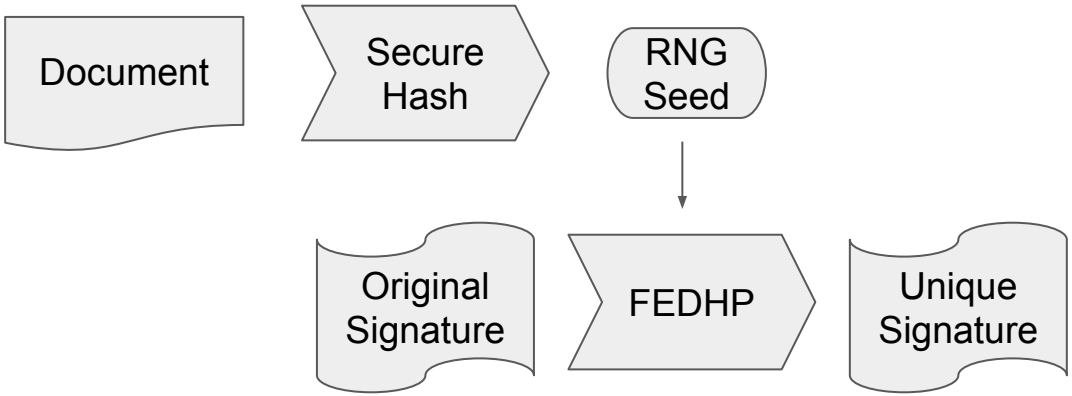
Bonus

2 interesting extension with “little” work:

- Freely Extensible and Dynamic Handwriting Publisher Font (FEDHP Font)
  - Hand write each letter of any language into FEDHP
  - For any given text, generate the letters dynamically using FEDHP
  - Place the generated letters in time-order on the paper
- Possible verification and authentication using only the FEDHP Signature
  - Use TLS-handshake to securely exchange baseline handwritten signatures
  - Document hashes can be used to seed FEDHP to generate signatures to then place on the document
  - Authenticity of documents can be verified by recomputing document hashes and comparing the computed signature with the signature placed on the document.

Note: We need to show this is a one-way function (non-trivial to prove) - we can come up with a few ideas!

Possible Scheme



Conclusion - Back to the Requirements!

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Thank You
More Demo? Questions?